

Exploring Price Level and Pricing Adjustment Mode in China's Online Retail Market: the Cases of JD Mall, Amazon and DangDang

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Abstract

Price wars are a major form of competition for Chinese online retailers. Based on empirical data from online retailers, JD Mall, Amazon(Z.cn) and Dangdang, this study explored the price competition in China's B2C e-commerce market. The average price level, the minimum price level, the price differential level and price variation were considered. The results showed that the average price levels between the three e-commerce websites had statistically significant differences. However, the minimum price level and the price differential level were similar. In terms of the price variation, the three websites adopted different price adjustments and did their best to avoid a direct price war. This suggests that the e-commerce market competition in China is becoming rational.

Keywords: Online retail market; Price competition; Price level; Pricing adjustment mode

1. Introduction

In recent years, China's online retail market has been growing quickly. The sales volume of online shopping hit new records and its proportion to the total retail sales increased each year for the last 10 years. In H1 2015, China online retail value reached RMB 1645.9 billion (USD 265.126 billion) with a YoY growth of 39.1%, online physical goods retail value reached RMB 1375.9 billion (USD 221.633 billion), and non-physical goods made up of RMB 270 billion (USD 43.492 billion). In China today, online shopping becomes a necessary consumption tool, it may play a more important role in future [1]. Despite the rapid development, domestic e-commerce retailers are still stranded in the traditional circulation mode characterized by large-scale and extensive management. The price war can become a commonly-used weapon for online retail market competition [2]. It leads to a series of problems such as impractically high sales, price speculations, fraud and so on. The corresponding services, such as logistics distribution, payment model and system security, which cannot keep pace with rising sales. It seems that the domestic e-commerce industry needs to get rid of the savage growth mode represented by price wars, establish a new business model with healthy competition and cultivate the real core competitiveness.

Many researchers have focused on price competition in the e-commerce market between online retailers and traditional retailers or on online price competition in general. For the former, researchers usually explored the equilibrium prices and profits between two parties by using information economics theories and game theories to establish

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models [3-5]. The models often were verified by simulation experiments and need further investigation using empirical data [6]. Hence some researchers collected price data for commodities such as CDs, books and software in the e-commerce market. Compared with offline channels, they concluded the lower pricing strategies in online direct selling through statistical analyses and tests [7-8]. Nonetheless, these studies paid little attention to the tendency toward price competition among e-retailers. As the impact of online markets on traditional markets for goods such as books and music gradually increased, researchers became concerned with the price competition between e-retailers. For example, taking Amazon and the Barnes & Noble bookstores research subjects, Judith *et al.* (2003) explored the pricing strategies under a duopoly from the aspects of price dispersion and price elasticity by employing methods such as regression analysis and the maximum likelihood estimate [9]. Their research revealed that both e-retailers were sensitive to price, but the price elasticity of demand of the Barnes & Noble bookstore was significantly higher than that of Amazon. The limitations on the data size (only two e-commerce retailers) and the product category (only books), however, limited the universality of the research results [10].

This paper explores the pricing modes, pricing strategies and pricing features of online retailers from four aspects, the average price level, the minimum price level, the price differential level and price variation, by collecting and analyzing the actual price data of online retailers. The research will provide an empirical basis for establishing a positive, competitive environment for the e-commerce retail market.

2. Related Work

Two aspects of the price competition in the e-commerce market were addressed through theoretical and empirical research. In order to investigate the effects of e-commerce implementation levels on the competitive pricing behaviors of retailers, researchers first analyzed the price competition between e-commerce retailers and traditional offline retailers. They established competition models to explain the equilibrium prices acceptable by two parties by using information economics theories and game theories. For example, Chen Yun *et al.* (2006) established a two-stage game model to analyze the price competition behaviors of e-commerce retailers and traditional offline retailers [3]. They determined the optimal price, equilibrium profit and customers' distribution states for both online and offline cases. They reported that the profits made by e-commerce retailers would be higher than those made by traditional retailers when the e-commerce implementation level reaches some critical value. However, the work of Chen Yun *et al.* didn't consider the influences of online behavioral differences among consumers and dual channels of price competition. To address these problems, Pan *et al.* (2002) built a price competition game model based on Hotelling's law where Internet outlets and dual channels could coexist [4]. Furthermore, they theorized that online direct sellers generally adopt lower pricing strategies than offline sellers. Considering different consumers and the two types of price competition strategies of Bertrand and Stackelberg, Zhao (2011) used game theory to explain the equilibrium prices and profits of e-commerce retailers and traditional offline retailers based on the demand functions established by using consumer utility theory [5]. His research used a numerical example and showed that traditional retailers tend to choose the preempting Stackelberg strategy to ensure greater commercial interests when they were faced with competition from e-commerce retailers.

The aforementioned research focused on the price competition between e-commerce retailers and traditional offline retailers. But these studies employed game theories based on deductive logic and the hypotheses and arguments need to be tested empirically results [6]. Some researchers, therefore, performed statistical

analyses on price data from some commodities *e.g.* CDs, books and software in thee-commerce market, to quantitatively describe the competition patterns of online and offline retail prices. Moreover, they found that online prices generally were lower than the offline prices [7-8].

With the expansion of the e-commerce retail market, academic researchers have become concerned about the price competition between e-retailers. For example, using data on best-selling books, Judith and Austan (2003) analyzed the price competition between Amazon and Barnes & Noble's online bofigureokstore and found that both sides were sensitive to price, but the price elasticity of demand of the physical Barnes & Noble bookstore was significantly higher than that of Amazon [9]. Ghose and Gu (2008) revealed the reasons for this phenomenon from the perspectives of the demand structure of consumers and market friction [11]. They posited that when the price of books was reduced, the price elasticity of Amazon rose while it fell for Barnes & Noble because Amazon had the advantages of a lower cost of price information and higher customer loyalty. Also, Ba *et al.* (2007) used game theories to construct the duopoly competition model [12]. They obtained the price competition strategies under the cases where both the service level of online retailers and the brand's cognitions were different and found the reverse price effect appeared in the price competition in an online retail market. On the basis of the work above, Ba *et al.* (2008) built the oligopoly model to analyze the conditions leading to the reverse price effect and gave corresponding suggestions on pricing strategies [10]. Based on the product information collected from Amazon.com and customer information surveyed and derived, Jiang *et al.* (2015) propose an analytical model to help e-tailers exploit optimal discount price and recommendation lists [13]. However, the hypotheses on the homogenization in the cost structure of online retailers in the model were too simple to measure the heterogeneities of consumers [14]. Hence this affected the applicability of the results [12,15-16].

The paper is structured as follows. Section 2 summarizes related literatures. In Section 3, we describe the dataset collection and process procedure. And the empirical analysis of price competition in online retail market is then offered. Finally, some findings are summarized and some thoughts are presented to future researches.

3. Empirical Research

3.1 Data Collection and Processing

The research for this paper was based on data from the IResearch Consulting Group (2013) that focused on top three self-operating online retailers, namely JD Mall (www.Jd.com), Dangdang (www.dangdang.com) and Amazon (Z.cn). These three websites have a 55.1% market share in the Chinese self-operating B2C business. Based on the product categories in Z.cn, product samples were selected. Then the same products were chosen from the other two websites. Eleven categories of products were used as research subjects. The database contained 235,171 pieces of pricing data on 515 kinds of products from October 15, 2012 to April 15, 2013. Table 1 illustrates the statistical analysis of the empirical data.

Table 1. Descriptive Statistics

Product Category	Count	Mean	sd	Max	Min
Books	148	44.15	79.94	676.40	10.80
Televisions	11	4,826.00	2,472.89	9,588	1,899
Air conditioning	19	4,084.53	1,424.45	6,640.00	1,999.00

units					
Refrigerators	11	1,329.82	682.67	2,399.00	519.00
Washing machines	18	2,357.78	1,999.94	7,349.00	249.00
Smart phones	29	1,358.69	1,262.30	4,488.00	139.00
Digital products	45	2,568.40	3,715.78	2,4399.00	349.00
Laptops	18	5,752.72	2,666.66	12,999.00	3,111.00
Health & beauty	128	79.09	73.67	489.00	16.00
Maternal and baby	43	210.93	90.91	458.00	70.00
Food	45	90.53	204.92	1,399.00	14.90
Total	515	924.45	2,044.77	24,399.00	10.80

3.2 Average Price Level Analysis

3.2.1 Multiple Comparisons

Hypothesis 1: There is a significant difference between the average price of JD (JD Mall) and Z.cn (Amazon), and the former's average price is lower than the latter's.

Hypothesis 2: There is a significant difference between the average price of Dangdang and JD (JD Mall), and the former's average price is lower than the latter's.

Hypothesis 3: There is a significant difference between the average price of Z.cn (Amazon) and Dangdang, and the former's average price is lower than the latter's.

Based on the price sample data, a single factor analysis of variance on the overall average price level was performed and Welch's t-test was used to test the results. The conclusions are summarized in Table 2 and Table 3.

Table 2. Single Factor Variance Test Results (Overall Average Price)

	Mean	JD	Z.cn	Dangdang	Sig
Average price	1,141.32	1,161.64	1,058.43	1,210.03	.000

* denotes the result is significant at 0.05 level; ** denotes the result is significant at 0.01 level; *** denotes the result is significant at 0.001 level

Table 3. Multiple Comparison Analysis Results (Overall Average Price)

Websites	Mean Difference	Sig.
JD vs.Z.cn	103.207***	.000
JD vs.Dangdang	-48.393***	.000
Z.cn vs. Dangdang	-151.600***	.000

* denotes the result is significant at 0.05 level; ** denotes the result is significant at 0.01 level; *** denotes the result is significant at 0.001 level

According to Table 2 and Table 3, the average prices of JD, Z.cn and Dangdang were 1161.64, 1058.43, and 1210.03 respectively; there was a significant difference between the average price of JD and Z.cn, $p < 0.001$, and the former's average price was higher than the latter's. There was a significant difference between the average price of JD and Dangdang, $p < 0.001$, and the former's average price was lower than the latter's. There was a significant difference between the average price of Z.cn and Dangdang, $p < 0.001$, and the former's average price was lower than the latter's. Therefore, there does not seem to be evidence to support any of the first three hypotheses as the overall average price level of JD was lower than that of both Dangdang and Z.cn.

Next, the single factor variances of 11 categories of products were analyzed by using Welch's T test method in the product category. The results are shown in Table 4 and Table 5.

Table 4. Single Factor Variance Analysis Results (Product Category)

Product Category	Average price (JD)	Average price (Z.CN)	Average price (Dangdang)	Sig	Description
Books	72.22	41.83	46.66	.000	JD> Dangdang >Z.cn
Televisions	5,119.14	5,296.88	4,883.02	.000	Z.cn >JD>Dangdang
Air conditioning units	3,626.15	3,839.94	3,755.63	.000	Z.cn >Dangdang>JD
Refrigerators	1,563.13	1,761.48	1,835.76	.000	Dangdang> Z.cn >JD
Washing machines	2,339.11	2,347.93	2,096.53	.000	Z.cn >JD>Dangdang
Smart phones	1,425.68	1,380.47	1,487.36	.000	Dangdang>JD> Z.cn
Digital products	2,505.01	2,429.95	2,531.23	.155	Dangdang>JD> Z.cn
Laptops	3,955.09	4,887.57	4,623.31	.000	Z.cn >Dangdang>JD
Health&beauty	173.7	73.78	170.16	.000	JD>Dangdang> Z.cn
Maternal and baby	250.16	200.39	259.26	.000	Dangdang>JD> Z.cn
Food	309.63	77.52	530.29	.000	Dangdang>JD> Z.cn

* denotes the result is significant at 0.05 level; ** denotes the result is significant at 0.01 level; *** denotes the result is significant at 0.001 level

Table 5. Multiple Comparison Test Results (Product Category)

Product Category	Websites _i vs.Websites _j	Mean Difference	Sig.
Books	JD-Z.cn	30.382**	.006
	JD-Dangdang	-596.246***	.000
	Z.cn -Dangdang	-626.628***	.000
Televisions	JD- Z.cn	-177.746**	.005
	JD-Dangdang	236.112***	.000
	Z.CN-Dangdang	413.857***	.000
Air conditioning units	JD- Z.cn	-213.791***	.000
	JD-Dangdang	-129.481**	.002
	Z.cn -Dangdang	84.310*	.038
Refrigerators	JD- Z.cn	-198.349***	.000
	JD-Dangdang	-272.633***	.000
	Z.cn-Dangdang	-74.283	.106
Washing machines	JD- Z.cn	-8.820	.856
	JD-Dangdang	242.581***	.000
	Z.cn -Dangdang	251.401***	.000
Smart phones	JD- Z.cn	45.216*	.025
	JD-Dangdang	-61.675**	.003
	Z.cn -Dangdang	-106.891***	.000
Digital products	JD- Z.cn	75.065	.163
	JD-Dangdang	-26.222	.635

	Z.cn-Dangdang	-101.287	.065
Laptops	JD-Z.cn	-932.474***	.000
	JD-Dangdang	-668.218***	.000
	Z.cn-Dangdang	264.256***	.000
Health & beauty	JD-Z.cn	99.921***	.000
	JD-Dangdang	3.539	.423
	Z.cn-Dangdang	-96.382***	.000
Maternal and baby	JD-Z.cn	49.772***	.000
	JD-Dangdang	-9.099	.100
	Z.cn-Dangdang	-58.871***	.000
Food	JD-Z.cn	232.107***	.000
	JD-Dangdang	-220.665***	.000
	Z.cn-Dangdang	-452.771**	.006

* denotes the result is significant at 0.05 level; ** denotes the result is significant at 0.01 level; *** denotes the result is significant at 0.001 level

From Table 4, we can see: i) There were significant differences between the price levels of most products in the three e-commerce websites ($p < 0.05$). The electronic digital product category was the only special one. Its price was the highest on Dangdang, in the middle on JD, and the lowest on Z.cn, but the price differences between the three websites were not significant ($p = 0.155$); ii) Although the prices of other products take on significant differences when they are compared between the three websites, not all of the product prices were significantly different when two by two comparisons were conducted.

In light of the product categories (as shown in Table 5), the average price level of refrigerators on Dangdang was the highest, in the middle on Z.cn, and the lowest on JD, but the average price level on Z.cn was not significantly higher than that of JD ($p = 0.016$). For the washing machines, the price sequence was Z.cn > JD > Dangdang, but the multiple comparison results indicated that the price difference between Z.cn and JD was not statistically significant ($p = 0.856$). And for cosmetic as well as maternal and infant products, the price sequence was JD > Dangdang > Z.cn and Dangdang > JD > Z.cn respectively, but the price differences were not statistically significant ($p > 0.05$). For books, the average price on JD was significantly higher than that of Dangdang, and the average price on Dangdang was significantly higher than that on Amazon. Thus it seems that Z.cn maintains an advantage over the other two stores. And since books are not JD's strength, it was not surprising that its book prices were higher than those on the other two websites.

From the average price comparisons of four kinds of household electrical appliances, the average prices on Z.cn were higher than the other two websites in most product categories. But the price differences between Z.cn and JD were not significant.

In the 3C digital product market, JD's average prices were significantly lower than the other two websites for notebook computers, while Z.cn's average prices were the lowest for mobile phone and digital products. Dangdang's average prices were the highest for all the 3C digital products. Thus for the 3C digital products which are the main source of profit for JD, JD doesn't use a low price competition strategy. In fact, JD has built up certain approval and loyalty among its customers for 3C digital products, so there is less price sensitivity.

In the general merchandise market, all price differences were significant except for maternal and infant products on JD and Dangdang. The average prices of the three kinds of merchandise on Amazon were the lowest. The reason may lie in the absolute price advantage of Z.cn since Amazon is a comprehensive e-commerce website, and its purchase costs and operation costs for general merchandise are lower than those of the other two websites.

3.2.2 Average Price Analysis by Time Period

The price data from October 15, 2012 to April 15, 2013 were divided into six time periods. The first period includes the data from October 15, 2012 to November 15, 2012; the second period is from November 16, 2012 to December 15, 2012, and so on. The single factor variance analysis and the multiple comparison test of average price were performed by time period. The results are shown in Table 6 and Table 7.

Table 6. Single Factor Variance Analysis Results (average price by time period)

Time Period	Mean	JD	Z.cn	Dangdang	F	Sig
T ₁	1,138.68	1,062.10	1,062.76	1,087.84	9.492***	.000
T ₂	1,051.80	1,102.27	1,004.46	1,047.49	4.298*	.013
T ₃	1,114.34	1,169.66	1,022.51	1,174.47	19.762***	.000
T ₄	1,202.77	1,137.39	1,039.96	1,440.16	108.391***	.000
T ₅	1,185.86	1,246.35	1,090.30	1,240.20	32.182***	.000
T ₆	1,226.19	1,184.69	1,093.56	1,405.17	67.820***	.000

* denotes the result is significant at 0.05 level; ** denotes the result is significant at 0.01 level; *** denotes the result is significant at 0.001 level

Table 7. Multiple Comparison Test Results (average price by time period)

Time period	Websites	Mean Difference	Sig.
T1	JD-Z.cn	76.582***	.000
	JD-Dangdang	75.915***	.000
	Z.cn-Dangdang	-.667	.974
T2	JD-Z.cn	97.805**	.004
	JD-Dangdang	54.776	.081
	Z.CN-Dangdang	-43.029	.176
T3	JD-Z.cn	147.155***	.000
	JD-Dangdang	-4.805	.871
	Z.cn-Dangdang	-147.155***	.000
T4	JD-Z.cn	-302.775***	.001
	JD-Dangdang	97.432***	.000
	Z.cn-Dangdang	-97.432***	.000
T5	JD-Z.cn	156.048***	.000
	JD-Dangdang	6.141	.793
	Z.cn-Dangdang	-156.048***	.000
T6	JD-Z.cn	-220.477***	.001
	JD-Dangdang	91.135***	.000
	Z.cn-Dangdang	-91.135***	.000

* denotes the result is significant at 0.05 level; ** denotes the result is significant at 0.01 level; *** denotes the result is significant at 0.001 level

As shown in Table 6, except the price differences of three websites in the second time period are significant at 0.05 level ($p=0.014$), the price differences of three websites in the other time periods are significant at the 0.001 level. So there are significant price differences between the three websites.

From the results of Table 7, the price differences between three websites in the fourth and sixth time periods were significant ($p \leq 0.001$). And in the other time periods, there were always the cases where the average price differences were not significant between dual comparisons. The cases where the average price differences were not significant

between JD and Dangdang appeared three times and two times between Z.cn and Dangdang. The average price differences between JD and Z.cn, however, were always significant. So the price competition among three websites seems rather clear, especially for the price competition between Dangdang and JD.

3.2.3 Average Price Level of Different Product Categories

In homage to past research (Friberg *et al.* 2000; Brynjolfson *et al.* 2000; Guo 2013) and to facilitate the horizontal comparisons between the three websites, the product categories were restricted to the following five: books, TVs, refrigerators, mobile phones and notebook computers. Each product category was divided into the best sales or the non-best sales

The *F* tests were performed on all products, the best sales product and the non-best sales product successively, and then the *F* tests were performed according to product categories. The results are shown in Table 8 and Table 9.

Table 8. F Test Results (All Products)

	All products	Best-sales product	Non-best-sales product
χ^2	247.338	98.234	214.962
Asymp. Sig.	.000***	.000***	.000***

* denotes the result is significant at 0.05 level; ** denotes the result is significant at 0.01 level; *** denotes the result is significant at 0.001 level

Table 9. F Test Results (Based on Product Categories)

	Book	TV	Refrigerator	Smart phone	Laptops
χ^2	70.772	40.696	288.816	19.233	11.327
Asymp. Sig.	.000***	.000***	.000***	.000***	.000***

* denotes the result is significant at 0.05 level; ** denotes the result is significant at 0.01 level; *** denotes the result is significant at 0.001 level

As shown in Table 8 and Table 9, there were significant average price differences in the overall six-category products, the best sales product and the non-best sales product between the three websites. And for the products in each category, the average price differences were also significant.

3.3 Minimum Price Level Analysis

To illustrate the price level of various kinds of products in the three websites comprehensively, empirical analyses were conducted on the minimum price level. The ANOVA test results are shown in Table 10.

Table 10. Single Factor Variance Analysis Results (Minimum Price)

	All products	Best-seller	Non-best-seller
<i>F</i>	.012	.015	.015
Sig	.988	.986	.979

* denotes the result is significant at 0.05 level; ** denotes the result is significant at 0.01 level; *** denotes the result is significant at 0.001 level

As shown by Table 10, there were no significant differences between the product minimum prices of the three websites. Even when the products were divided into the best

sales product and the non-best sales product, the product minimum prices of the three parties were not significantly different.

To make a detailed understanding of the minimum price differences in different kinds of products in three e-commerce websites, the single factor variance analysis on each product category was performed individually. The ANOVA test results are shown in Table 11.

Table 11. Single Factor Variance Analysis Results on Different Product Category (Minimum Price)

	Book	TV	Refrigerator	Smart phone	Laptops
<i>F</i>	.105	.002	.032	.003	.041
Sig	.901	.998	.969	.997	.960

* denotes the result is significant at 0.05 level; ** denotes the result is significant at 0.01 level; *** denotes the result is significant at 0.001 level

Table 11 indicates that there were no statistically significant differences between the minimum prices of five kinds of products including books, TVs, refrigerators, smart phones and laptops in the three websites ($p > 0.05$). The results reveal that domestic online shopping consumers still are sensitive to the minimum price. So to increase a website's click-through rates, flows and then sales, e-commerce retailers look to the minimum price as an important way to attract consumer. This leads to intensive price competition in retail e-commerce.

3.4 Price Differential Level Analysis

The price differential is the difference between the maximum price and the minimum price of a product. Single factor variance analyses on the price differential levels of three websites were conducted. The ANOVA test results are shown in Table 12 and Table 13.

Table 12. Single Factor Variance Analysis Results (Price Differential)

	All products	Best-seller	Non-best-seller
<i>F</i>	1.242	.265	1.305
Sig	.293	.768	.280

* denotes the result is significant at 0.05 level; ** denotes the result is significant at 0.01 level; *** denotes the result is significant at 0.001 level

Table 13. Single Factor Variance Analysis Results on Different Product Category (Price Differential)

	Book	TV	Refrigerator	Smart phone	Laptops
<i>F</i>	1.571	.071	.643	.702	5.228
Sig	.226	.932	.536	.509	.019*

* denotes the result is significant at 0.05 level; ** denotes the result is significant at 0.01 level; *** denotes the result is significant at 0.001 level

According to the results in Table 12 and Table 13, the price differentials of various kinds of products on different websites were not significant ($p > 0.05$). The ANOVA test results on different product categories indicated that the price differentials of all kinds of products in the three websites had no statistical significance ($p > 0.05$) except for notebook

computers. The results seem to support the conclusions on the minimum price levels, that the price competition between the three websites was quite intense.

3.5 Price Variation Analysis

According to traditional pricing theory and the actual observations on the e-commerce marketing activities, three kinds of price adjustment modes of e-commerce websites were identified: a periodic price adjustment, a holiday price adjustment and a seasonal price adjustment. The periodic price adjustment reflects price changes in light of the market variation at different time periods. The holiday price adjustment means prices are modified in celebration of various holidays. The seasonal price adjustment means that prices change based on season.

Here, the time period for periodic price adjustment is defined by weekends. The time period for holiday price adjustment covered the first day and the last day of the holiday. And the seasonal period was denoted by monthly alternate intervals and the middle of a month. Specifically, the monthly alternate intervals included the beginning three days of the current month and the last two days of the previous month, and the middle of a month referred to the middle three days of the current month.

In considering the effects of time factors on price variation, the following logistic regression model was established:

In considering the effects of time factors on price variation, the following logistic regression model was established:

$$Y_j = \beta_1 F + \beta_2 W + \beta_3 B + \beta_4 A + \beta_5 M + \beta_6 H + \alpha$$

Here, Y_j was the price variation level; j represented the e-commerce retailer (JD, Z.cn, Dangdang), F was the first day and the last day of the holiday, W denoted weekends; B implied the situation within a week before holiday; A implied the situation within a week after a holiday; M denoted the monthly alternate days; H denoted the middle days of a month; α was a constant; and β_i was the variation coefficient ($i=1,2,\dots,6$).

The regression analyses on the price variation of the three websites were carried out respectively. The results of the regression coefficients and their significance are shown in Table 14.

Table 14. Regression Coefficient and its Significance

Variable	JD		Z.cn		Dangdang	
	β	Sig.	β	Sig.	β	Sig.
<i>F</i>	.695	.001**	.562	.000***	.345	.106
<i>W</i>	.322	.019*	.064	.488	.171	.193
<i>B</i>	.116	.525	-.267	.037*	-.101	.582
<i>A</i>	-.127	.533	-.011	.924	-.125	.515
<i>M</i>	.548	.001**	.004	.971	.818	.000***
<i>H</i>	-.103	.647	-.266	.063	-.093	.669

* denotes the result is significant at 0.05 level; ** denotes the result is significant at 0.01 level; *** denotes the result is significant at 0.001 level

The results in Table 14 show that the effects of F , W and M on price variation are significant in the JD mode ($p<0.05$); the effects of F and B on price variation are significant in the Z.cn mode ($p<0.05$); the effects of M on price variation are significant in Dangdang mode ($p<0.05$).

The regression results also show that the three websites had different price adjustment strategies. JD adopted all three strategies. When the holiday price adjustment strategy was employed, the range of price adjustment within a week after the holiday was bigger than that in the holiday period. Z.cn adopted the holiday price adjustment strategy. The range of its price adjustment in the holiday period was the same as that within a week after the

holiday. In contrast, Dangdang employed a seasonal price adjustment strategy. Even when the three websites used the same price adjustment strategy, the time in which they adjusted their prices was different. During the holidays, weekends and monthly alternate interval days, JD adjusted its product prices more frequently. Z.cn adjusted its product prices more frequently during the holiday and before the holiday, while Dangdang adjusted its product prices more frequently only in monthly alternate interval days.

Thus it can be seen that when setting their price adjustment strategies, the three websites consistently adopted the price adjustment time complementary to their adversaries to avoid an aggressive price competition. Appropriate price adjustment strategies can increase the flows and sales of websites, and can reduce the negative effects brought by a price war too. So the price collusion behind the price war in the B2C e-commerce market is gradually forming, and the rational price competition tendency is rising.

4. Conclusions

A price war is the most common and unreasonable competition in domestic e-commerce. This study employed quantitative methods to analyze the features and differences of price strategies adopted by e-commerce retailers within China from four aspects --the average price level, the minimum price level, the price differential level and the price variation -- using the empirical price data from three self-operating e-commerce retailers. The empirical results showed that price is still the primary factor influencing online shopping behaviors, and the e-commerce retailers realize that price is their main competitive strategy. For five product categories, including books, TVs, refrigerators, smart phones and laptops available on the JD, Z.cn and Dangdang websites, there were significant differences in the average price levels while no significant differences in the minimum price levels and price differential levels. As for price variation, JD adopted all three kinds of price adjustment strategies including periodic price adjustment, holiday price adjustment and seasonal price adjustment, while Z.cn and Dangdang adopted the holiday price adjustment strategy and seasonal price adjustment strategy respectively. Moreover, there appeared to be obvious inconsistencies in the time points where the three e-commerce retailers utilized their price adjustment strategies. This implies that there is some degree of price collusion between e-commerce retailers, and that the competition tends to be rational. E-commerce retailers are resuming their nature to make profits and trying their best to avoid being lost in the price wars. However, this paper focused only on the Chinese B2C e-commerce retailers who mainly operate their businesses by themselves. In addition, the time span for data collection was short (only six months), and the product category sample was relatively small. These factors restrict the comprehensive research of dynamic price evolution over a year in the e-commerce retail market. In addition, they influence the universality of the empirical results. In the future, other B2C retailers such as Suning.com, Tmall.com, yhd.com, yixun.com and Tencent should be considered and the time span of data should be extended so the analyses can have wider reaching implications, and the evolutionary laws of price competition in the China's e-commerce market can be explored further.

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