The Analysis of China Trans-regional Mobile Communication Roaming Charges based on Product Differentiation Model

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Abstract: *The trans-regional roaming charges of China Mobile communications has been the focus concerned by the people., its rationality has always been the debated topic. Based on the analysis of China trans-regional mobile communications roaming charges and the Hotelling spatial competition model to analyze the rationality of roaming charges. It conclude that the existence of roaming charges for customers is the difference between local mobile communications and non local mobile communications, the two factors of unit price and roaming charges are considered in the selection of mobile communication at the same time，so as to weakening the price competition between operators，maintaining the telecom enterprises profit foundation of rapid development and expansion.*

Keywords: *Roaming charges; Hotelling spatial competition model Rationality; Weakening price competition*

1. INTRODUCTION

China telecom industry is developed in the reform and opening up, after thirty years of development has made considerable progress. At present, china has more advanced telecommunications network infrastructure and telecommunication technology in the world, but also has the largest telecommunications market. However, as of 2015, most of the world countries will no longer be charged the domestic mobile phone roaming calls, while china's domestic mobile phone roaming calls still exists. Since the roaming cost is much less than its charges and mobile roaming fees computing too complicated and other reasons encourage consumers to repeatedly proposed to reduce or even abolish roaming charges[1][2]. From the perspective of product differentiation, this article analyzes the reason of china trans-regional mobile roaming charges, it is concluded that product differentiation leads to different price levels between the operators, thereby weakening the price competition between operators, maintaining the telecom enterprises profit foundation of rapid development and expansion.

2. THE GENERATION OF CHINA TRANS-REGIONAL MOBILE COMMUNICATION ROAMING CHARGES

China across-regions mobile roaming charges produced in the 1990s, at that time China's mobile communication industry has just started, less than ten million mobile phone users. The eastern region are much better than the western region in terms of network resources, the number of users and the tariffs competition, taking into account this imbalance, that time it proposed to collect domestic mobile roaming charges[3].To prevent situation such as the following, consumers and users in the western region who buy a telephone number in the eastern region or Beijing, Shanghai, Jiangsu, and then used in the western region, in this case, it is tantamount to using the network in the western region,but the income is owned by eastern companies, at this rate, it will exacerbate the imbalance in the development of mobile communications. The generation process of roaming

charges show in Fig1,assuming that the consumer a is one of mobile communication client in the A city and the consumer b is one of mobile communication client in the C city, now the customer a in the B city want to call the customer b, because the B city's mobile communications companies do not know the information of customer a, so ask the A city's mobile communications business for the information of customer a, and then the information is fed back to the B city's mobile communications business, so the customer a can telephone the customer b in the C city. In this process, both the A city and the B city's mobile communications business to provide the customer service, thus the customer a should pay for the A city and B city's mobile communications business, resulting in roaming charges.
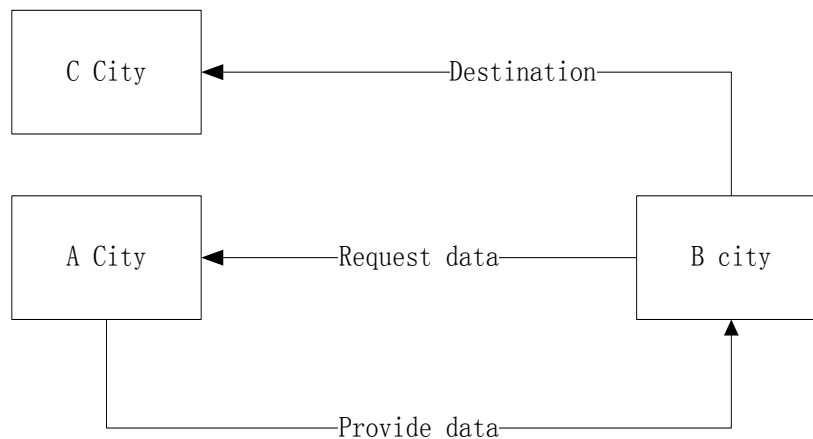

Fig1. *The analysis of roaming charges genarated*

From the above we can know that the roaming charges arising from the exchange and storage of mobile phone's identity and service information in HLR and VLR about the network planning, construction and maintenance, cost is relatively small, in this case why charged roaming fees[4]?Next, this paper analyze from the perspective of product difference model.

3. PRODUCT DIFFERENTIATION MODEL

Product differentiation is one of the most important features of modern economics, spatial competition theory model constructed by Hotelling (1929) is one of important part, taking into account the location (non-price) competition and price competition[5]. The main assumptions include: consumers are uniform distribution along a bounded straight line; there are only two companies competing in the market; each company produces only one product; the two companies' marginal cost of production is constant and equal, and the fixed cost is zero (cost structure symmetry); the company changed location without cost; unit distance transportation cost of unit commodity is fixed; perfectly inelastic demand of individual consumers, etc[6]. Hotelling's analysis contains a assumption: price competition is always easier than the site (non-price) competition. Therefore, the game process is: two companies at the same time to determine the location at a certain point of the market, and then sell their products. As consumers demand inelastic, so the total demand for a company's products is directly proportional market width. Hotelling model represented by Fig2, two companies in the market are respectively located in A and B, their product prices are separately p1 and p2, the marginal cost of the two companies is a constant, the two companies are pursuing profit maximization and treat potential customers or the entire market share as a 1. As consumers pay transportation costs, therefore, for consumers, the delivered price is ex-factory price plus transport costs. Each customer only buy one unit of the product from the company 1 or the company 2.

If and only if the following conditions are satisfied, the customer in the position X to buy the product of company 1.

$$P_1 + tX^2 < P_2 + t(1 - X)^2$$

Similarly, if and only if the following conditions are satisfied, the customer in the position X to buy the product of company 2.

$$P_1 + tX^2 > P_2 + t(1 - X)^2$$

t- customer's sensitivity to the difference in distance, the square of distance is the extension of difference.

First, locate the customer in the X_0 position, which remained neutral on the two companies' products, we can conclude that is located on the left side ($<X_0$) of its customers strictly prefers to purchase the products of company 1; namely the right side ($> X_0$) of its customers strictly prefers to purchase the products of company 2. Have the following solution to get the customer X_0:

$$\text{Make}: P_1 + tX^2 = P^2 + t(1 - X)^2$$

$$\text{Solve for}: X_0 = \frac{P_2 + t - P_1}{2t}$$

Which we can get the demand function (the function reflect demand and price relationship) of the company 1and company2:

$$D_1\left(P_1, \ , \ P_2\right) = X = \frac{P_2 + t - P_1}{2t}$$

$$D_2\left(P_1, \ , \ P_2\right) = X = 1 - \frac{P_2 + t - P_1}{2t}$$

Take the company 1 as an example to get its profit function:

$$\pi_1(P_1, \ P_2) = (P_1 - c)X = (P_1 - c)D_1(P_1, \ P_2) = (P_1 - c)\frac{(P_2 + t - P_1)}{2t}$$

The best decision is obtained by the first order derivative of the company 1 profit function.

$$(P_1{}^* - c)\left(\frac{-1}{2t}\right) + \frac{(P_2 + t - P_1{}^*)}{2t} = 0$$

$$P_1^* = \frac{P_2 + t + c}{2}$$

Solving Nash equilibrium is the most strategic combination
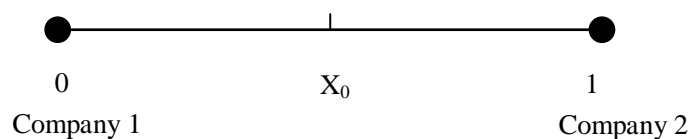
$$P^* = P_1^* = P_2^* \qquad P^* = c + t$$

Fig2. *Hotelling space competition theory model diagram*

It can be seen, the product price depends on the cost and customer sensitivity to regional differences, the greater variable t, the greater product differentiation and the higher price, thus weakening the price competition between operators, which are produced differentiated profit. If only the cost to determine the price, for homogeneous product company, the price is the only variable of interest to consumers, companies will compete for market share through price competition, eventually led to the company's product price down to its marginal cost, it is not conducive to the development of company[7].

4. THE DIFFERENTION MODEL OF CHINA TRANS-REGIONAL MOBILE COMMUNICATION ROAMING CHARGES

3.1. The Application of Hotelling Spatial Competition Theory Model in Roaming Charges

Assuming that the region A and region B respectively have a mobile communications company, provide homogeneous service, the total amount of customers in the two area (the overall market share) is set to 1, through the Hotelling space competition theory model, it can be known that the customer can choose to become the customer of A area, also can choose to become the customer of B area, hypothesis the consumers in the A region and the B region can only become clients of these two regions. By the unit price and the sensitivity of roaming charges to determine the customer to become one of the A area clients or one of the B area clients. The variable P1 and P2 are the set unit price of the A area and the B area respectively, the variable t is the customer sensitivity to roaming charges, the variable m is the roaming charges of A and B region.

From this, we can know that the unit cost of the customers in the A area choose the mobile communication in the A area:

$$Y_{AA} = P_1$$

Similar, the unit cost of the customers in the A area choose the mobile communication in the B area:

$$Y_{AB} = P_1 + tm$$

the unit cost of the customers in the B area choose the mobile communication in the B area:

$$Y_{BB} = P_2$$

the unit cost of the customers in the B area choose the mobile communication in the A area:

$$Y_{BA} = P_2 + tm$$

3.2. The Differential Analysis of Trans-Regional Mobile Communication

When m>0, if and only if $P_1 < P_2 + tm$, the customers in the A area choose the A region's mobile communications; if and only if $P_1 > P_2 + tm$, the customers in the A area choose the B region's mobile communications.

In the same way, if and only if $P_2 < P_1 + tm$, the customers in the B area choose the B region's mobile communications; if and only if $P_2 > P_1 + tm$, the customers in the B area choose the A region's mobile communications.

Therefore, when selecting a mobile communication, the customers will consider both the price and roaming charges of these two factors, and then they will choose the low unit cost of the two area, the bigger variable t, the greater of the difference between the two areas of mobile communications.

When m=0, mobile communication in the two areas has become homogeneous products and services, they are completely substitutes, customers only need to consider the price factor, then the two areas of mobile communication in order to gain market share, correspondingly lower price and thus fall into a fierce price competition, eventually led to the company's unit cost down to its

marginal cost, in this case the mobile communication companies cannot profit, it is not conducive to the rapid development of enterprise. Visible, the difference between the products has the function of easing the price competitiont, cross-regional mobile communication roaming charges for mobile communications in different regions with differences in order to maintain the local market share, so as to obtain the profit of enterprise development foundation[8] [9].

Taking the customers in A area choose mobile communications example, the relationship curve of variable Y (unit cost of mobile communications in the A area) and variable t (the customer sensitivity to roaming charges)is established by using variable t as the horizontal coordinate and variable Y as the vertical coordinate, the variable Y_{AA} is the cost of the customers in the A area choose mobile communication in the A area; assume that when $P_2>P_1$, the customers in the A area choose the B area of mobile communications, in which case we set up the cost for variable Y_{AB1};similar, assume that when $P_2=P_1$, the customers in the A area choose the B area of mobile communications, in which case we set up the cost for variable Y_{AB2}; assume that when $P_2<P_1$, the customers in the A area choose the B area of mobile communications, in which case we set up the cost for variable Y_{AB3}.

When m>0, $P_2<P_1$, the customers sensitivity to roaming charges in the rang of $t<t_1$ will choose the B mobile communications in the B region; likewise, the customers sensitivity to roaming charges in the rang of $t>t_1$ will choose the mobile communications in the A region. When $P_2 \geq P_1$,customers in the A area will choose mobile communications in the A region.
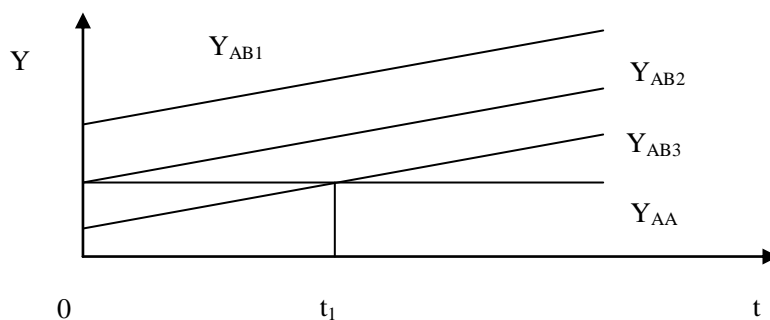

Fig3. *When m>0, the cost of A regional customers choose mobile communication*

When m=0, the roaming charges for customers is not the factors considered that they choose mobile communications, namely the mobile communication in the two areas is only related to unit price. When $P_2<P_1$, the customers in the A area will choose mobile communications of the B area; likewise, when $P_2=P_1$, the customers in the A area will choose mobile communications of the B region or mobile communications of the A region; when $P_2>P_1$, the customers in the A area will choose mobile communications of the A area. Thus, the customers in the A region will choose the lower unit cost of mobile communications, it will result in taking the price-cutting strategy in the two areas of mobile communications companies.
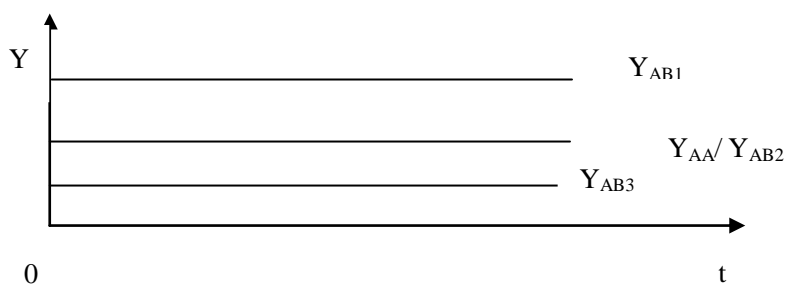

Fig4. *When m=0, the cost of A regional customers choose mobile communication*

5. CONCLUSION

By Hotelling spatial competition theory model, we know that the product differentiation plays a central role in the market operation process and price decision, it has been viewed as a major strategic variable by the manufacturer, thereby try to weaken unsteady and damage caused by intense price competition[10]. Trans-regional mobile roaming fees for customers is the difference between the local and other regions, based on the differences in the competition can ease the price competition between mobile operators, thereby obtaining more profits[11].In this paper, we first introduce the generation of china cross-regional mobile communication roaming charges; secondly, the Hotelling model of product differentiation is described, It is concluded that the factors which determine the customers' choice of products are not only the unit price but also the length of the distance(the product difference); Finally, the application of Hotelling model in cross-regional mobile communication, thus proving the roaming fee is reasonable.

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