INVESTIGATING THE QUALITY OF PRODUCTS OF DIFFERENTIATED TRADEMARK PRODUCERS (GAME THEORY APPROACH)

Naeimeh HOZOURI
PhD student of Economics,Urmia University
n.hozouri@yahoo.com

Kiumars SHAHBAZI
Professor of Economics, Urmia University
k.shahbazi@urmia.ac.ir

Abstract

Quality, as one aspect of product differentiation, is the main factor in survival and sustainability of producing firms. In this paper, two main producing firms are considered, one being the main producing firm offering high quality trademarks and the other producing low quality trademarks. Then, the game is designed for these two firms, the implications of this game are referred to, and the strategies for producers of high-quality and low-quality trademarks in terms of equilibrium price, quality, and profit are discussed. The results indicate that by increasing the production costs of each producer lead the producer of high quality trademarks to increase their quality. In addition, an increase in production costs for a low quality producer lead them to reduce their quality; however, an increase in production costs for a high quality producer leads the producer of low quality trademarks to increase their quality. Finally, the relationship between the profits of a high quality producer is directly related to the quality of its own trademark and inversely related to the low quality trademark.

Keywords: Quality, Vertical differentiation, Market entrance, Game theory
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1. Introduction

Product differentiation in economy and marketing refers to the process of differentiation of a product or service from others for competition purpose and making it more attractive for a special target market. This differentiation is possible for the products of competitors or the company. The product differentiation models are classified into two groups: spatial and non-spatial models. The latter is classified to a fixed number trademark model and diversified model which is endogenously determined. From another point of view, differentiation in economy is classified into horizontal and vertical differentiations, which are, respectively, defined as the products of the same quality and products of different quality. In fact, horizontal differentiation is taken to refer to the situation, when in the case of promoting the distinct feature of the product, there is a consumer with increased desirability and another consumer with decreased desirability. The vertical differentiation is taken to refer to the situation when the promotion of the district feature of a product is to the benefit of all consumers (Shy, 2014).

Quality in economy is taken to mean desirability; i.e., the set of characteristics of a product and its services, which makes it demandable and therefore, able to be sold. The word quality has several different meanings. Quality in economy has two complementary concepts: First, quality means the presence of some features in the product (quality features) which respond to the customers' needs and leads to customers' satisfaction. The objective is to have higher quality, increase the customers' satisfaction and income level. Increasing the quality and creating better quality features require investment and increased costs. Therefore, higher quality is costly; however, for higher income and revenue. Here, quality is related to revenue. Second, quality means lack of defect and failure. Defect and failure lead to damages, repair, reworking, returned products, complaints, fine and loss of customers; which are all costly. Therefore, higher quality includes lower defect and error and consequently, less cost. Here, quality is related to cost (Hill, 2006). Thus, the products can be divided into two groups:

products of original trademark (high quality products) and products of non-original trademark (low quality products). Those of original trademarks are valuable for consumers for two reasons: first, they reduce the consumers' risk and second, they save the decision making costs. Nowadays, trademarks are very advantageous for consumers; e.g. a) Reducing the consumers' sense of risk: reduced sense of risk is one of the main advantages of trademarks for consumers who, at the time of purchase, are concerned that the product or services might not conform to their expectations or what the firm claims or even that it might not really be as good as it seems; however, the presence of high quality trademarks reduce this risk. b) Reducing the search: the consumer always investigates and searches to find the best goods or services proportionate to the purchase conditions and his needs and demands (Mansuri et al, 2016).

Products of non-original trademarks (low quality products) are highly similar to the original ones; however, they are of a lower level in terms of function, quality and durability (Kwong et al., 2009).

When a consumer take action to purchase a product; they indeed purchase the values associated with it. This is more obvious especially with the products of original trademarks where the consumers prefer the associated values of the product to its functions and features.

Undoubtedly, if a firm has a strong trademark it is considered as its main asset; however, unfortunately, a trademark which has succeeded in the market and dominated a main portion of the target market can lead to production of low quality products not up to the usual standard of that trademark (Maldonado & Hume, 2005). In this regard, producers of low quality products copy the original trademarks and this has become widespread throughout the world. Unfortunately, low quality products with original trademarks are known as a substation for original products and drive the consumers towards purchasing such products (Wilcox, 2008).

Customers and consumers are always in search of suppliers who provide higher quality and better goods and services. On the other hand, economy can only flourish and grow when the groundwork is laid including efficient and well-thought-out human resources programs, sufficient material capital, management and planning, high quality production, proper provision of services and so on. The quality of products and proper provision of services are the most important factors in economic growth in so far as they promote the public trust in goods and services and, therefore, the highest capital of society, i.e. trust in products and services will be achieved. In this way, economy would flourish and grow. Quality, as one of the product differentiation aspects, is the main factor in survival and sustainability of manufacturing firms. There are usually some firms that produce original goods or trademarks and others that produce lower quality trademarks and therefore take over the market from the original producers. Based on this, the main aim of present study is to investigate the competition between two producers, one presenting high quality and the other low quality products. Some questions are raised here: What strategy should a high quality producer, who is competing with a low quality producer, follow concerning equilibrium price, equilibrium quality and equilibrium profit to maximize its profit? How do the production costs affect the equilibrium quality and profit? What would the demand of consumers be like for high quality and low quality products concerning their desirability function?

Concerning the abovementioned points and due to the role and significance of product quality in the economic and industrial growth of countries, as well as, the individual’s need to study academic researches and investigate the models on how to compete in markets with various types of producers, this study was deemed necessary.

This paper is organized into four parts. The first part includes the introduction and then experimental literature is presented in the second part. The model is presented in the third part and in two subsections. The fourth and final part includes the conclusion and recommendations.

2. Literature review

To follow, some of the studies which have investigated the quality of product as one of the aspects of product differentiation in the market are presented:

Beath & Katsoulacos (1991) in a study entitled, "The economic theory of product diversity" have explained and systematically analyzed the spread of this main category of

products. This study focuses on the models with endogenous product selection process which predict the differentiation level of the product that appears in a market equilibrium condition. This market equilibrium is first compared with certain distinctive products and then with desirability of social welfare. Special attention to the difference between horizontal and vertical differentiation and the issues related to product quality and durability are the other features of this study.

Motta et al. (1997) in his paper entitled, " On the Persistence of Leadership or Leapfrogging in International Trade " showed the significance of internal conditions for international trade in vertically differentiated products. Their standard model includes two firms in two countries with the same population. The consumers are determined according to their taste and this includes paying quality costs that vary in different countries. The quality is taken as a cost for production. The firms that produce a product with quality index strategically compete for international market share in a two-stage game. In the first stage, the firms simultaneously select quality for supply. In the second stage, they compete in Bertrand competition or the non-cooperative Cournot competition. The results indicate that in equilibrium, mutual trade occurs; however, multiple Nash equilibria exists. Although, "mutation" balance cannot emerge if the difference between the tendency of two countries for paying for high quality is big enough.

Jansen & Faria (2002) in their paper entitled, "Product labeling, quality and international trade" showed that in asymmetric data environment where the consumers are unable to recognize the quality of products without a label, the higher quality products incline toward disappearance. The results indicate that if the quality costs for production are high but the consumers are unable to recognize low quality product the results will not be appealing or desirable. This shows how low quality products could overcome the free markets.

Malaval & Benoroya (2005) showed that personalization (which is the source of differentiation and innovation) is more compatible especially with high quality products. The other example can be found among equipment and suppliers of workpieces in the automobile industry. Among the manufacturers of workpieces, Siemens developed the customization strategy for high quality vehicles which facilitates customers' satisfaction especially concerning geographical location. Siemens has designed a variety of injection chips for Renault Safrane that are different depending on the engine and geographical destinations. These chips are designed to take into account differences such as atmospheric pressure.

Furthermore, customization shows its limitations where it is difficult to make enough adjustments to differentiate or innovate, and here the benefits of using a standard product become highlighted. For example, in the automotive industry, a good example would be airbags. Likewise, earlier models of cars used standard equipment to a greater extent.

Sandmeier (2008) in his study entitled, "Merging customer in innovative projects of industry" has referred to Hilti as a global leader in construction and construction devices. By presenting high quality products (a widespread method in steel production in US), Hilti created a customization strategy which considered construction specialists in various countries with common designs through local knowledge. For example, one mechanical device used in steel making reflects this strategy. Although this device was first developed for use in the European market, it was necessary to redesign it for the American market taking into consideration various working methods. Therefore, Hilti succeeded in selling his new product in the US and considerably increase his market share. Of course, it does not mean that all firms that are active in such a sector should necessarily use the same strategy. While Hilti used the strategy of responding to special needs of customers and his main rivals tried to compete with him in terms of cost by presenting standard but low quality products, he sold his products with a higher premium of up to 20 percent to 40 percent more than the price of his competitors.

Gaussens et al. (2009) in a paper entitled, "Personalization versus standardization: International merging and consumer surplus" dealt with the impact of international merging of oligopolistic markets on the consumer surplus. The results indicate that in the first stage, merging might reduce the competition and consumer surplus and but in the second stage, it might reduce the consumer surplus and even increase the competition.

Petropoulou (2013) in his paper entitled, "Vertical differentiation of product, minimum quality standards and international trade, two-seller monopoly" created vertical differentiation

to analyze the motivations to make minimum qualitative standards in an open economy. The markets are divided and the national firms compete in both markets which constitutes an international two-seller monopoly. The firms tolerate the costs of dependent variables on quality and the local and foreign products for sale could benefit from the certain amount of quality; while the national quality standards are endogenously determined. According to the results, the trade flows indicate that minimum Nash equilibrium standards are less than maximum international standards. In addition, if the firms are specialist in products with various qualities, maximum international standards would not be accessible because of mutual adjustments in national standards. This is indicative of limitation in effectiveness of international negotiations regarding minimum quality standards.

Halim et al. (2014) in a study entitled, "The effect of products' quality, the trademark sign and quality of services on customer trust and loyalty (the study of electronic products of SHARP customer trademark in South Kalimantan)" investigated the following objectives: 1) The impact of product quality, trademark signs and quality of services on customer's trust, 2) The impact of products' quality, trademark image and quality of services on customers' loyalty, 3) The customer's trust is used in research design in the reasons for customer's loyalty to investigate the effects between variables. 200 electronic customers of SHARP trademark were randomly selected in a sample and data was collected using questionnaires. The structural model hypothesis was tested through GeSCA The results indicate that there is a significant effect on the quality of product, trademark image and quality of services on customer's trust and the quality of product has a significant effect on customer's loyalty, while, the trademark sign does not have a significant effect on the customer's loyalty. Moreover, customer trust has a significant effect on customer loyalty.

Calmette et al. (2016) in a study entitled, "An international trade model with vertical differentiation and Stackelberg" utilize a two-seller monopoly international trade model to study in which condition the entrance of a big country in international markets can create less diversity for consumers rather than more consumption. The results indicate that the quality of the self-sustaining economy is directly related to the willingness to pay for the quality and size of the domestic market, and is inversely related to the quality cost. They strategically formed interacted firms and identified areas in which a low-quality producer could expel high-quality producers from the market. This is more likely in areas where the emerging exporter is very large and when the difference in willingness to pay for quality between countries is not too large.

Baumann & Klymak (2017) in their study entitled, "Low quality dominance in a search market with complete consumer information, identified a consumer search market where firms are vertically differentiated and consumers are heterogeneous in entrance to the domestic market. The results indicate that in asymmetric information, high quality and low quality firms achieve equal sales and high profits in this market. Conversely, when complete information is available, search sensitivities create an unexplained mechanism that results in a unique equilibrium in which all consumers approach low-quality firms and high-quality firms make no sales or profits.

In foreign studies, the market for goods of different qualities has been examined in a closed economy within a country, and if it had been carried out internationally, they would not have reached a single conclusion. Therefore, how the firms entered these markets, consideration of two countries and an open economy and examination of the ways of entering these markets in a foreign country, taking into account the effects of vertical differentiation of goods in foreign markets have not been studied. Moreover, there is no local study in this area. Concerning the literature, as observed, to date no study has been carried out on how manufacturers behave in the markets of products with different quality taking into consideration vertical differentiation features that these firms could have. Therefore, this study seeks to analyze these cases through game theory to pave the way for more researches in this area and be able to be used by individuals, producers and policy makers. It should be reminded that the main focus of this study is on vertical differentiation of products.

3. Designing model

The problem solving method in this study is game theory. There are two firms shown by A and B, each presenting a different high quality product. A produces high quality products,

shown by qH, which requires cost CH. B produces low quality products shown by qL, which requires cost CL. Therefore, $C_H > C_L > 0$ and $q_H > q_L > 0$. θ is uniformly considered in [0, 1] and shows the consumer's inclination to pay for quality. If consumers do not purchase a product, they will achieve desirability of zero; otherwise, they will have desirability of $u = \theta q - p$. The total number of consumers is normalized to 1. There is a two-period game, where the firms select (q_H) or (q_L) for first period and (p_H) or (p_L) for the second period.

This game is solved through backward induction method such that firstly, the firms select the price at the first stage and then quality at the second stage.

3.1. The competition between two firms (high quality producer and low quality producer)

The model taken in this study is Hotelling vertical differentiation model. Assume the firms are uniformly and continuously distributed at [0, 1]. The two firms are shown by A and B that are respectively located at a and b points from the source ($0 \leq a \leq b \leq 1$). It is assumed here that the high quality producer firm solely produces high quality trademarks and the low quality producer firm solely produces low quality trademarks. Moreover, assume that each consumer purchases one unit of the produced products by two companies. The production cost for high quality producer is C_H unit for each unit of product and it is C_L for low quality producer. In these circumstances, it is possible to find indifference of consumer in purchasing each trademark according to figure 1:

Figure 1: Vertical differentiation

To this end, the desirability function of consumers (equation 1) in [0, 1] is specified when purchasing from high and low quality producers.

$$Ux(i)=\begin{cases}\theta q_L - p_L & i = L\\ \theta q_H - p_H & i = H\end{cases} \qquad \text{Equation (1)}$$

Where p_L is the price offered by the low quality producer and p_H is the price offered by the high quality producer.

The threshold limit, $\hat{\hat{\theta}}$, for consumer (who does not purchase the product) is determined from the following equation:

$$\theta q_L - p_L \leq 0 \Rightarrow \hat{\hat{\theta}} \leq \frac{p_L}{q_L}$$

Now, the indifference of the consumer is determined as follows, concerning equation 1:

$$\theta q_L - p_L = \theta q_H - p_H$$

Thus, if

$$\hat{\theta} = \frac{p_H - p_L}{q_H - q_L},$$

then the consumer shows indifference in purchasing high quality and low quality trademarks. This can be taken as corresponding to the indifferent consumer's location.

By achieving the indifferent consumer, the demand functions of high quality producer ($1 - \hat{\theta}$) and low quality producer $\left(\hat{\theta} - \hat{\hat{\theta}}\right)$ is determined as follows:

$$\rightarrow Z_L = \hat{\theta} - \hat{\hat{\theta}} = \frac{p_H - p_L}{q_H - q_L} - \frac{p_L}{q_L}, \quad Z_H = 1 - \hat{\theta} = 1 - \frac{p_H - p_L}{q_H - q_L} \qquad \text{Equation (2)}$$

It can be concluded that in the range of $\hat{\hat{\theta}}$ indifferent consumers, all consumers achieve more desirability from purchasing low quality products compared to high quality products. Moreover, the consumers after indifferent consumer prefer the trademark produced by the high quality producer to low quality producer.

Now, the profit functions achieved for high and low quality trademarks will be determined as follows:

$$\begin{cases} \pi_L = (p_L - C_L)\left(\hat{\theta} - \hat{\tilde{\theta}}\right) = (p_L - C_L)\left(\frac{p_H - p_L}{q_H - q_L} - \frac{p_L}{q_L}\right) \\ \pi_H = (p_H - C_H)(1 - \hat{\theta}) = (p_H - C_H)(1 - \frac{p_H - p_L}{q_H - q_L}) \end{cases}$$ Equation (3)

By putting the final costs as zero and replacing the demand values of each firm (equation 2) in related profit function (equation 3) and then differentiating in respect to costs, it is possible to obtain equilibrium prices. First, the optimum reaction functions are calculated as follows:

$$P_L = \frac{q_L P_H}{2q_H}$$

$$P_H = \frac{q_H + P_L - q_L}{2}$$

Then, the equilibrium prices will be calculated as follows by solving two equations; two unknown systems.

$$\begin{cases} P_L^e = \frac{q_L(q_H - q_L)}{4q_H - q_L} \\ P_H^e = \frac{2q_H(q_H - q_L)}{4q_H - q_L} \end{cases}$$ Equation (4)

3.2. The presented theorems

Furthermore, concerning the price, quality and profit functions, six theorems will be presented concerning the equilibrium price, equilibrium quality and equilibrium profit of high and low quality producers:

Theorem 1: The price of a low quality trademark is directly related to the quality of a high quality trademark (increase in quality by high quality producer lead to increase in price of low quality producer). This theorem is reverse for high quality producer.

Proof: To prove this theorem, equation 4 should be differentiated in terms of equilibrium qualities and then solved. First, in order to prove the first part of theorem 1, see comments below:

$$\frac{\partial P_L^e}{\partial q_H} = \frac{3{q_L}^2}{(4q_H - q_L)^2}$$

The above equation indicates that this relation is always positive. Therefore, the more the high quality producer increases the quality; the more the low quality producer will increase their price.

To prove the second part of theorem 1, see comments below:

$$\frac{\partial P_H^e}{\partial q_L} = -\frac{6{q_L}^2}{(4q_H - q_L)^2}$$

This equation shows that this relation is always negative. Moreover, the higher the quality of the low quality producer, the less the equilibrium price of high quality trademark would be.

To follow, the relation between the prices of high quality trademarks will be studied:

Theorem 2: The price of high quality trademarks is directly related to its quality; however, this is not specified for the low quality producer.

Proof: To prove this theorem, only equation 4 should be differentiated in terms of equilibrium qualities and then solved. First, to prove the first part of theorem, see comments below:

$$\frac{\partial P_H^e}{\partial q_H} = \frac{2\,(4{q_H}^2 - 2q_H q_L + {q_L}^2)}{(4q_H - q_L)^2}$$

The above equation shows that this relation is always positive; thus, the more the high quality producer increases their quality, the more the equilibrium will increase the equilibrium price.

For proving the second part of the theorem, see comments below:

$$\frac{\partial P_L^e}{\partial q_L} = \frac{4{q_H}^2 - 8q_H q_L + {q_L}^2}{(4q_H - q_L)^2}$$

Concerning the above equation, it is not definitely specified whether the equation is positive or negative. The relation between low quality trademarks and their quality is not clear.

By substituting equilibrium prices (relation 4) in profit functions (relation 3),

$$\pi_L = \left(\left(\frac{q_L(q_H - q_L)}{4q_H - q_L}\right) - C_L\right)\left(\frac{\left(\frac{2q_H(q_H - q_L)}{4q_H - q_L}\right) - \left(\frac{q_L(q_H - q_L)}{4q_H - q_L}\right)}{q_H - q_L} - \frac{\left(\frac{q_L(q_H - q_L)}{4q_H - q_L}\right)}{q_L}\right)$$

$$\pi_H = \left(\left(\frac{2q_H(q_H - q_L)}{4q_H - q_L}\right) - C_H\right)\left(1 - \frac{\left(\frac{2q_H(q_H - q_L)}{4q_H - q_L}\right) - \left(\frac{q_L(q_H - q_L)}{4q_H - q_L}\right)}{q_H - q_L}\right)$$

and then differentiating in terms of quality, the equilibrium qualities will be obtained in two equations of two unknowns. Finally, by solving this system, the Nash values of equilibrium quality will be as follows:

$$q_L = -\frac{2\left((5C_L + 2C_H)\sqrt{23C_L + 2C_H}\sqrt{2C_H - C_L} + (C_L - 2C_H)(17C_L + 2C_H)\right)}{3\left(7\sqrt{23C_L + 2C_H}\sqrt{2C_H - C_L} - 5C_L - 14C_H\right)} \quad \text{Equation (5)}$$

$$q_H = -\frac{-\sqrt{23C_L + 2C_H}\sqrt{2C_H - C_L} - C_L + 2C_H}{12} \quad \text{Equation (6)}$$

Now, the relationship between production costs and quality will be examined:

Theorem 3: Increase in production costs for each manufacturer (low quality and high quality manufacturers) makes the high quality producer increase its quality.

Proof: To prove this, it is sufficient to differentiate equation 6 in terms of costs. Then the following equation will be achieved after solving it:

$$\frac{\partial q_H}{\partial C_L} = \frac{\sqrt{23C_L + 2C_H}\sqrt{2C_H - C_L} - 23C_L + 22C_H}{12\sqrt{23C_L + 2C_H}\sqrt{2C_H - C_L}}$$

Given the above equation, it is clear that this relation is always positive. Therefore, the more the costs of the low quality producer increases, the higher the quality producers will increase the quality of its products.

Concerning the following relation, see the comments below:

$$\frac{\partial q_H}{\partial C_H} = -\frac{\sqrt{23C_L + 2C_H}\sqrt{2C_H - C_L} - 11C_L - 2C_H}{6\sqrt{23C_L + 2C_H}\sqrt{2C_H - C_L}}$$

The above relation is always positive. Therefore, as the cost of producing high quality products increases, the manufacturer of high quality trademarks increases quality.

Theorem 4: Increase in production costs for low quality producer makes them decrease their quality; however, increase in production costs for the high quality producer makes the low quality producers increase their costs.

Proof: To prove this, it is sufficient to differentiate equation 6 in terms of costs and then solve it. The final results are as follows:

$$\frac{\partial q_L}{\partial C_L} \leq 0 \quad , \quad \frac{\partial q_L}{\partial C_H} \geq 0$$

The following comments are two theories about quality and profit:

Theorem 5: The profit of the low quality producer increases when the quality of their trademark is less than the specified limit or the quality of the high quality producer is more than a specified limit. In other words, the low quality producer profits when:

$$q_L \leq \frac{4q_H(C_L - q_H)}{C_L - 7q_H} \quad or \quad q_H \geq \frac{q_L(C_L - q_L)}{2(2C_L + q_L)}$$

Proof: To prove this, it is sufficient to first replace the prices and equilibrium values (equations 4 and 6) in the profit function (equation 3), and then, differentiate in terms of low quality and simplify the equation. The profit function for the low quality producer will be as follows after substituting and simplifying:

$$\pi_L = \frac{q_H\,(q_L\,(q_H - q_L) - C_L(4q_H - q_L))}{(4q_H - q_L)^2}$$

Then, by differentiating this function and then simplifying, it is shown:

$$\frac{\partial \pi_L}{\partial q_L} = \frac{q_H\,(C_L(4q_H - q_L) - q_H(4q_H - 7q_L))}{(q_L - 4q_H)^3}$$

$$\Rightarrow \frac{\partial \pi_L}{\partial q_L} \geq 0 \Leftrightarrow q_L \leq \frac{4q_H(C_L - q_H)}{C_L - 7q_H}$$

To prove the second part, as seen below:

$$\frac{\partial \pi_L}{\partial q_H} = \frac{q_L\,(C_L(4q_H - q_L) + q_L(2q_H + q_L))}{(4q_H - q_L)^3}$$

$$\Rightarrow \frac{\partial \pi_L}{\partial q_H} \geq 0 \Leftrightarrow q_H \geq \frac{q_L(C_L - q_L)}{2(2C_L + q_L)}$$

Theorem 6: The relationship between the profits of the high quality producer and their own trademark is direct, and with low quality trademarks it is reversed.

Proof: To prove this, it is sufficient to first substitute prices and equilibrium values (equations 4 and 6) in the profit function (equation 3), and then, differentiate in terms of low quality and simplify the equation. The profit function for the low quality producer will be as follows after substituting and simplifying:

$$\pi_H = \frac{2q_H\,(2{q_H}^2 - 2q_H(2C_H + q_L) + C_H q_L)}{(4q_H - q_L)^2}$$

Now, by differentiating this function and then simplifying, we can see the following results:

$$\frac{\partial \pi_H}{\partial q_L} \leq 0 \;\; , \;\; \frac{\partial \pi_H}{\partial q_H} \geq 0$$

These results clearly indicate that the relationship between the profits of the high quality producer and their own trademark is direct, and with low quality trademark it is reversed.

4. Conclusion

The concept of product differentiation was first introduced in 1933 by Edward Chamberlain. Product differentiation is known to refer to the process of distinguishing a product or service from other products or services in order to compete and make it more attractive for a specific target market. Undoubtedly, a strong trademark is the main asset of a firm; however, unfortunately when the trademark succeeds in the market and conquers a large part of the target market, it can cause production of a low quality product of that trademark. In this regard, the act of copying original trademarks by producers of low quality products has become widespread throughout the world.

In the contemporary world, there are usually some firms that produce original goods or trademarks, and some that produce low quality variants of the original trademarks and thus, take the market away from the original producer. Accordingly, the main purpose of the present study was to examine the entrance of high quality producers to the market of low quality products. In fact, this study intends to examine whether in a world where firms produce the same or different goods although the quality of goods may differ, will new firms be able to enter the market; and whether the firm producing high quality products may be able to produce both high quality and low quality products. Furthermore, in these cases, if a firm wants to enter the market, whether this entry is in its favor or not.

The results of this study showed that:

1. The price of low quality trademarks is directly related to the quality of high quality trademarks. For the producer of high quality trademarks, this relation is inverse.
2. The relation between the price of high quality products and its quality is direct; however, this is unclear for the producer of low quality trademarks.
3. Increase in production costs for either producer (high quality and low quality producers) leads to the high quality producer increasing their quality.

4. Increase in production costs for low quality producers leads to the low quality producer decreasing their quality; however, increase in production costs for the high quality producer makes the low quality producer increase their quality.
5. The profit of the low quality producer increases when the quality of his own trademark is below a certain limit or the quality of trademarks of the high quality producer is more that the specified limit.
6. The relation between the profit of the high quality trademark producer and their own trademark is direct and with the trademark of low quality producer, it is reverse.

Finally, concerning this study and the presented theorems, it is recommended that the producers of high quality trademarks, with whom the producers of low quality trademarks can always compete as a potential competitor in their trademark markets, utilize the results of this study and keep their equilibrium quality and profit at optimum level concerning the presented theorems.

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