Pricing convergence between dot.coms and hybrids: Empirical evidence from the online toy market

Received (in revised form): 18th November, 2003

Fang-Fang Tang

obtained his PhD in Quantitative and Information Economics from the University of Bonn in 1996. His research interests include information economy and internet marketing, game theory and experimental/behavioural research, and business in China.

Lydia Gan

obtained her PhD in Economics from the University of Texas at Austin in 1997. Her research interests are internet marketing strategies, the pricing behaviour of online products and e-learning.

Abstract Online branches of traditional retailers price slightly lower than the pure internet players, on average, by only 0.4 per cent in posted prices and 1.4 per cent in full prices (which include shipping costs) for branded toys. The difference is statistically insignificant, indicating that pricing convergence is emerging in the online toy market.

INTRODUCTION

As the internet reaches every aspect of our lives, many traditional retailers find that the internet is a new channel for selling their goods. More and more conventional retailers have started selling online. It is interesting to see how these conventional retailers compete with online-only retailers on the web. Tang and Xing¹ compared pricing behaviour between online branches of multichannel retailers (MCRs) and pure internet retailers (dot.coms) in the DVD market. They found that online prices and price dispersions by dot.coms were significantly lower than online branches of MCRs but the former did not change their prices more often than the latter. These results are also consistent with Tang and Lu² in the online CD market.

Online retailing promises low barriers to entry, easy access to information and

low transaction costs. These features imply that the growth of e-commerce has the potential to realise the economic ideal of a competitive market: low search costs, fierce price competition, low margins and weak market power. If conventional retailers can successfully translate their market power and branding to online markets, it can rationally be expected that they will charge higher prices than dot.coms when they go into online markets.

Clay, Krishnan and Wolff³ examined prices of books sold by 32 online bookstores and found that competition led to low prices and price dispersion. Brynjolfsson and Smith⁴ compared prices of books and CDs sold through internet and conventional channels in 1998 and 1999 and found that online prices were 9–16 per cent lower than those in conventional stores. Morton,

Fang-Fang Tang
Department of Marketing,
Faculty of Business
Administration, Chinese
University of Hong Kong,
Shatin, Hong Kong.
Tel: +852 2609 7820;
Fax: +852 2603 5473;
e-mail: fftang@baf.msmail.
cuhk.edu.hk

Zettelmeyer and Silva-Risso⁵ compared prices of cars sold in online and conventional channels. They found that, on average, online consumers paid 2 per cent less than offline consumers. Based on comparison between online retailing and traditional retailing, these results lend support to the hypothesis that online retailers charge lower prices than offline retailers.

This study explores the different pricing behaviour between dot.coms and online branches of MCRs in the market for toys. Most empirical studies so far have focused on homogenous goods such as books, CDs and DVDs. The toy market is different from the markets for books, music and films. Some sales services are needed to sell toy products, which may result in free riding among retailers (see eg Carlton and Chevalier).⁶ Thus retailers in the toy market may carry on different pricing strategies from those in other markets, such as books, music and films. Investigating pricing behaviour in the toy market will add to understanding of market space and online efficiency.

In this paper, the authors investigate prices of toys sold on the web by both dot.com and the online branches of MCRs. They seek to contrast the pricing of MCRs with that of dot.coms and derive implications. As far as they know, this is the first and only study of the online toy market from such a perspective.

The hypotheses are discussed in detail in the following section. The third section describes the data collection methodology. The fourth section presents the results of the empirical analysis and the fifth concludes the paper.

HYPOTHESES

According to Smith, Baily and Brynjolfsson,⁷ 'in retail markets where

sellers set prices, efficiency occurs when prices are set equal to the retailer's marginal cost. Marginal cost pricing is the efficient outcome since pricing above marginal cost excludes welfare enhancing trades from consumers who value the product at a level between the price and the marginal cost'. Although marginal cost pricing may not prevail on the internet, lower online search costs will result in both lower prices and lower price dispersion for homogeneous goods.^{8,9}

As mentioned earlier, empirical studies have shown that online retailers are more efficient than retailers with physical storefronts and will charge lower prices.^{10,11} Since MCRs may wish to coordinate prices across different channels to prevent destructive competition, they may charge higher prices online than their dot.com counterparts, although it is not necessary for an MCR to charge the same prices online and offline. The first hypothesis is thus formed:

H₁: MCRs charge higher prices than dot.coms.

Efficiency can be argued from the perspective of price dispersion. While uniform pricing may never be applied truly in any retail markets, a relatively small spread between the highest and the lowest prices nevertheless provides evidence for pricing efficiency. In a Bertrand model with homogeneous goods, price competition drives all retail prices down to marginal cost. Search costs and asymmetric information, however, may prevent the market system from achieving pricing efficiency.

Price dispersion across firms for a homogenous good was first analysed by Stigler.¹² A costly search will force an imperfectly informed consumer to restrict his choices of sellers to compare prices. Thus, higher search cost in a market

with imperfectly informed customers would lead to greater dispersion of prices, and greater price dispersion would result in more searches. Following Stigler's seminal paper, both theoretical and empirical studies in the literature have attempted to explain the existence of price dispersion. For example, Nelson¹³ extended Stigler's model by assuming that consumer behaviour was affected by both price and quality. Pratt, Wise and Zeckhauser¹⁴ theoretically showed several cases where even small search costs can lead to substantial price dispersion. Sorensen's¹⁵ empirical study showed that price dispersion could be substantial even in a small local retail market for prescription drugs.

Several studies have shown considerable price dispersion in online markets as well. Clemons, Hann and Hitt¹⁶ looked at online markets for airline tickets and found differences as large as 20 per cent in prices across online travel agents, even after controlling for observable product heterogeneity. Brynjolfsson and Smith¹⁷ initially found higher price dispersion in online markets for books and CDs than their conventional counterparts. After weighting these prices by proxies for market share, however, they reversed their conclusion to the statement that the price dispersion was lower on the web than in conventional stores. Their explanations were the dominance of certain heavily branded retailers, asymmetric information, search costs and retailer heterogeneity. Morton *et al.*¹⁸ also found that price dispersion in the car market in California declined with online sales.

Since empirical evidence has shown that price dispersion may be greater among traditional retailers than among the pure dot.coms, higher price dispersion may be expected among the online branches of the traditional retailers

than their pure dot.com counterparts as well, due to internal channel coordination or market power extension. This suggests the next hypothesis:

H₂: Price dispersion is smaller across dot.coms than across MCRs.

The third argument for pricing efficiency is the frequency of price change that allows retail systems to adjust faster according to variations in demand and supply costs, thus enhancing market efficiency. Bailey^{19,20} indicated that online menu costs were lower than those of traditional stores. Brynjolfsson and Smith²¹ concluded that price adjustments over time by internet retailers are at least 100 times smaller than those of traditional retailers — presumably reflecting lower menu costs in online channels. These results support the hypothesis that online retailers change their prices more frequently and therefore their markets are more efficient. Even if online menu costs are low, however, MCRs may not adjust their prices frequently if they coordinate their online and offline retail operations. Hence, their online pricing behaviour becomes part of an integrated strategy of doing business in both the online and offline markets. Therefore, it is hypothesised:

H₃: MCRs change their prices less frequently than dot.coms.

DATA COLLECTION METHODOLOGY

In order to test the hypotheses, the online toy market was investigated for several reasons. First, as far as the authors know, there has not yet been a similar study on the online toy market. Secondly, the online toy market is one of the most successful ones to have

Table 1: Retailers and their average shipping costs per item

MCRs	Per item average	Dot.coms	Per item average
KBKids ²²	1.93	Amazon	2.78
Wal-Mart	1.92	Etoys	2.23
Kmart	1.68	Smarterkids	2.00
Zanny Brainy	2.10	Nutty-Putty	1.60

migrated online and enjoys considerable growth and sales. Thirdly, the fact that branded toys are homogeneous makes data collection tractable and price comparison meaningful.

The selected retailers must meet the criteria of selling a general selection of toys and games online with their respective prices posted on their website. Two types of online retailers are defined: those that conduct commerce only through the internet and those that sell also through conventional channels.

Eight top dot.coms and MCRs selling a general selection of toys and games were selected (see Table 1) based on the following web ranking sites: 100 Hot Shopping toy and games by Web21.com, top ten toy sites by Forrester's Power Ranking, Gomez.com, RatingWonder.com, and top ten toy links by Top10Links.com. Together, the market share of the eight retailers is substantial, ensuring that their pricing behaviour represents the online toy market. To minimise selection bias, the more specialised retailers in a specific entertainment niche such as Disney or Warner Brothers were not included.

A total of 42 toy and game items were then selected and their prices compared over a period of 12 weeks.²³ Twenty items were selected as an even mix of the top bestsellers among the retailers at the point the study was initiated while the other 22 were chosen randomly. The reason for such a combination is that if all the products were selected from a specific bestseller list such as the Amazon's Toy Topsellers,

which contains only popular items from a specific retailer, the results may be biased as these items are likely to be loss leaders selected by the respective retailer. On the other hand, if all items were selected randomly, one major trend of pricing behaviour might be overlooked since the top selling items occupy a substantial market share in the toy market and competition in the bestsellers' segment is crucial for any market structural analysis. The first category of products is referred to as 'popular' and the second as 'random'. Further, during the data collection process, best efforts were made to ensure that the toy version and manufacturer were exactly the same for a given item.

The frequency of data collection was determined as follows. The interval between data collection should not be too long so as not to miss the point at which a price changes. If the interval chosen is too short, however, data collection costs become extensive. Thus, the data were collected once a week by accessing the websites of the selected retailers and recording the prices of the selected products. In order to ensure the independence of the samples collected, the general price was selected instead of any membership price. Data collection was commenced on 19th October, 2000 and stopped on 4th January, 2001, after the Christmas holiday week. This covered the period of Halloween, Thanksgiving and Christmas, to soon after the New Year — traditionally noted as the busiest shopping and gift-giving season of the year, especially

Table 2: Analysis of per item shipping costs

Per item shipping cost	Mean	Median
Dot.com	2.15	2.13
MCR	1.92	1.97
Wilcoxon test	0.24	0.44

for toys and games. After removing a few items that had become unavailable in some stores during the period of the data collection, mostly due to out of stock items caused by unusually heavy demand during the major shopping season, 4,032 price observations were obtained.

Table 1 reviews the standard shipping costs by each retailer for normal delivery within the USA. Since the shipping cost structure varies by retailer as well as by date, it was necessary to standardise all shipping costs in order to compare. The per item average shipping cost for each retailer was derived from their shipping cost tariff tables for various baskets of typical purchases for the entire period under study. (The authors began with ten baskets of goods with each basket containing, say, five randomly selected items from the 42 products, and computed the average shipping cost per item per basket by each retailer for the entire 12 weeks. Applying the same method, they extended the computation of average shipping cost per item per basket to 20 baskets, then 30 baskets and so on until the average shipping cost per item per basket by each retailer eventually converged across the number of baskets of goods in each week.) Table 2 summarises the mean and median per item shipping costs by the two types of retailers, with the MCRs being lower in both measures, and Wilcoxon tests show that the difference in per item shipping costs by either type of retailer is not significant in any conventional statistical sense. That is, any consumer who shops randomly among

Table 3: Retailer type and mean prices

Type	Dot.com	MCR
Posted-price mean	\$18.80	\$18.73
Percentage-price mean	83.3%	84.1%
Full-price mean	\$20.95	\$20.65

these retailers with a random basket of purchases would discover that the difference in per item shipping costs is insignificant.

EMPIRICAL RESULTS

Relative price levels

Several parametric and non-parametric statistical tests were run to analyse the relative levels of prices between these two types of online retailers. Table 3 summarises the mean prices of the data sample at the most aggregate level.

The table shows that posted prices are slightly lower for MCRs than for dot.coms by an average of \$0.07 or 0.4 per cent. The percentage of the posted prices by each retailer for each product at each date relative to the list price of each product was also calculated. The percentage price is more comparable across products because it avoids any weighting caused by some toys being higher priced than others. Here it is seen that dot.coms sampled in the survey offered an average 16.7 per cent discount compared to 15.9 per cent by the MCRs, which indicates that the dot.coms gave higher discounts on less expensive items. Further, the respective retailer's per item shipping cost was added into the posted prices by that retailer for each item at each date. The new price indicates how much a random shopper actually pays for each item from that retailer to have the item delivered to the doorstep by the standard delivery procedure. The difference seems clear,

Table 4: Retailer type and mean percentage discounts

Type	Dot.com %	MCR %
Popular items	84.1	84.0
Random items	82.5	84.1

with the MCRs being lower on average by \$0.30 or 1.4 per cent. In the rest of this paper, posted price will refer to the absolute posted prices, percentage price to the percentage of the absolute posted prices relative to the list prices for each item, and full price to the prices including shipping costs as defined above.²⁴

To control for the serial correlation problem, statistical tests were run for each data set day by day. For both the posted and full prices, *t*-tests could not reject the null hypothesis that the mean dot.com price is equal to the mean MCR price in every case even at the significance level of 0.20. For the percentage price, except for the last three weeks, none of the *t*-test results is significant at the conventional level of 0.05. This pattern also holds when the data sets are further divided by the categorisation of popular items versus random items, except that the last three weeks' significance results only come from the random items (*p*-values of 0.054, 0.042 and 0.045 respectively) while over 0.11 for the popular items.²⁵ Examining the detailed data reveals that dot.coms gave more price discounts for the random items during the Christmas–New Year weeks (from 21st December, 2000 to 4th January, 2001), notably to clear the year end inventory stocks by having Christmas sales as well as post-Christmas and New Year clearances.

Whether price discounts differed across the two types of retailers for the popular items and the random items was also

tested. Table 4 shows that both types of retailer offer similar discounts for the popular products, however, the discount difference between the two types of retailer is much higher for the random items (1.6 per cent) than the popular items (0.1 per cent). Statistic tests (*t*-test and Wilcoxon test) exhibit clear-cut significance below 0.01. This probably reflects an MCR policy of approaching dot.com prices more closely for items that are more frequently purchased.

Note that the power efficiency of the *t*-test decreases when sample sizes decrease, and this problem becomes more severe with smaller subsamples because of its distribution assumption. Thus, in order to control for the possible bias associated with distribution assumptions, the median test²⁶ was run. This is a non-parametric test that does not require any assumption on sampling distribution properties to ensure that this finding is robust. The median test was run for each data set, day by day. For both the posted and full prices, all *p*-values are again above 0.20, not significant in any conventional sense. For the percentage price, again, except the last three weeks, none is significant at the conventional level of 0.05 either. The pattern is similar to that observed above, ie the last three weeks' significance results only come from the random items.

In addition to the tests on mean and median prices, a third test was run on the price difference between the two types of retailers. The lowest prices found among all the dot.coms in the sample for each product were compared with the lowest prices found among all the MCRs sampled. The minimum posted price among the dot.coms was found to be \$0.53 lower on average than the minimum posted price charged by MCRs. For the full price, this difference is \$0.28 on average in the same direction. Further, Table 5 shows that

Table 5: Retailer type and minimum prices

Minimum prices	Dot.com < MCR (%)	Dot.com = MCR (%)	Dot.com > MCR (%)
Posted	32.5	1.6	65.9
Full	43.1	0	56.9

Table 6: Mean prices of individual retailers

Prices (dot.coms)	Amazon	eToys	SmarterKids	Nutty-Putty
Posted	17.40 (2)	18.74 (4.5)	18.74 (4.5)	20.29 (7)
Full	20.18 (3)	20.97 (6)	20.74 (4)	21.89 (7)
Prices (MCRs)	KBKids	Wal-Mart	Kmart	Zanny Brainy
Posted	18.96 (6)	17.18 (1)	17.85 (3)	20.92 (8)
Full	20.96 (5)	19.10 (1)	19.53 (2)	23.02 (8)

during this period the lowest posted price is found among the dot.coms only 32.5 per cent of the time while for almost two thirds of the time it goes to the MCRs (note that the posted price and percentage price cases coincide in this situation), but it is almost a half-half situation for the full price case.

For each day, if the null hypothesis that minimum prices are the same for both dot.coms and MCRs is formed, that is, half the time the lowest prices should be found by each type of the retailers, this statistic should follow a binomial distribution. Then, the binomial test can be run against the alternative hypothesis that it is more likely to find minimum prices by the MCRs in each day. In the case of posted prices, for seven weeks (week 1 and weeks 4 to 9), the results clearly reject the null hypothesis ($p < 0.005$), in favour of the alternative hypothesis. None of the test results for the other five weeks appear significant in any conventional sense however ($p > 0.14$). For full prices, it is clear that none of the test results is significant in any conventional sense ($p > 0.15$).

For the individual retailers, their mean prices were calculated (posted and full) across the period of the study and this

information is summarised in Table 6 (numbers in brackets are rankings). The Wilcoxon test could not reject the null hypothesis ($p > 0.34$), in favour of either alternative hypothesis that the individual dot.com or MCRs' mean prices are lower. The lowest-pricing retailer seems to be Wal-Mart, an MCR, both in posted and full prices, while the highest-pricing retailer seems to be Zanny Brainy, also an MCR.

Overall, insufficient evidence was found to support hypothesis H_1 , from these possible tests of differences (t -test on means, median test, binomial test on minimum prices and Wilcoxon test on individual retailers' mean prices). In fact, there does not seem to be evidence showing that either type of retailer prices lower than the other on average in the online toy market. This finding is very different from the previous studies by Tang and Ho,²⁷ Tang and Lu²⁸ and Tang and Xing.²⁹

Price dispersion

Following Sorensen³⁰ and Brynjolfsson and Smith,³¹ both absolute and relative measures were used to analyse dispersion in posted prices by the dot.coms and MCRs. Absolute price dispersion refers

Table 7: Absolute price dispersion

Mean (posted price)	Dot.com	MCR
Range	5.88	6.20
STD	2.80	2.85
Mean-popular		
Range	6.18	7.54
STD	2.91	3.48
Mean-random		
Range	5.60	4.97
STD	2.10	2.28
Mean (percentage price)	Dot.com %	MCR %
Range	24.2	29.7
STD	11.3	13.7
Mean-popular		
Range	25.1	29.9
STD	13.8	11.6
Mean-random		
Range	23.3	29.6
STD	11.1	13.9
Mean (full price)	Dot.com	MCR
Range	6.06	6.40
STD	2.80	2.93
Mean-popular		
Range	6.22	7.75
STD	2.85	3.56
Mean-random		
Range	5.92	5.17
STD	2.76	2.35

to the range of either the posted price, full price or percentage price across the sampled dot.coms and MCRs, that is, the highest price minus the lowest price for a particular product at each date for the dot.coms or the MCRs. While the absolute dispersion statistics for the data show a substantial range of prices for both dot.coms and the MCRs for the same toy item during the same time period, the MCR case seems much larger in the sense of posted and percentage prices. The range of posted prices across the dot.coms averages \$5.88 (see Table 7) which corresponds to an average percentage price range of 24 per cent, and it is \$6.20 or almost 30 per cent across the MCRs. For the full prices, the range averages \$6.06 across the dot.coms and \$6.40 across the

MCRs. Further, one interesting pattern is exhibited when the popular and random categories are examined separately. The dispersions of both posted and full prices across the MCRs appear remarkably larger than the dot.com case for the popular items, but smaller for the random items. It seems to indicate that the MCRs charged very different prices (both posted and full) for the fast-moving items, while the dot.coms did so more for the slower-moving items. This probably reflects pricing strategy differences between the two types of retailers — the dot.coms put more sales emphasis on the popular items.

To control for serial correlation, the *t*-test was run day by day for each data set for both the popular items and the random items. For the posted prices, none of the results was significant in the conventional sense of 0.05 (most *p*-values well exceeded 0.10, except four in the range 0.07–0.09). The pattern for the full prices was also similar, with only three *p*-values for the popular items in the range 0.067–0.088 for the weeks of 19th October, 9th November and 16th November, 2000, while the other 32 *p*-values well exceeded 0.10. Further, similar results were exhibited for the standard deviation (calculated according to the standard formula).

For the relative dispersion in prices across MCRs and dot.coms, measures of the price range and the standard deviation were compared by counting the number of products where a particular measure is smaller by the dot.coms than by the MCRs, for each date. For the first seven weeks, only between nine and 15 items for which either the price range or the standard deviation was smaller for the MCRs than for the dot.coms was found each week, for either posted or full prices. Applying the binomial test as in the section on relative price levels above, the results are

Table 8: Retailer type and weekly price changes

Price increase	Total	>0.99	>1.99	>2.99
MCRs	66	63	57	36
Dot.coms	80	78	56	41
Price decrease	Total	<−0.99	<−1.99	<−2.99
MCRs	80	78	71	48
Dot.coms	116	114	97	78

significant below 0.05. For the last five weeks, the binomial tests are not significant in any conventional sense ($p > 0.082$) since at least 16 such cases as above occurred in each week. It seems clear that even the relative price dispersion converged when the Christmas shopping season approached, probably due to competitive pressure.

From these measures and tests, the statistical evidence does not seem to support hypothesis H₂, especially in the full price sense.

Incidence of price change

Price changes were first measured by subtracting the previous date data from the current date data (except for the first data set), for each product by each retailer. In total, 342 price changes out of 3,696 observations were found. In other words, price changes occurred only 9 per cent of the time during the measured period.

As summarised in Table 8, price changes by dot.coms were more than the price changes by MCRs (146 cases for MCRs vs 196 cases for dot.coms). In other words, although both types of internet retailer made relatively few changes, the dot.coms were generally more active in price adjustment than the MCRs. This is consistent with the hypothesis formed above — that dot.coms would adjust prices more frequently than MCRs. In addition, it is interesting to notice that both types of

retailer reduced prices in more cases when making a change which could probably be attributed to the general price reduction to boost sales during both the Halloween and Christmas season. The mean price change is $-\$0.03$ for the MCRs and $-\$0.12$ for the dot.coms.

Ancillary findings show that large price changes seem characteristic of both retail types, as a price change of $\$0.99$ or more represented over 97 per cent of all the price changes (333 cases) while almost 60 per cent of the price changes were at $\$2.99$ or more (203 cases). In other words, although both the dot.coms and MCRs changed their selling prices rather infrequently, if they were changed they were typically changed rather sharply.

The price changes were also measured in another way, by subtracting the 19th October, 2000, data from the 4th January, 2001, data for each product by each retailer, that is, the price change across the whole period during which all data were collected. A similar pattern to the above can be observed. In total, 101 price changes out of 336 observations were found, but no price change was the norm 70 per cent of the time across the 12 weeks (more detail is given in Table 9). The difference between the retailer types seems rather clear now, however, in the sense that the mean price change is $-\$1.33$ for the dot.coms and $-\$0.31$ for the MCRs. Both t -test and median test reject the null hypothesis in favour of the alternative hypothesis that the

Table 9: Retailer type and 12-week price changes

Price increase	Total	≥ 0.99	≥ 1.99	≥ 2.99
MCRs	10	9	8	5
Dot.coms	18	17	11	7
Price decrease	Total	≤ -0.99	≤ -1.99	≤ -2.99
MCRs	29	27	25	20
Dot.coms	44	44	42	36

dot.com price decrease is larger than that of the MCRs ($p < 0.03$).

More specifically, there are only ten cases of price increases and 29 decreases by MCRs, fewer than by dot.coms (18 increases and 44 decreases). Again, most price changes are at least \$0.99 in magnitude, over 96 per cent of all the price changes (97 cases out of 101).³² Further, the price changes of at least \$2.99 are over 67 per cent of all the price changes (68 cases). Again, both the dot.coms and MCRs change their selling prices rather sharply, and the price changes by dot.coms (62 cases) are much more than the price changes by MCRs (39 cases) across the same time span of 12 weeks.

Across these tests, the empirical evidence seems to support hypothesis H₃.

CONCLUSION

This study applied the methodology of market price evaluation to online retailer formats that have not been extensively compared in the literature. Instead of comparing online prices with those offered in conventional retailers, the authors investigated how online branches of multichannel retailers compete with their online-only counterparts. Their purpose was to determine whether online pricing efficiency declines as a consequence of the presence of MCRs, or whether the same set of shopping pressures would force the prices to converge in the online markets where

information access is easy and search cost is low.

The main findings in the online toy market support the latter. It was found that the MCRs sold at slightly lower prices — only 0.4 per cent in posted prices and 1.4 per cent in full prices which include shipping costs — than their pure internet rivals, the dot.coms, but the difference was not significant in any conventional sense by several parametric or non-parametric tests. Nevertheless, differences between the two types of retailer for their popular products as compared to randomly selected items were found. The difference in price discounts for the popular items was almost negligible (only 0.1 per cent), but significantly higher for the random items (1.6 per cent). This indicates that online competition is most intensive for best-selling products. The greater consumer demand for the fast-moving items probably evokes most comparison shopping in the aggregate and stronger market pressure, much as it does among land-based retailers generally.

In conformity with this pattern, price dispersions were found to be similar between the dot.coms and the MCRs, exhibiting statistically insignificant difference during most of the time throughout the study period.

Nevertheless, the dispersions of both posted and full prices across the MCRs appear remarkably larger than the dot.com case for the popular items, but somehow smaller for the random items.

This probably reflects pricing strategy differences between the two types of retailers online, the dot.coms putting more sales emphasis on the popular items, probably due to the higher risk of inventory costs for the dot.coms which do not have brick and mortar branches offline. Since the extent of price dispersion reflects the power of the market to force sellers to a single price, from the observation that the absolute dispersion statistics for the data show a substantial range of prices for both dot.coms and MCRs for the same toy item during the same time period, it is seen that such power is rather weak for both MCRs and dot.coms.

Contrary to the first two findings, the evidence is more or less consistent with respect to the role of MCRs on the third. It had been hypothesised here that pure online retailers, being more sensitive to the market, would make price changes more frequently than MCRs. This view was partially supported by the presence of a more active price adjustment process by the dot.coms. To be sure, neither retail type adjusted prices frequently. The dot.com retailers changed prices only 11 per cent of the time, while the MCRs did so only 8 per cent of the time, if the price changes are counted weekly. The figures become clearer if the total price changes across the entire data collection period are counted, that the dot.coms changed prices 37 per cent of the time across the 12 weeks but the MCRs did so only 23 per cent of the time. Furthermore, the mean price change is $-\$1.33$ for the dot.coms and $-\$0.31$ for the MCRs, highly significant in their price decrease differences. Hence, from a price change perspective, although the market appears a bit sleepy, the dot.coms were indeed more aggressive in a likely tendency to compete more in pricing.

Further, no retailer in the online toy

market adopted the one-cent-price-change strategy documented in Brynjolfsson and Smith³³ and, in fact, most price changes are at least \$0.99 in magnitude. Online menu management costs may be lower than those in conventional stores, as Brynjolfsson and Smith³⁴ conclude. A retailer, however, may not change prices frequently for other reasons. For example, online prices may be easier to change, but may be prone to error. A typing mistake of a single digit or a decimal point could cost an online retailer dearly.³⁵ So, even if the online menu cost is small, online retailers seem reluctant to change their prices frequently because the cost of changing prices is not negligible in practice.³⁶

What are the broader implications of these somewhat mixed findings? Perhaps the most important is that pricing convergence anticipated in the online market is finally observed, although only in the toy industry for the moment. Researchers had been very much puzzled by the highly significant price differences between the two types of internet retailer for the online book,³⁷ CD³⁸ and DVD³⁹ markets. For homogeneous goods in a competitive market, this should not happen since retailers offering higher prices may not be viable after a while. Since the online markets have been in existence only for a few years, previous studies could only derive limited implications because market dynamics could not be observed in the short time horizon. This study has filled the gap. Equipped with reasonably recent data, the authors have found that the anticipated pricing convergence is indeed emerging, at least in the online toy market. Business has more or less come back to fundamental economic laws. It will, however, be important to assess whether this pattern of pricing convergence is emerging in other web markets. Whether these price pressures

provide the dot.coms with sufficient margin to survive also remains a fascinating issue.

Acknowledgment

The work described in this paper was partially supported by a grant from the Research Grants Council of the Hong Kong Special Administrative Region, China (Project No. CUHK4310/02H).

References

- 1 Tang, F. F. and Xing, X. (2001) 'Will the growth of multi-channel retailing diminish the pricing efficiency of the web?', *Journal of Retailing*, Vol. 77, pp. 319–333.
- 2 Tang, F. F. and Lu, D. (2001) 'Pricing patterns in the online CD market: An empirical study', *Electronic Markets*, Vol. 11, No. 3, pp. 171–185.
- 3 Clay, K., Krishnan, R., and Wolff, E. (2001) 'Prices and price dispersion on the web: Evidence from the online book industry', *Journal of Industrial Economics*, Vol. 49, No. 4, pp. 521–540.
- 4 Brynjolfsson, E. and Smith, M. D. (2000) 'Frictionless commerce? A comparison of internet and conventional retailers', *Management Science*, Vol. 46, No. 4, pp. 563–585.
- 5 Morton, F. S., Zettelmeyer, F. and Silva-Risso, J. (2001) 'Internet car retailing', *Journal of Industrial Economics*, Vol. 49, No. 4, pp. 501–520.
- 6 Carlton, D. W. and Chevalier, J. A. (2001) 'Free riding and sales strategies for the internet', *Journal of Industrial Economics*, Vol. 49, No. 4, pp. 441–461.
- 7 Smith, M. D., Bailey, J. P. and Brynjolfsson, E. (2000) 'Understanding digital markets: Review and assessment', in Brynjolfsson, E. and Kahin, B. (eds) 'Understanding the digital economy', MIT Press, Boston.
- 8 Bakos, Y. (1997) 'Reducing buyer search costs: Implications for electronic marketplaces', *Management Science*, Vol. 43, No. 12, pp. 1676–1692.
- 9 Bakos, Y. (1998) 'The emerging role of electronic marketplaces on the internet', *Communications of the ACM*, Vol. 41, No. 8, pp. 35–42.
- 10 Brynjolfsson and Smith (2000) *op. cit.*
- 11 Morton *et al.* (2001) *op. cit.*
- 12 Stigler, G. (1961) 'The economics of information', *Journal of Political Economy*, Vol. 69, No. 3, pp. 213–225.
- 13 Nelson, P. (1970) 'Information and consumer behavior', *Journal of Political Economy*, Vol. 78, No. 2, pp. 311–329.
- 14 Pratt, J. W., Wise, D. A. and Zeckhauser, R. (1979) 'Price differences in almost competitive markets', *The Quarterly Journal of Economics*, Vol. 93, No. 2, pp. 189–211.
- 15 Sorensen, A. T. (2000) 'Equilibrium price dispersion in retail market for prescription drugs', *Journal of Political Economy*, Vol. 108, No. 4, pp. 833–850.
- 16 Clemons, E. K., Hann, I. H. and Hitt, L. M. (1998) 'The nature of competition in electronic markets: An empirical investigation of online travel agent offerings', Working Paper, The Wharton School of the University of Pennsylvania.
- 17 Brynjolfsson and Smith (2000) *op. cit.*
- 18 Morton *et al.* (2001) *op. cit.*
- 19 Bailey, J. P. (1998a) 'Intermediation and electronic markets: Aggregation and pricing in internet commerce', PhD thesis, Technology, Management and Policy, Massachusetts Institute of Technology.
- 20 Bailey, J. P. (1998b) 'Electronic commerce: Prices and consumer issues for three products: Books, compact discs, and software', Organization for Economic Co-Operation and Development, OECD/GD, working paper series No. 4.
- 21 Brynjolfsson and Smith (2000) *op. cit.*
- 22 KB Toys (which owned KBKids.com) acquired key assets of eToys as part of eToys' bankruptcy proceedings in April 2001, and bought over \$40m worth of merchandise at a substantially discounted price. KB Toys acquired additional eToys' assets that include eToys' trade names, logos, URLs and trademarks and services in May 2001. eToys was re-launched on 10th October, 2001.
- 23 In order to ensure that all retailers in the test carried each product for each data collection point, 60 products were selected at the beginning — 30 bestsellers and 30 random items. The complete data set comprises 42 products, as shown in the Appendix.
- 24 Shipping costs of various kinds of purchase combination baskets have been used as well. Since the results seem qualitatively similar, only the basic pattern is reported here.
- 25 All data and details of reported statistic test results are available from the authors upon request.
- 26 Sheskin, D. J. (1996) 'Handbook of parametric and nonparametric statistical procedures', CRC Press, New York.
- 27 Tang, F. F. and Ho, H. P. (2000) 'Online trading paradox: Evidence and interpretation', Working Paper, Nanyang Technological University, Singapore, under revision, Chinese University of Hong Kong, 2002.
- 28 Tang and Lu (2001) *op. cit.*
- 29 Tang and Xing (2001) *op. cit.*
- 30 Sorensen and Ho (2000) *op. cit.*
- 31 Brynjolfsson and Smith (2000) *op. cit.*
- 32 Only two price decreases of 2 cents each by Wal-Mart, one price increase of 40 cents by Zanny Brainy and one price increase of 4 cents by Nutty Putty.
- 33 Brynjolfsson and Smith (2000) *op. cit.*
- 34 *Ibid.*
- 35 A well-known example was the mispricing case by buy.com in February 1999. A monitor that sold for \$565 was mispriced as \$165 on its website. Rob Cole made his online purchase and later found out his order could not be honoured. He then created a complaint website called boycottbuy.com when his problem could not be resolved after numerous

attempts. The website became so popular that he received more than 1,000 e-mails within a week, complaining about pricing errors and shipping problems by buy.com. (Chen, C. (2000) 'All I want for Christmas is a Pulse', *Fortune*, Vol. 142, No. 13, pp. 194–204). Similar stories were reported in Malaysia about Dell Computers' local website mislabelling in Ringgit what was supposed to be in US dollars and in Singapore by Courts (a local

chainstore) selling some computers by misplacing the decimal point one space to the left.

36 Since the list prices stay constant during the data collection period, it does not seem to be the case that the large adjustments in prices are the result of price changes from the manufacturers or distributors.

37 Tang and Ho (2000) *op. cit.*

38 Tang and Lu (2001) *op. cit.*

39 Tang and Xing (2001) *op. cit.*

APPENDIX

List of products (popular: 1–20; random: 21–42)

No.	Product	Manufacturer	List price (US\$)
1	Baby Baseball	Fisher Price	14.99
2	Bop It Extreme	Parker Brothers	29.99
3	Easy Bake Oven	Hasbro	22.99
4	Game of Life	Hasbro	19.99
5	Girl Tech Password Journal	Radica	24.99
6	Intelli Table	Fisher Price	79.99
7	Kick and Play Piano	Fisher Price	29.99
8	Leap Pad	Leap Frog	69.99
9	Lite Brite	Hasbro	19.99
10	Magna Doodle	Fisher Price	20.99
11	Monopoly Deluxe Edition	Parker Brothers	29.99
12	Phonics Bus	Leap Frog	29.99
13	Rock-a-Stack Infant Toy	Fisher Price	6.50
14	Scrabble Junior	Hasbro	13.99
15	Sesame Street ABC Desk	Fisher Price	11.99
16	Sesame Street Talking CD Player	Fisher Price	12.99
17	Sparkling Symphony Stacker	Fisher Price	13.99
18	Trivial Pursuit Junior	Hasbro	19.99
19	Twist & Shout Addition	Leap Frog	24.99
20	Who wants to be a Millionaire Game	Pressman	34.99
21	Boggle Junior	Hasbro	12.99
22	Chutes and Ladder	Hasbro	9.99
23	Geosafari Talking Globe	Educational Insights	99.99
24	Guess Who	Milton Bradley	19.99
25	Little People Dump Truck	Fisher Price	16.99
26	Mastermind for Kids	Pressman toy	12.99
27	Medical kit	Fisher Price	14.99
28	Mr. Potato Head (Says) Game	Hasbro	27.99
29	Othello	Pressman	17.99
30	Outburst Junior	Hasbro	19.99
31	Parcheesi	Hasbro	9.99
32	Phonics Learning System Writing Desk	Leap Frog	48.99
33	Pictionary Game	Hasbro	19.99
34	Pit Deluxe	Parker Brothers	15.99
35	Pooh Candy Land	Milton Bradley	9.99
36	Rescue Heroes: Nemo the Dolphin	Fisher Price	5.99
37	Rubiks Cube	OddzOn	11.99
38	Sesame Street Talking Alphabet	Fisher Price	21.99
39	Talking Cellphone	Playskool	9.99
40	Tap 'n' Turn Bench	Fisher Price	8.99
41	Twist-A-Pillar	Fisher Price	12.99
42	Yahtzee Electronic Handheld	Milton Bradley	14.99