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Price dispersion under the Adverse Selection Environment

in E-Commerce Markets

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Abstract: The price dispersion means different prices for same goods. In the Internet economy, many economists reckon that the price dispersion in the e-commerce markets should descend along with the dropping of search cost. However, the correlative empirical studies reach a contrary opinion: there not only exist price dispersion in the e-commerce market, but also has larger dispersion degree than the traditional market, thereby gaining a ‘price paradox’ that is inconsistent with traditional economic principle. Based on the adverse selection Perspective, this paper puts up a new interpretation about the price dispersion in the e-commerce markets. Actual data from five online markets in China serves as a case study to help analyze the characteristics of the price dispersion. Finally, the paper probes into resolving approaches eliminating and decreasing price dispersion in order to raise the business efficiency in the e-commerce markets.

Keywords: price dispersion, adverse selection, ‘lemon’ problem, price discrimination

1. INTRODUCTION

In general, the price dispersion means different prices for same goods. It is talked about all the time by economists that whether the e-commerce markets are more efficient than traditional market. According to the view of micro Information Economics the price dispersion in the e-commerce markets should descend along with the dropping of search cost. Both theoretical analysis and empirical analysis prove that by providing many kinds of searching tools the e-commerce markets reduce the information search cost greatly. Some scholars think that since the Internet reduces the information search cost greatly, adds the value of industry chain, and shifts the markets to benefit customers, it can make customers get more products information, and compare the prices easily. So these scholars think that the price dispersion degree should be lower and the e-commerce markets should be more efficient than the traditional markets [1].

However, correlative empirical research doesn’t support this statement consistently. By doing empirical research on the price level and the price dispersion in the e-commerce markets compared with the traditional markets many scholars reach a conclusion opposite to general views that in the e-commerce markets the price dispersion degree is larger than that in the traditional markets. This phenomenon is durative and it is what the economists most interested in.

2. LITERATURE REVIEW

Bailey investigated the prices of books, CDs, and software between 1996 and 1997 [2]. His research showed that the average price of goods online is higher than that of goods off-line. Bailey gathered 24,000 price data of three categories of goods and compared online prices of every kind of goods with off-line prices from three
aspects: the average prices, the degree of price dispersion, and the change frequency. Bailey found that for these three categories of goods the change frequency of online prices is much higher than off-line and the average online prices are higher than off-line significantly. With respect to price dispersion, the dispersion degrees of online book markets and CDs markets are larger than those in traditional markets, and it is opposite for software markets. Based on the research of Bailey, Brynjolfsson and Smith analyzed the features of Internet as a distribution channel which is mainly for marketing two similar but different categories of goods: books and CDs [3]. With the method of econometrics they concluded that there existed substantive and systematic differences in the online retail prices. They found that online prices for books and CDs changed more frequently and the price dispersion degrees are much larger.

In addition, Lee studied the online drug markets between 1999 and 2000 [4]. His research showed that the online prices for OTC are lower than off-line prices, but when considering delivery costs the online prices are higher than off-line prices, have larger price dispersion degree, and changed more slowly.

The latest statistical research gets the same conclusion. Xing Pan, Ratchford and Shankar observed for 6,739 times the prices from 105 online retailers (on 8 product categories, 581 subclasses) [5]. The observations showed that online price dispersion is durable even if excluding the heterogeneity of online retailers. Eric, Hann and Lorin analyzed the airline ticket price data provided by OTAs (online travel agents) to examine the price dispersion and the product differences [6]. They found that for many OTAs the same customer would get different prices and different characteristic service. This was probably caused by the difference between OTAs systems, for example, some OTAs wanted to reduce the number of transport lines and they need to cooperate in the time of launch and return. But after excluding these factors, the price dispersion degree came to 18% of the total OTAs amount, among which the dispersion of return tickets reached between 2.2% and 28%. Su analyzed the online prices of 14 categories and found that prices of three categories (books, CDs, and airline tickets) changed most greatly and thereto the price dispersion degree of CDs markets was the largest [7].

Obviously the conclusions of those empirical researches differ from theoretical analysis of traditional microeconomics. Some researches found that average online prices are lower than off-line and some researches reach the opposite conclusion, but all researches showed that the price dispersion degree in the e-commerce markets is much larger. So the ‘price paradox’ comes into being which contradicts the theory of traditional microeconomics.

According to the view of the traditional microeconomics, the larger the price dispersion degree comes, the less mature the markets develop. So economists pay close attention all the time to analyzing the cause of price dispersion and probe into reducing the price dispersion. Many scholars provide different causes about this problem.

Brynjolfsson and Smith think that online price dispersion comes from two heterogeneities of retailers: the heterogeneity of consumers’ cognition and the heterogeneity of the brand and trust of retailers [3]. They think that compared with traditional business channel these heterogeneities between online retailers are enlarged. Bailey concluded that the phenomenon that the online prices were higher came from the less mature of the markets [2]. His conclusion was proved by Brynjolfsson and Smith who collected research data two years after. In that period as the online book markets and CD markets became more mature the average prices were lower. Chen and Hitt concluded that the price dispersion was the result of heterogeneity of customer loyalty to one brand [8]. Lal and Sarvary thought that the price dispersion was due to the heterogeneity of digital attributes [9]. In general, digital attributes refers to attributes that can be evaluated by vision inspection and can be transmitted via the Internet. Non-digital attributes can only be evaluated by Physical examination and cannot be transmitted via the Internet. They thought when the Internet got enough users and non-digital attributes were not important for customers, customers would become more loyal to their familiar brands and then price monopoly would lead to
price dispersion. Eric, Hann and Lorin hold that customers needed to register to get information they want, to decrease their searching time, and to get the qualification of booking ticket [10]. Therefore when the cost of transfer and search is ‘nonzero’, it would decrease customers’ chance of choosing OTAs. Su point out two factors -- online retailers’ inducement on customers’ search and evaluations on commodity utility -- were relevant to price dispersion in the e-commerce markets [6]. Bounie et al have found that price dispersion is sensitive to the maturity of the market [7].

By summarizing these scholars’ viewpoints, price dispersion results from the following factors: (1) diversities of releasing signals in the e-commerce markets such as trademark and brand; (2) heterogeneities of customers’ cognition and loyalty for one product; (3) market position of online customers and path dependence on Internet utilities, for example, different cost of transfer; (4) differences between digital and non-digital attributes; (5) different marketing strategies adopted by online retailers, e.g. inducement for products.

3. THE ‘PRICE PARADOX’ IN THE E-COMMERCE MARKETS AND AVERSE SELECTION

These factors listed above explain the phenomenon of online price dispersion to a certain extent. But in this paper, it is proved that the intrinsic factor of online price dispersion is the adverse selection (the ‘lemon’ problem) which is caused by information asymmetry during the online transaction.

2.1 Adverse selection in the e-commerce markets and pricing strategy

Adverse selection refers to the choice customers make when they are in information inferiority. Adverse selection theory was put forward by Professor George A. Akerlof, an American economist who is one of the winners of Nobel Prize in economics in 2001. This theory studies the impact of information asymmetry of products quality on market efficiency. This theory starts from research on ‘lemon’ problem, so it is called ‘lemon market’ theory. By the ‘lemon market’ model, also called Akerlof model, Akerlof proved the result of information asymmetry: adverse selection caused by ‘lemon’ problem reduced market trading efficiency [11]. Akerlof studied the traditional markets and traditional business and how about the e-commerce markets which based on the Internet? In fact, when people are elated and inspired by a variety of convenience and high efficiency brought by the Internet, at the same time they have to confront such a fact: adverse selection caused by information asymmetry during online business tends to be worse for some external factors such as virtuality of online business because of the fact that the Internet has no space-time limit [12]. If virtuality of online business is related to Internet pricing, then adverse selection will enlarge the price dispersion of online business.

Internet pricing is one important part of cyber marketing, and there are a variety of pricing strategies used in e-commerce markets. (1) Discrimination Pricing. It is the most often used strategy in cyber marketing by now. Discrimination pricing refers to setting online prices according to the level that digital products meet the demand of customers. The Internet can easily provide not only personalized products but also personalized prices. (2) Penetration Pricing. Penetration pricing is the pricing technique of setting a relatively low initial entry price, sometimes a zero or negative price, to attract more customers to get the threshold. By the preemptive action, companies can ‘lock in’ customers. Some digital products got advantageous pioneer position in the Internet browser market by adopting low or zero initial prices. (3) Segmented Pricing. Many online companies set different prices for one product on the basis of customers or geographical positions. (4) Dynamic Pricing, XML and other techniques made dynamic WebPages possible. These techniques can list database information systematically. This information can change with time or customer. (5) Contrast Pricing. By adding high-priced items into the e-commerce marketing product line, companies raise customers’ reference price invisibly and made the prices of other products appear lower. For example, the cost of adding ‘gold edition’, the edition with technical support by paying extra-fees, will be low if few people choose it. (6) Track Pricing. By using Internet techniques, i.e. Customer Tracking System, companies can set prices frequently after finding out customers’
demand, potential customers’ demand change, or their psychological change.

From the variety of e-commerce markets pricing methods listed above we can know that because the e-commerce markets have high efficiency in communication the Internet technology brings online companies flexibility in pricing which can never come true in traditional markets. But from the viewpoint of economists, it is just the information asymmetry problem, i.e. lemon problem, which is brought by price discrimination leads to online price dispersion.

2.2 The internal causes of adverse selection and price dispersion in the e-commerce markets

First, modern Internet technologies make it possible for online companies to collect consumers’ preference information easily and provide online companies with price discrimination conditions. But it is the very low menu cost and customization cost that makes online companies change the interface and decide what information customers get according to their preferences. It helps to further segment customers and make online companies’ ability of price discrimination come true. By modern Internet technologies, it is possible to apply marketing methods which cannot be used in traditional environment. But these methods take into account sellers’ strong subjective assessment and preference on quality, so the products with same quality have huge price variance [13]. Under these circumstances, the emergence of price dispersion is objectively inevitable.

Second, sellers tend to provide incomplete information for some strategic considerations. In fact sellers provide information just to seek differentiation strategies which prevent comparison pricing. It is impossible and infeasible to prove the truth of some information [14]. Furthermore, even if sellers give information, it will include sellers’ strong subjective assessment and preference on quality. When consumers buy products it is impossible for them to find out not only the product quality distribution but also the sellers’ motive. So their disadvantage of product quality information gets serious and so does the adverse selection. As a result products with same quality have different prices and the price dispersion comes about.

Third, from consumers’ point, in the e-commerce markets they can use a variety of search and comparison tools and can collect more price information at very low search cost. But the Internet reduces search cost not only for consumers but also for sellers. It has dual characters. For example, the ‘Shopbots’ that exist in the e-commerce markets now increase price elasticity of demand. But others invent ‘Pricelbots’, which respond to ‘Shopbots’ by a price-operation method. Then, the ‘Shopbots’ consumers interact with ‘Pricelbots’ sellers on the Internet. In addition, Gallaughe and Downing found through surveys that either search engines (e.g. Google) or price comparison websites (e.g. Pricescan.com) provide incomplete information [15]. The reason is that search engines have some defects. Choi, Stahl & Whinston summed up these defects into the following four aspects [13]:

1. The full catalogue that includes all websites and all documents doesn’t exist. Because in order to compensate for the loss of editing database, many search engines only concentrate on attracting advertisers instead of improving data integrity and efficiency.
2. For the continuous renewal of websites, the database have inaccurate and outdated data which will give users invalid links.
3. Metadata standards on digital document has not been built, so some websites will produce information not relevant to key words.
4. Some search engines pick information by vague standards and this affects the objectivity of results. For example, some search engines ignore websites that are considered as offensive, indecent, or frivolous according to their own standards. In this case, only consumers with complete information can buy low price products. Consumers with incomplete information will buy randomly and may get high prices. On the other hand, if consumers are still in adverse selection with the assistance of search engines and price comparison tools, they can only use reputation, brand, etc, to avoid adverse selection. Usually they need to pay extra ‘reputation rent’ except the price.

4. EVIDENCE EMPIRICAL ANALYSIS: BASED ON FIVE ONLINE MARKETS

Now we choose online book market, online digital camera market, online CD-ROM market, online
3G mobile phone market and online notebook computer market as a sample point, and analyze the price dispersion in the five markets. The time span is three months (2011.9 - 2011.11). The Explained variable is commodity price dispersion. The explanatory variables include seller number, the number of buyers, the cost of goods search site itself features service features and website feedback. The unit of the Variable is day.

Panel data models with variable intercepts of the five markets are as follows:

\[ DP_i \times t = a + \log(M1_i)h + \log(M2_i)g + \hat{C}_i + \hat{P}_i + \hat{GB}_i + \hat{WX}_i + \hat{XT}_i + \hat{JR}_i + \hat{AY}_i + \mu_i + \epsilon_i \]

\[ DP_i \] represent price dispersion of commodity \( i \) in time \( t \), \( a \) represent fixed intercept , \( \mu_i \) represent fixed intercept of commodity, \( M1_i \) represent the price of commodity, \( M2_i \) represent the favorable ratio of the e-seller, \( \hat{C}_i \) represent search cost, \( \hat{P}_i \) represent delivery and payment services, \( \hat{GB}_i \) represent credit of seller, \( \hat{WX}_i \) represent virtual digress , \( \hat{XT}_i \) represent information availability, \( \hat{JR}_i \) represent the length of time to carry out e-commerce business, \( \hat{AY}_i \) represent favorable ratio of website \( \hat{b}_i \) represent the coefficient corresponding to the explanatory variable, \( \epsilon_i \) is random error.

We choose the Explained variable is standard deviation coefficient \( \frac{\sqrt{\text{Var}(P)}}{\text{E}(P)} \) to measure price dispersion and use statistical software to estimate the variable intercept model. We can get the estimation results (table 1).

<table>
<thead>
<tr>
<th>Table 1 Variable intercept model estimation results</th>
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<tbody>
<tr>
<td>R-squared</td>
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<tr>
<td>Adjusted R-squared</td>
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<tr>
<td>S.E. of regression</td>
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<tr>
<td>F-statistic</td>
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</tbody>
</table>

With the variable intercept model, we get the estimation results of on-line book market (table 2).

<table>
<thead>
<tr>
<th>Table 2 Parameter estimation results</th>
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<tbody>
<tr>
<td>Variable</td>
</tr>
<tr>
<td>On-line book market</td>
</tr>
<tr>
<td>Price of commodity</td>
</tr>
<tr>
<td>Favorable ratio of e-seller</td>
</tr>
<tr>
<td>Search cost</td>
</tr>
<tr>
<td>Delivery and payment</td>
</tr>
<tr>
<td>Credit of seller</td>
</tr>
</tbody>
</table>
According to the regression results, we get on-line book market regression model:
\[ DP'_r = 0.065841 - 0.635247 \log(M/1_r) + 0.214358 \log(M/2_r) + 0.425315 C_r \\
- 0.151586/PZ_r - 0.602104GB_r + 0.323366\bar{H}_Y - 0.045875 \cdot T_r \\
+ 0.434751 \cdot \bar{R}_r - 0.616273.1Y_f \]

From the regression coefficients of the model, we can find that the coefficients of favorable ratio of e-seller, delivery and payment, credit of seller, information availability and favorable ratio of website is negative. The fact shows that these factors have increasing the price dispersion. In fact, thanks to favorable ratio of e-seller, favorable ratio of website and credit of seller reducing adverse selection in e-commerce market, the price dispersion can be less.

The regression coefficients also tell us that the coefficients of the price of commodity, search cost, virtual digress as well as length of time coefficient is positive. It shows that that the cyber adverse selection phenomenon not only exists, but also increases price dispersion in e-commerce markets. For example, the price of commodity has a more significant influence for the sale of goods, but its coefficient is positive. This shows that the higher prices of goods more difficult to sell. Because the buyers can not identify the quality, they can only accept low prices - this is the characteristics of cyber ‘lemon’. The results show that the cyber ‘lemon’ phenomenon still exists in on-line book market, which will increase price dispersion. In addition, the search cost has a significant influence on the price dispersion. This phenomenon validates our above analysis. The Internet reduces search cost not only for consumers but also for sellers, the search cost still strengthen price dispersion.

According to the same procedure, we can get the regression model of online digital camera market:
\[ DP'_r = 0.154123 - 0.608423 \log(M/1_r) + 0.301422 \log(M/2_r) + 0.504452 C_r \\
- 0.530102/PZ_r - 0.564621 GB_r + 0.412362 \bar{H}_Y - 0.095412 \cdot T_r \\
+ 0.5135821 \cdot \bar{R}_r - 0.741953.1Y_f \]

We can get the regression model of online CD-ROM market:
\[ DP'_r = 0.324156 - 0.502317 \log(M/1_r) + 0.2362011 \log(M/2_r) + 0.498124 C_r \\
- 0.485134/PZ_r - 0.512479 GB_r + 0.430415 \bar{H}_Y - 0.084562.1T_r \\
+ 0.495413 \cdot \bar{R}_r - 0.842179.1Y_f \]

We can get the regression model of online 3G mobile phone market:
\[ DP'_r = 0.203351 - 0.6047211 \log(M/1_r) + 0.2547263 \log(M/2_r) + 0.402174 C_r \\
- 0.512793/PZ_r - 0.662802 GB_r + 0.530127 \bar{H}_Y - 0.072413.1T_r \\
+ 0.489534 \cdot \bar{R}_r - 0.623014.1Y_f \]

We can get the regression model of online notebook computer market:
\[ DP'_r = 0.362413 - 0.6423751 \log(M/1_r) + 0.287526 \log(M/2_r) + 0.463842 C_r \\
- 0.105861/PZ_r - 0.654128 GB_r + 0.362531 \bar{H}_Y - 0.084512.1T_r \\
+ 0.462581 \cdot \bar{R}_r - 0.625847.1Y_f \]

According to the comparative analysis of five online market regression models, we can find that the different kinds of markets have the different price dispersion. It depends on the degree of adverse selection and asymmetric information in these five markets.
5. CONCLUSIONS

Market efficiency, the basis for market to exist, is what economists interested in all the time. Bertrand built a price competition model on a market where there is no difference between products, customers have perfect information, and the cost of searching is zero [10]. This model described companies’ behavior of price competition and their marginal cost pricing strategies. But Bertrand’s model is just a theory model. Of course the real markets cannot meet the assumptions listed above neither can the e-commerce markets. It was proved by the previous analysis that the internal reasons of online price dispersion lie in the asymmetry of quality information and the adverse selection in the e-commerce markets. Therefore it’s necessary to explore solutions to avoid adverse selection in the e-commerce markets in order to decrease price dispersion and improve trading efficiency.

- We should fully understand the impact of adverse selection on the development of ecommerce. When we are intoxicated in the convenience of modern Internet technology, we cannot neglect the information asymmetry of Internet virtuality. This is the non-ignorable premise to observe, exploit, and develop ecommerce.
- Technical methods should submit to the establishment of value chains. We should confirm that ecommerce based on modern Internet technology changes the theorem of operation and competition but it doesn’t change the basis for enterprise to survival. Customers’ satisfaction and their willingness to buy still are the focuses of enterprises competition.
- Cyber marketing should combine with traditional marketing. Online companies should use their credibility and brand in the traditional market as a stepping-stone towards ecommerce.
- Give full consideration to our own national conditions. Be sure to fully consider consumer acceptance and receptivity in order to construct a Internet model suitable for Chinese national conditions.
- Strategic orientations, suggestions and countermeasures should adapt to the environment of cultural and ethics. Trust, which is a social order recognized and accepted, plays a great role which cannot be substituted by economic measures in decreasing online price dispersion. Therefore, building trust mechanism in the e-commerce markets and developing mutual trust and understand between Internet markets participants are important problems that we confront when developing Internet economics at present. We should pay attention to these problems.

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