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Pricing Dynamics in the Online Consumer Electronics Market

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Abstract

This paper investigates prices of consumer electronics sold on the Web by both online-only retailers (Dotcoms) and the online branches of multi-channel retailers (MCRs). Surprisingly, we find that Dotcoms charge higher price than MCRs, a conclusion contradictory to the results of most of empirical studies. We also find that the electronics prices decreased over the period of study in general, dropping about 0.6% per week, and the prices of MCRs and Dotcoms went down with time at a similar speed. Further, the prices across MCRs are 35.3% more dispersed than the prices across the Dotcoms based on full prices, and 33.1% more dispersed based on percentage prices. However, our results show that price dispersion moved up with time in general, with no significant difference in the speeds between MCRs and Dotcoms.

(Online retailing; pricing; electronics market; online-only retailers; multi-channel retailers; price dispersion)

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Introduction

With the steady growth of electronic commerce, many traditional retailers find that the Internet is a new channel of 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. Based on data from books, CDs, DVDs and videos, empirical studies involving pricing of online branches of multi-channel retailers (henceforth referenced as MCRs) and online-only retailers (Dotcoms) have shown that MCRs charge higher prices than Dotcoms (see, e.g., Tang and Ho, 2003; Tang and Lu, 2001; and Tang and Xing, 2001 and 2003). But retailers may have different pricing behavior for different product categories sold in the Internet.

In this paper, we investigate prices of consumer electronics sold on the Web by both Dotcoms and MCRs. Brand names and after-sale services make the electronics market significantly different from the markets for books, music, and movies. Ward and Lee (2000) examined whether consumers used brands as sources of information when shopping online. They found that recent adopters of the Internet would be less proficient at searching and would rely more on brands. Thus, online shoppers are more likely to buy goods from the online branches of the well-established traditional retailers even if they charge higher prices. Nevertheless, Carlton and Chevalier (2001) investigated online prices for DVD players and found that the online branches of multi-channel retailers charged higher prices than online-only retailers. We want to use our data to examine if there exist such pricing differences in the online electronics market. As far as we know, this is the first study involving the online electronics market from such a perspective.

A variety of related studies of price comparison have investigated online and offline price differences among different retailer types, including single-channel and multi-channel retailers, but the results so far seem conflicting. For example, Bailey (1998) found that online prices for books, CDs, and computer software were higher than in conventional stores. Clay, Krishnan, and Wolff (2001) and Clay et al. (2002) compared prices between online and offline stores and found that average prices were similar in both online and offline book markets. But taking sales tax and shipping cost into account, total prices were lower in conventional stores than in online stores. Other studies discovered that online retailers tend to charge lower prices than traditional retailers. Brynjolfsson and Smith (2000) compared prices of books and CDs sold through Internet and conventional channels in 1998 and 1999 and found that online prices were 9-16 percent lower than that in conventional stores. Morton, Zettelmeyer, and Silva-Risso (2001) compared prices of cars sold in online and conventional channels and found that, on average, online consumers paid two percent less than offline consumers. Carlton and Chevalier (2001) discussed free-riding problems on the sales and promotional efforts of retailers. They discovered that MCRs may internalize some of the free-riding between online and retail stores and therefore charge higher prices than do Dotcoms.

Since customers can obtain price information in online markets easily and inexpensively, it was expected that online price dispersion should be small. However, recent empirical studies have showed considerable price dispersion in online markets. Clemons, Hann, and Hitt (2002) investigated online markets for airline tickets and found differences in prices across online travel agents as large as 20 percent, even after controlling for observable product heterogeneity. Baye, Morgan, and Scholten (2003a,b) examined online pricing for 1000 of the best-selling consumer electronics products found on the price comparison site Shopper.com, and found substantial price

dispersions (about 40 percent in the average range of prices and the average gap between the two lowest prices listed for a given product remained stable at around 5 percent). Even after controlling for shipping costs and firm heterogeneities, they found that prices did not converge, although the average range in prices did fall when the number of competing firms decreased. The difference in prices charged for homogeneous products could not be fully explained by firm heterogeneities, which implies that firms may randomize pricing strategies.

Although price dispersion exists in online markets, some empirical studies did find that such price dispersion was lower across Dotcoms as compared to MCRs. Tang and Xing (2001) found that in online DVD market, the price dispersions (and the prices) are significantly lower among Dotcoms than that among MCRs. Clay, Krishnan, and Wolff (2001) observed that, in the online book market, although some multi-channel retailers set online prices very similar to their Dotcom rivals, others charge the same prices as their physical stores. Thus, there may be a great price difference among MCRs.

Our paper attempts to examine if there are different pricing patterns in the online electronics market. We seek to contrast the pricing dynamics of MCRs with those of Dotcoms and derive implications. In particular, we will examine (a) if Dotcoms and MCRs charge different prices in the online electronics market; (b) if the two types of retailers have different online price dispersions; and (c) if online prices and online price dispersion increase or decrease over time. Our results show that the online electronics market is different from the online markets of books, music, and movies, which implies that retailers have different pricing strategies for different product categories in online markets. We will discuss economic reasons for the differences. In the following, Section 2 describes the data collection methodology and

provides a brief summary of data. Section 3 introduces the econometric models and presents the results of our empirical analysis. In Section 4 we present our conclusions.

Data and summary statistics

Our analysis uses panel data collected in the online electronics market, which is one of the most successful markets that have migrated online and enjoy considerable growth and sales. The fact that branded electronics products are homogeneous makes data collection tractable and price comparison meaningful.

Data collection

Unlike the data collection in the online markets for books, music and movies, it was difficult for us to find enough common items carried by various retailers in the online electronics market. There are many electronics products that multi-channel retailers carry in their land-based stores which are not yet sold online, and some manufacturers do not allow some retailers to sell their products online or limit the scope of online product offerings. Since electronics products are well-known for "branded variants," i.e., small changes in the product models and design to avoid comparison across retailers, we had to work very carefully to ensure it is the identical item compared across retailers. We checked each item's model and manufacturer part number, and made sure that the item was the same in every store. We have also been very careful in the whole process of data collection. Thus, our data deal with identical items with identical brand names across retailers. Since all the information about brands, product models and manufacturer part numbers are clearly posted on each retailer's Web site, online shoppers are fully aware of the fact that these are identical brands and products. Among the hundreds of electronic products and

nearly 30 online stores that we started with, we found fourteen common items carried by eight major online retailers. These fourteen items include four camcorders, four DVD players, two tube TVs, one portable CD player, one walkman, one VCR, and one Shelf system, and the eight retailers are Best Buy, Circuit City, J&D Music World, Abt Electronics, 800.com, Amazon.com, Buy.com and Output.com[1].

We determined the frequency of data collection as follows. The interval between data collection should not be so long as to miss the point of price change. Considering the fact that many retailers, such as Best Buy and Circuit City, issued a new catalog every week, indicating possible changes in price, we decided to collect data once every week. We accessed the Web sites of the selected retailers and recorded the prices of the selected products for both types of retailers. Our data collection process started on December 9, 2000 and ended on June 9, 2001, but our actual analysis is based on the data from December 9, 2000 to April 28, 2001, because more than five items became unavailable in some retailers' sites after the April 28 week. We decided to exclude these weeks in our statistical analysis to avoid introducing unnecessary bias[2]. Also, no data collection was conducted after the February 10 week and before the March 10 week because we were occupied by other obligations. In total, we have obtained 2016 price observations from eighteen collections.

Shipping costs are another difficult issue in the electronics case. Unlike books, CDs, videos and DVDs, electronics products vary greatly in size and weight. Further, two MCRs (Circuit City and Best Buy) offer an in-store pick-up option (that is, buy online but pick up oneself in their land-based branch). We used the following method to estimate shipping costs: various baskets of one, two up to three electronics products were chosen and actual standard shipping costs (that is,

[1] All data and detailed analysis tables are available upon request.

not any special or express shipping) were obtained by checking the respective retailers' online calculated shipping rates for these baskets. For example, we found that the average shipping cost for the basket of one item is $23.38 for MCRs while $19.75 for Dotcoms. The *p*-values of the *t*-test (on individual items) and the Wilcoxon test (on the retailer-specific means) for comparing shipping costs between MCRs and Dotcoms are 0.37 and 0.44, respectively, showing that the difference in shipping cost between MCRs and Dotcoms is not significant in any conventional sense. This finding is qualitatively robust with baskets of two items or three items as well. For the in-store pickup option, we used another way to check the robustness of this finding. Brynjolfsson and Smith (2000) used the US government reimbursement rate of $0.32 per mile to approximate the pick-up cost for book and CD purchasers (for baskets of three items). Similarly, we replaced the standard shipping rates of Best Buy and Circuit City by $1.60 (for five miles) and $6.4 (for twenty miles) for the respective items and recalculated all the statistics. Nothing changed qualitatively either, that is, there is no significant difference in shipping costs between MCRs and Dotcoms even if in-store pickup option is taken.[3]

Summary statistics

We first calculate the averages of the posted prices, percentage prices and full prices. The posted price is the posted dollar price, percentage price is the percentage of the posted dollar price relative to the manufacturer's suggested retail price (MSRP) for each title, and the full price is posted price plus the shipping costs. Clearly, the percentage price shows how much discount

[2] For the occasional out-of-stock situations during the effective data collection period, we used the previous week's price of the same product as the approximation.

[3] The in-store pickup option provides customers with immediate access to goods. Taking into consideration of parking, getting the product and driving, the pickup costs may be higher than what we estimated here, especially for

each retailer gives to each product compared to the MSRP for this product. The results summarized in Table I show that Dotcoms charge on average $12.26 or 3.1% more than MCRs in posted prices, 1.72 units more in percentage prices, and $10.1 or 2.4% more in full price. It seems that the MCRs on average offered a bigger discount than Dotcoms (21.65% vs 19.07%).

Take in Table I

Breaking the analysis into product categories (Camcorder, DVD Player, Tube TV and Others) allows us to see a more detailed picture on the price differences as well as the effect of adding shipping costs. Price differences occurred mainly on the more expensive items while the shipping costs made a difference mainly on the large items (not necessarily the expensive ones). MCRs charged more for shipping large items than Dotcoms did, which makes the full price of Tube TV higher for MCRs than for Dotcoms.

We also calculated the average prices of items for each of these online retailers (Table II). Interestingly, the lowest pricing one is the online branch of ABT Electronics while the highest pricing one is Buy.com, from either posted, full or percentage price sense. Buy.com frequently marketed itself as a lowest-pricing online retailer and was reputed to be so, but our data indicate that it charged higher prices than other online retailers in the electronics market.

Take in Table II

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time-pressured customers. But shoppers can always choose delivery by paying shipping costs if they think that in-store pickup is more costly.

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Econometric Model and Empirical Results

Econometric model and relative price levels

Clearly, a fair comparison can only be done when the unwanted price variations are controlled for. There are three major factors that would affect the price levels: *retailer*, *product* and *time period* (in week). We thus propose the following econometric model:

$$\log(\text{Price}) = \alpha_0 + \alpha_1 \text{MCR} + \alpha_2 \text{Dotcom} + \sum_{i=1}^{8} \beta_i \text{Retailer}_i + \sum_{i=1}^{14} \theta_i \text{Product}_i + \sum_{i=1}^{18} \gamma_i \text{Week}_i + e \quad (1)$$

where $\alpha_1 + \alpha_2 = 0$, $\sum_{i=1}^{4} \beta_i = 0$, $\sum_{i=5}^{8} \beta_i = 0$, $\sum_{i=1}^{14} \theta_i = 0$ and $\sum_{i=1}^{18} \gamma_i = 0$ are constraints that remove the redundant parameters. All the variables are binary with 1 = present and 0 = absent of the factor level indicated by the variable. For example, Dotcom=1 if the retailer involved is a Dotcom retailer and 0 otherwise. The most important variables in the model are MCR and Dotcom. Equality of their coefficients means that MCRs and Dotcoms charge the same price. Of secondary importance are the retailer variables. Similarly, equality of the βs means that all retailers charge the same price. Further, equality of the θs means that all products have the same price and equality of the γs means that price stays the same from week to week. The Price variable in the model could be the posted price, full price or percentage price. The errors (e) in the model are assumed to be independent normal with zero mean and constant standard deviation. The results from running Model (1) are summarized in Table III.

Take in Table III

From the results we see that the coefficients of the retailer type variables (MCR and Dotcom) are significantly different from zero, irrespective of whether the analysis is based on log posted price, or log full price, or percentage price. This means that Dotcoms charge higher price than MCRs, a conclusion contradictory to the results of most of empirical studies (see, e.g., Brynjolfsson and Smith, 2000; Morton, Zettelmeyer, and Silva-Risso, 2001; and Tang and Xing, 2001). The difference between the coefficients of Dotcom and MCR can be converted to give an estimate of percentage difference between the average prices of Dotcom and MCRs. That is, after controlling the product and time effects, we find that Dotcoms charge $100[\exp(2 \times 0.0112) - 1] = 2.3\%$ higher than MCRs based on the posted price, and $100[\exp(2 \times 0.0078) - 1] = 1.6\%$ based on the full prices (see Table III for the numbers used in calculations). The difference in the percentage price model represents the average difference in percentage prices between the two types of retailers. The results show that MCRs offer 1.7% more discounts than Dotcoms. The *t*-statistics for the product dummies show that all the products have prices significantly different from the overall average. The 18 time dummies (Week 1 to Week 18) reveal an interesting phenomenon: price dropping significantly by weeks.

To check the above analysis from another angle, an ANOVA model is run with retailer type, product and time as three qualitative factors, having 2, 14 and 18 levels, respectively. An ANOVA model including all the main effects and two-way interactions is fitted, and the results are presented in Table IV. The 'type' factor is highly significant in all three models, indicating the prices of MCRs and Dotcoms do differ. Further, the product factor and the time factor, as well as the two-way interactions (except the interaction between type and time which has $Pr > F = 0.9895$ as seen from Table IV), are all highly significant. Clearly, the implications of these are: i) when comparing the prices between MCRs and Dotcoms one has to control the effects of

product and time, ii) the price difference between MCRs and Dotcoms changes from one product to other but not with time; iii) the product prices change with time and the way they change is different from one product to another; and iv) the difference between prices charged by MCRs and Dotcoms does not change over time. Hence, although Dotcoms charge higher price than MCRs in an overall sense, there might be only a part of the products responsible for such a price difference. Much insight has been gained by this ANOVA. We will carry out more detailed analysis in the following subsections.

Take in Table IV

Price dispersions

Following Sorensen (2000) and Brynjolfsson and Smith (2000), we use both price ranges and standard deviations across retailers of the same type for each product at each date as measures to compare dispersions among Dotcoms with that among MCRs. Table V summarizes the average of all price ranges and the average of all price standard deviations, in posted, full, and percentage prices. From the table we see that the differences in price dispersion between MCRs and Dotcoms are sizable in full prices, but are negligible in posted or percentage prices. This is interesting and perhaps an indication that dispersions in shipping costs are different between MCRs and Dotcoms although their average levels are about the same. Formal tests for difference in price dispersion again should be carried out after controlling for certain factors.

Take in Table V

In our formal econometric modelling, the price dispersion is defined as either the standard deviation (SD) or the range of prices of a given product from the retailers of the same type. In

other words, we are interested in comparing the price variations across MCRs with that across Dotcoms. The model has the similar form as (1) except the individual retailer effects disappear.

$$\log(\text{Price Dispersion}) = \alpha_0 + \alpha_1 \text{MCR} + \alpha_2 \text{Dotcom} + \sum_{i=1}^{14} \theta_i \text{Product}_i + \sum_{i=1}^{18} \gamma_i \text{Week}_i + e \qquad (2)$$

Similar parameter constraints as in (1) need to be imposed on αs, θs and γs. The results are summarized in Table VI. The difference in price dispersion between MCRs and Dotcoms is insignificant based on posted prices, but significant based on full prices. Most of the product dummies are significant, indicating that price dispersion changes from one product to another. Contrary to the case of price analysis, the time dummies here indicate that price dispersion increase with time. Further, the prices across MCRs are 35.3% (100[exp(2 × 0.1513) – 1]) more dispersed than the prices across the Dotcoms based on the SDs of full prices, and 33.1% (100[exp(2 × 0.1428) – 1]) more dispersed based on the range of full prices. The result of lower price dispersion across Dotcoms may be because of the easier online search, which prompts online retailers to price close to each other. To avoid internal competition and conflict between online and offline channels, however, MCRs have to keep their prices same or similar in the two channels. Therefore, the prices across MCRs are more dispersed than that across Dotcoms.

Take in Table VI

Again, to reexamine the above results and to gain further insights on the price dispersion patterns, we run an ANOVA model with three factors and their two-way interactions. The results summarized in Table VII clearly reveal that price dispersions differ between MCRs and Dotcoms in full price but not in posted price. Products and time periods make significant difference on the price dispersion. The difference in price dispersion between MCRs and Dotcoms also depends significantly on what types of products we are dealing with. These

findings indicate that the online electronics prices and price dispersions are quite dynamic with a complicated structure, which will be further examined in detail in the following subsection.

Take in Table VII

Price trends

Analysis of price changes might be one of the most challenging issues in studying the online pricing dynamics. Table VIII summarizes the prices by week where a clear decreasing trend is shown in each of the price forms and for each type of retailer.

Take in Table VIII

Figures 1 and 2 give insightful graphical summary of the mean prices and price dispersion by product category, retailer type, and price form. In Figure 1, we plot dynamics of mean prices in both posted prices and full prices. Figure 2 demonstrates the changes in price standard deviations over time. From the plots we see that prices of camcorder are the most dynamic among the four product categories, followed by the prices of DVD players. Prices of camcorders decreased sharply, but their price dispersion increased sharply over the period of study. Prices of DVD players exhibit similar pricing behavior, but with changes in smaller magnitude compared with camcorders. Price and price dispersion for Tube TV and other products both remain fairly stable over the period of study. A closer examination of the plots reveals that the MCRs have a lower price but higher price dispersion compared to the Dotcoms. To obtain more concrete conclusions, formal tests using a well-designed econometric model need to be carried out.

Take in Figures 1 and 2

Two econometric models are proposed for the analysis of price movements, one for the average prices and the other for the price dispersion. Several time trend variables are used in the model: an overall time trend Time, its interaction with MCR and Dotcom, and the three-way interactions among Time, Retailer Type, and Product Category.

$$\log(\text{Price}) = \alpha_0 + \alpha_1 \text{MCR} + \alpha_2 \text{Dotcom} + \delta \log(\text{List Price}) + \sum_{i=1}^{8} \beta_i \text{Retailer}_i + \sum_{i=1}^{4} \theta_i \text{Cat}_i + \sum_{i=0}^{10} \gamma_i \text{Trend}_i + e \quad (3)$$

$$\log(\text{Price Dispersion}) = \alpha_0 + \alpha_1 \text{MCR} + \alpha_2 \text{Dotcom} + \lambda \log(\text{Mean Price}) + \sum_{i=1}^{4} \theta_i \text{Cat}_i + \sum_{i=0}^{10} \gamma_i \text{Trend}_i + e \quad (4)$$

where Cat_i, i=1, 2, 3, 4, represent the product categories: Camcoder, DVD Player, Tube TV and Others; Trend_i, i = 0, ..., 10, represent the time trend variable and its interaction with retailer type and product category. The results from fitting Model (3) are summarized in Table IX and the results from fitting the Model (4) are summarized in Table X. The constraints in Models (3) and (4) are as follows: $\alpha_1 + \alpha_2 = 0$, $\sum_{i=1}^{8} \beta_i = 0$, $\sum_{i=1}^{4} \theta_i = 0$, $\gamma_1 + \gamma_2 = 0$, $\sum_{i=3}^{6} \gamma_i = 0$ and $\sum_{i=7}^{10} \gamma_i = 0$.

From Table IX we see that the *Time* variable (overall time trend) is highly significant and has a negative coefficient. Hence the electronics prices decreased over the period of study in general. The coefficients of TM and TD variables are both no different from zero, showing that the prices of MCRs and Dotcoms went down with time at a similar speed. When the time trends are further broken into the product categories, we find that the price decreasing is mainly caused by the price drop in camcorders and DVD players. The prices for Tube TV and other products stayed fairly stable. To conclude, prices of MCRs and Dotcoms both went down with time. On top of this, we further conclude that their decreasing speeds are similar, and it was the

camcorders and the DVD players that caused the overall price drop. The conclusions obtained from the model analysis are consistent with the plots given in Figure 1.

Quantitative estimates on price changes over time can be obtained from the results of Table IX, in particular the coefficients of time trends. For example, the per week price drop in posted price is about 0.6% overall, 0.6% for MCRs, 0.6% for Dotcoms, 1.4% for MCR camcorders, 1.4% Dotcom camcorder, 0.8% for MCR DVD player, and 0.9% for Dotcom DVD player. The same set of numbers corresponding to the full price becomes 0.6%, 0.6%, 0.6%, 1.5%, 1.3%, 0.8% and 0.8%. Similarly, one can estimate per week price drops in percentage prices. Further calculations show that the prices of Tube TV and other products are almost unchanged during the period of our study.

Take in Table IX

From the results of Table X, we see that price dispersion moved in an opposite direction as the price level - it went up with time in general, with no significant difference in the speeds between MCRs and Dotcoms. Again, such an overall movement trend in price dispersion is mainly caused by the camcorder category. It might be the case that some retailers lowered down the camcorder price significantly over time while the others kept the price fairly constant. This made the overall price decreasing and price dispersion increasing with time.

Price dispersions for MCRs and Dotcoms both changed with time. In particular, we conclude that they both went up with time at a similar speed. Quantitatively, the per week increment in price dispersion based on posted price is 8.1% overall, 7.6% for MCRs, 8.7% for Dotcoms, 24.3% for MCR camcorder, 20.7% for Dotcom camcorder, 13.1% for MCR DVD player, and 13.5% for Dotcom DVD player. The same set of numbers can be easily calculated based on the full price standard deviation or full price range.

Take in Table X

Conclusion

This study investigates consumer electronics market on the Internet. Surprisingly, we find that Dotcoms on average charge higher prices than do MCRs. This finding is contradictory to the results of most empirical studies involving books, CDs, videos and DVDs. One may think that as shopping online reduces search costs, online shoppers are more sensitive to prices. Lynch and Ariely (2000) experimentally investigated the relationships between search costs and price sensitivity. They found that price sensitivity for common products increased when cross-store comparison was made easy, but easy comparison had no effect on price sensitivity for differentiated goods. Thus, retailers have incentives to avoid price competition by carrying unique products. Unlike many other empirical findings, our results show that online-only retailers may have successfully established their reputations and differentiated themselves although they were selling homogenous products on the Internet. Lowering price is no longer the only tactic for Dotcoms to attract consumers.

We also find that the electronics prices decreased over the period of study in general, and the average prices of MCRs and Dotcoms went down with time at a similar speed. Breaking the time trends into the product categories, we find that the price decrease was mainly caused by the price drop in camcorders and DVD players, while the prices of Tube TV and other products were almost unchanged during the period of our study. Such a result is not surprising. Unlike books, CDs, and DVDs, the types of consumer electronics differ in terms of novelty and speed of

innovation.[4] Camcorders and DVD players are newer products and have significantly faster pace of innovation than tube TVs, shelf systems and walkman. As new models of camcorders or DVD players appear in the market, the market demand for the old models will decrease dramatically and many of them may never be sold in the market. To reduce their inventory costs, retailers may cut the prices for these old models, resulting in a decrease in average prices.

Our results also show that price dispersion went up with time in general, with no significant difference in the speed between MCRs and Dotcoms. Again, such an overall movement trend in price dispersion is mainly caused by the product categories of camcorders and DVD players. Our data show that the per week increment in price dispersion based on posted price was 24.3% for MCR camcorder, 20.7% for Dotcom camcorder, 13.1% for MCR DVD player, and 13.5% for Dotcom DVD player, while the price dispersion for Tube TV and other products had no significant change during the period of our study. Since some low-cost retailers may undercut rivals on the prices of the novel products, price dispersion increases more for camcorders and DVD players than for the others (see Figure 2).

Our results suggest different pricing patterns in the electronics market. Economic theory tells us that market prices are determined by both demand and supply, and in a competitive market, price competition will push prices down toward marginal costs. We have discussed above that as the demand for old models of novel products decreases fast, the retailers may reduce their prices significantly. But reduction in prices is limited by marginal costs. In the electronics market, there may be different cost structures between MCRs and Dotcoms. Among the four MCRs, Best Buy and Circuit City are nationwide retailers. In addition to the retail operation, J&R reaches customers throughout the United States with a huge catalogue. Abt Electronics is one of the largest single-store operations in the United States, and is an authorized

[4] We are grateful to an anonymous referee for raising this point.

retailer for every major brand. These multi-channel retailers have huge inventory that may result in tremendous buying power. So they can charge lower prices than Dotcoms.

Another reason for the different pricing patterns in the electronics market may be that unlike books, CDs and DVDs, price margins for electronics products are not huge even in traditional markets. We observed that many multi-channel retailers, such as Best Buy and Circuit City, now allow their customers to purchase online and pick up the products in local stores. These multi-channel retailers' online pricing behavior will affect demand in their physical stores. It may well be critical to keep prices same or similar in order to avoid internal competition and conflict between the two channels. So MCRs charge relatively low prices for these electronics products when they go to the Internet. In order to promote their products, the retailers may also apply different pricing strategies across the electronics products. For example, they may use cheap DVD players as an attraction. Since the electronics market is significantly different from markets of books, music, and movies, it is very interesting to further investigate the same retailers that operate in different markets and see if they behave differently in different product categories.

The findings of this study are based on our limited data sample. Ideally, one should choose both products and retailers randomly to ensure representativeness. However, price comparability requires that all the products chosen must be carried by all the retailers involved. This seems a practically infeasible task, especially for online electronics markets. Nevertheless, the fourteen products and eight retailers that we had chosen did represent some major electronic products and major online retailers. Thus, our results may still shed some insights on the pricing patterns in this market, although one should be cautioned to keep in mind that our data sample size is limited.

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Table I. Mean and Median (lower entry) Prices by Retailer Type and Product Category

	Posted Price ($)		Percentage Price (%)		Full Price ($)	
	MCR	Dotcom	MCR	Dotcom	MCR	Dotcom
Overall	393.54	405.80	78.35	80.07	414.47	424.57
	299.99	309.99	81.65	81.82	330.47	334.72
Camcorder	742.39	764.26	78.12	80.43	746.16	773.10
	743.50	719.99	81.82	81.82	743.50	736.69
DVD Player	360.30	371.95	74.77	75.55	367.13	382.91
	258.99	249.99	75.01	76.00	264.47	269.44
Tube TV	363.06	377.91	85.23	88.93	440.98	432.13
	363.47	379.99	87.51	88.45	437.47	436.46
Others*	93.18	95.16	78.70	79.80	116.87	113.95
	69.75	69.99	84.23	83.11	78.33	78.23

*Include portable CD players, walkman, VCR and shelf system.

Table II. Mean and Median (lower entry) Prices by Retailers

Retailer	Posted Price ($)	Full Price ($)	Percentage Price (%)
Best Buy	392.42	408.41	77.98
	299.99	331.95	81.82
Circuit City	404.83	416.61	79.84
	309.99	328.48	83.34
J&D Music World	402.04	436.19	79.00
	309.99	377.94	82.51
ABT Electronics	374.88	396.67	76.56
	305.50	356.35	74.75
800.com	413.12	431.71	80.68
	324.95	358.40	83.11
Amazon.com	399.99	421.16	77.41
	316.24	353.68	77.86
Buy.com	417.93	443.92	82.18
	339.99	381.19	83.34
Output.com	392.18	401.51	80.02
	309.99	328.27	83.34

Table III. Analysis of Price Levels: Estimated Coefficients and their *t*-Statistics of Model (1)

	Log Posted Price		Log Full Price		Percentage Price	
	Estimate	t-stat	Estimate	t-stat	Estimate	t-stat
MCR	-0.0112	-5.49	-0.0078	-3.62	-0.8623	-5.63
Dotcom	0.0112	5.49	0.0078	3.62	0.8623	5.63
BestBuy	-0.0070	-1.41	-0.0153	-2.89	-0.3615	-0.96
CircuitCity	0.0199	3.99	-0.0067	-1.27	1.4931	3.98
JDMWorld	0.0094	1.89	0.0535	10.10	0.6546	1.74
ABTElectronics	-0.0223	-4.47	-0.0314	-5.94	-1.7862	-4.76
800.Com	0.0104	2.08	0.0083	1.57	0.6052	1.61
Amazon.Com	-0.0362	-7.26	-0.0238	-4.51	-2.6578	-7.08
Buy.Com	0.0279	5.60	0.0480	9.07	2.1062	5.61
Output.Com	-0.0021	-0.42	-0.0325	-6.14	-0.0535	-0.14
Camcorder 1	0.9061	123.42	0.8387	107.68	-0.1705	-0.31
Camcorder 2	1.0994	149.75	1.0304	132.29	-0.9649	-1.75
Camcorder 3	1.0411	141.80	0.9725	124.87	2.2398	4.06
Camcorder 4	0.7768	105.80	0.7102	91.19	-0.8385	-1.52
CD Player	-1.5724	-214.17	-1.5678	-201.30	5.3111	9.62
Walkman	-1.7191	-234.15	-1.7007	-218.36	-6.1281	-11.10
DVD Player 1	-0.2327	-31.69	-0.2704	-34.71	-3.5864	-6.49
DVD Player 2	-0.1493	-20.33	-0.1899	-24.39	2.6589	4.82
DVD Player 3	0.0273	3.72	-0.0189	-2.42	-5.9614	-10.80
DVD Player 4	0.8912	121.38	0.8279	106.29	-9.2884	-16.82
VCR Player	-1.0381	-141.39	-1.0306	-132.32	-6.4913	-11.76
Shelf System	-0.5488	-74.75	-0.2947	-37.84	7.4798	13.55
Tube TV 1	0.1789	24.37	0.2789	35.81	6.0768	11.00
Tube TV 2	0.3396	46.25	0.4144	53.20	9.6631	17.50
Week 1	0.0517	6.16	0.0508	5.70	3.8807	6.15
Week 2	0.0400	4.76	0.0399	4.48	2.9368	4.65
Week 3	0.0399	4.76	0.0393	4.41	2.9653	4.70
Week 4	0.0391	4.66	0.0385	4.33	2.8794	4.56
Week 5	0.0401	4.77	0.0394	4.42	2.9580	4.68
Week 6	0.0321	3.83	0.0320	3.59	2.3324	3.69
Week 7	0.0299	3.56	0.0291	3.27	2.1637	3.43
Week 8	0.0196	2.33	0.0189	2.12	1.3747	2.18
Week 9	0.0226	2.69	0.0220	2.47	1.6536	2.62
Week 10	-0.0039	-0.46	-0.0042	-0.48	-0.4171	-0.66
Week 11	-0.0238	-2.83	-0.0236	-2.65	-1.7961	-2.84
Week 12	-0.0281	-3.34	-0.0279	-3.14	-2.0610	-3.26
Week 13	-0.0313	-3.73	-0.0309	-3.47	-2.3034	-3.65
Week 14	-0.0379	-4.51	-0.0370	-4.16	-2.7828	-4.41
Week 15	-0.0436	-5.20	-0.0427	-4.79	-3.1951	-5.06
Week 16	-0.0444	-5.29	-0.0436	-4.90	-3.2316	-5.12
Week 17	-0.0465	-5.54	-0.0457	-5.13	-3.3418	-5.29
Week 18	-0.0555	-6.61	-0.0541	-6.08	-4.0157	-6.36
R^2	0.9902		0.9882		0.4750	

Table IV. ANOVA (Analysis of Variance) for Price

Effect	Log Posted Price			Log Full Price			Percentage Price		
	DF	F	Pr > F	DF	F	Pr > F	DF	F	Pr > F
Type	1	34.1	<.0001	1	13.8	0.0002	1	36.1	<.0001
Product	13	17308	<.0001	13	13338	<.0001	13	118.2	<.0001
Time	17	22.1	<.0001	17	17.6	<.0001	17	21.1	<.0001
Type*Product	13	11.0	<.0001	13	15.2	<.0001	13	11.9	<.0001
Type*Time	17	0.4	0.9895	17	0.3	0.9979	17	0.4	0.9836
Product*Time	221	2.1	<.0001	221	1.7	<.0001	221	2.1	<.0001
R^2	0.9924			0.9902			0.5965		

Table V. Price Dispersion Summary

	Posted Price ($)		Full Price ($)		Percentage Price (%)	
	Dotcom	MCR	Dotcom	MCR	Dotcom	MCR
Mean	393.54	405.80	414.47	424.57	80.07	78.35
Range	65.66	69.74	73.73	90.57	10.44	11.21
StDev	31.22	32.88	34.10	41.92	4.97	5.33

Table VI. Analysis of Price Dispersion: Estimated Coefficients and *t*-Statistics of Model (2)

Variable	Log SD (Posted Price)		Log SD (Full Price)		log Range (Full Price)	
	Estimate	*t*-stat	Estimate	*t*-stat	Estimate	*t*-stat
MCR	0.0277	0.42	0.1513	5.27	0.1428	5.05
Dotcom	-0.0277	-0.42	-0.1513	-5.27	-0.1428	-5.05
Camcorder 1	1.6383	6.86	1.0071	9.73	0.9805	9.63
Camcorder 2	2.5467	10.67	1.7635	17.04	1.7328	17.01
Camcorder 3	1.8603	7.79	1.2013	11.61	1.2151	11.93
Camcorder 4	0.8547	3.58	1.1129	10.75	1.0618	10.43
CD Player	-2.8004	-11.73	-2.0881	-20.17	-2.0756	-20.38
Walkman	-1.5997	-6.70	-2.8022	-27.07	-2.7790	-27.29
DVD Player 1	0.8001	3.35	0.0165	0.16	0.0048	0.05
DVD Player 2	-2.6737	-11.20	-0.8206	-7.93	-0.8053	-7.91
DVD Player 3	-0.3211	-1.35	-0.8491	-8.20	-0.8338	-8.19
DVD Player 4	1.5449	6.47	0.7105	6.86	0.6810	6.69
VCR Player	-0.1115	-0.47	-0.5706	-5.51	-0.5839	-5.73
Shelf System	-0.2561	-1.07	0.3241	3.13	0.3337	3.28
Tube TV 1	0.4373	1.83	0.5804	5.61	0.6503	6.38
Tube TV 2	-1.9197	-8.04	0.4142	4.00	0.4175	4.10
Week 1	-0.3383	-1.24	-0.2074	-1.75	-0.2137	-1.83
Week 2	-0.6558	-2.40	-0.5050	-4.27	-0.4952	-4.25
Week 3	-0.6678	-2.45	-0.4322	-3.65	-0.4259	-3.66
Week 4	-0.4182	-1.53	-0.3089	-2.61	-0.3006	-2.58
Week 5	-0.4560	-1.67	-0.3174	-2.68	-0.3087	-2.65
Week 6	-0.3080	-1.13	-0.2489	-2.10	-0.2407	-2.07
Week 7	-0.2272	-0.83	-0.1149	-0.97	-0.1163	-1.00
Week 8	0.1055	0.39	0.0160	0.13	0.0194	0.17
Week 9	0.0736	0.27	0.0233	0.20	0.0246	0.21
Week 10	0.0769	0.28	0.0372	0.31	0.0513	0.44
Week 11	0.1727	0.63	0.1897	1.60	0.1825	1.57
Week 12	0.1738	0.64	0.1654	1.40	0.1438	1.23
Week 13	-0.1126	-0.41	0.0623	0.53	0.0606	0.52
Week 14	0.4167	1.53	0.2863	2.42	0.2737	2.35
Week 15	0.4162	1.52	0.2918	2.47	0.2772	2.38
Week 16	0.4564	1.67	0.3196	2.70	0.3212	2.76
Week 17	0.4846	1.78	0.3495	2.95	0.3587	3.08
Week 18	0.8075	2.96	0.3937	3.33	0.3881	3.33
R^2	0.5824		0.8102		0.8120	

Table VII. ANOVA (Analysis of Variance) for Price Dispersion

Effect	Log SD (Posted Price)			Log SD (Full Price)			Log Range (Full Price)		
	DF	F	Pr > F	DF	F	Pr > F	DF	F	Pr > F
Type	1	0.23	0.6334	1	47.53	<.0001	1	42.16	<.0001
Product	13	61.96	<.0001	13	249.44	<.0001	13	243.77	<.0001
Time	17	2.96	0.0001	17	9.31	<.0001	17	8.95	<.0001
Type*Product	13	9.75	<.0001	13	16.48	<.0001	13	15.18	<.0001
Type*Time	17	1.20	0.2691	17	1.50	0.0955	17	1.39	0.1451
Product*Time	221	1.11	0.2141	221	1.57	0.0004	221	1.52	0.0009
R^2	0.8497			0.9481			0.9466		

Table VIII. Mean Prices by Week and by Retailer Type

	Posted Price ($)		Full Price ($)		Percentage Price (%)	
Week	MCR	Dotcom	MCR	Dotcom	MCR	Dotcom
1	425.06	435.04	445.99	453.82	82.45	83.72
2	417.29	435.52	438.22	454.30	80.87	83.42
3	418.39	429.63	439.32	448.40	81.47	82.87
4	418.97	427.84	439.89	446.62	81.46	82.71
5	417.56	429.63	438.48	448.40	81.46	82.87
6	411.47	426.46	432.40	445.23	80.60	82.48
7	403.27	427.16	424.20	445.93	79.94	82.80
8	399.56	416.53	420.48	435.30	79.53	81.63
9	402.51	419.60	423.44	438.37	79.69	82.03
10	381.30	403.87	402.22	422.64	77.31	80.28
11	375.27	391.44	396.20	410.21	76.01	78.82
12	374.73	386.97	395.65	405.74	76.13	78.16
13	373.96	386.17	394.88	404.94	75.98	77.83
14	374.89	382.16	395.82	400.93	75.88	76.97
15	375.06	377.25	395.98	396.02	75.81	76.22
16	373.81	377.43	394.73	396.20	75.71	76.24
17	371.83	377.75	392.76	396.52	75.44	76.30
18	368.85	374.00	389.78	392.77	74.47	75.91

Table IX. Analysis of Price Movement based on Model (3)

	Log Posted Price		Log Full Price		Percentage Price	
	Estimate	*t*-stat	Estimate	*t*-stat	Estimate	*t*-stat
MCR	-0.0132	-2.77	-0.0098	-1.56	-1.0940	-3.04
Dotcom	0.0132	2.77	0.0098	1.56	1.0940	3.04
Log List Price	0.9683	152.10	1.0333	123.28	-2.0131	-4.19
Best Buy	-0.0070	-1.26	-0.0153	-2.08	-0.3615	-0.86
Circuit City	0.0199	3.56	-0.0067	-0.91	1.4931	3.54
JD Music World	0.0094	1.69	0.0534	7.25	0.6546	1.55
ABT Electronics	-0.0223	-3.98	-0.0314	-4.27	-1.7862	-4.23
800.com	0.0104	1.86	0.0083	1.13	0.6052	1.43
Amazon.com	-0.0362	-6.47	-0.0238	-3.24	-2.6578	-6.29
Buy.com	0.0279	4.99	0.0480	6.52	2.1062	4.99
Output.com	-0.0021	-0.38	-0.0325	-4.41	-0.0535	-0.13
Camcorder	0.0906	9.05	-0.0487	-3.70	6.7966	8.99
DVD Player	-0.0364	-4.49	-0.1060	-9.93	-3.3371	-5.45
Tube TV	0.0434	4.23	0.1108	8.21	3.5973	4.65
Others	-0.0975	-8.66	0.0439	2.96	-7.0568	-8.30
Time	-0.0062	-13.45	-0.0061	-10.02	-0.4547	-13.08
TM (Time*MCR)	0.0001	0.15	0.0003	0.56	0.0107	0.32
TD (Time*Dotcom)	-0.0001	-0.15	-0.0003	-0.56	-0.0107	-0.32
TM*Camcorder	-0.0082	-9.92	-0.0090	-8.34	-0.6229	-10.02
TM*DVDPlayer	-0.0012	-1.43	-0.0022	-2.02	-0.0564	-0.91
TM*TubeTV	0.0042	3.99	0.0061	4.41	0.2796	3.54
TM*Others	0.0052	6.28	0.0052	4.75	0.3997	6.43
TD*Camcorder	-0.0076	-9.26	-0.0069	-6.33	-0.6037	-9.71
TD*DVDPlayer	-0.0033	-4.05	-0.0021	-1.95	-0.2298	-3.70
TD*TubeTV	0.0062	5.95	0.0043	3.14	0.4714	5.97
TD*Others	0.0047	5.74	0.0046	4.28	0.3620	5.83
R^2	0.9875		0.9769		0.3284	

Table X. Analysis of Price Dispersion Movement based on Model (4)

Variable	Log SD (Posted Price)		Log SD (Full Price)		Log Range (Full Price)	
	Estimate	*t*-stat	Estimate	*t*-stat	Estimate	*t*-stat
MCR	0.0360	0.23	0.1954	3.05	0.1753	2.78
Dotcom	-0.0360	-0.23	-0.1954	-3.05	-0.1753	-2.78
Log Mean Price	1.8819	8.89	1.7209	21.72	1.7029	21.83
Camcorder	-1.1134	-3.29	-0.9874	-7.59	-1.0151	-7.92
DVD Player	-0.7039	-2.65	-0.5899	-5.46	-0.5558	-5.23
Tube TV	-0.5031	-1.49	0.2631	1.90	0.2893	2.12
Others	2.3204	6.09	1.3142	9.02	1.2816	8.93
Time	0.0781	5.15	0.0565	9.12	0.0558	9.15
TM (Time*MCR)	-0.0051	-0.35	-0.0022	-0.36	-0.0011	-0.18
TD (Time*Dotcom)	0.0051	0.35	0.0022	0.36	0.0011	0.18
TM*Camcorder	0.1446	5.34	0.0731	6.60	0.0753	6.90
TM*DVDPlayer	0.0502	1.86	0.0139	1.26	0.0096	0.88
TM*TubeTV	-0.1050	-3.05	-0.0283	-2.01	-0.0280	-2.02
TM*Others	-0.0898	-3.32	-0.0587	-5.31	-0.0569	-5.22
TD*Camcorder	0.1052	3.88	0.0822	7.43	0.0832	7.63
TD*DVDPlayer	0.0433	1.60	0.0323	2.92	0.0281	2.58
TD*TubeTV	-0.0146	-0.42	-0.0449	-3.20	-0.0429	-3.10
TD*Others	-0.1339	-4.95	-0.0696	-6.29	-0.0684	-6.28
R^2	0.4433		0.7751		0.7769	

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Figure 1. Time Series Plots of Mean Prices

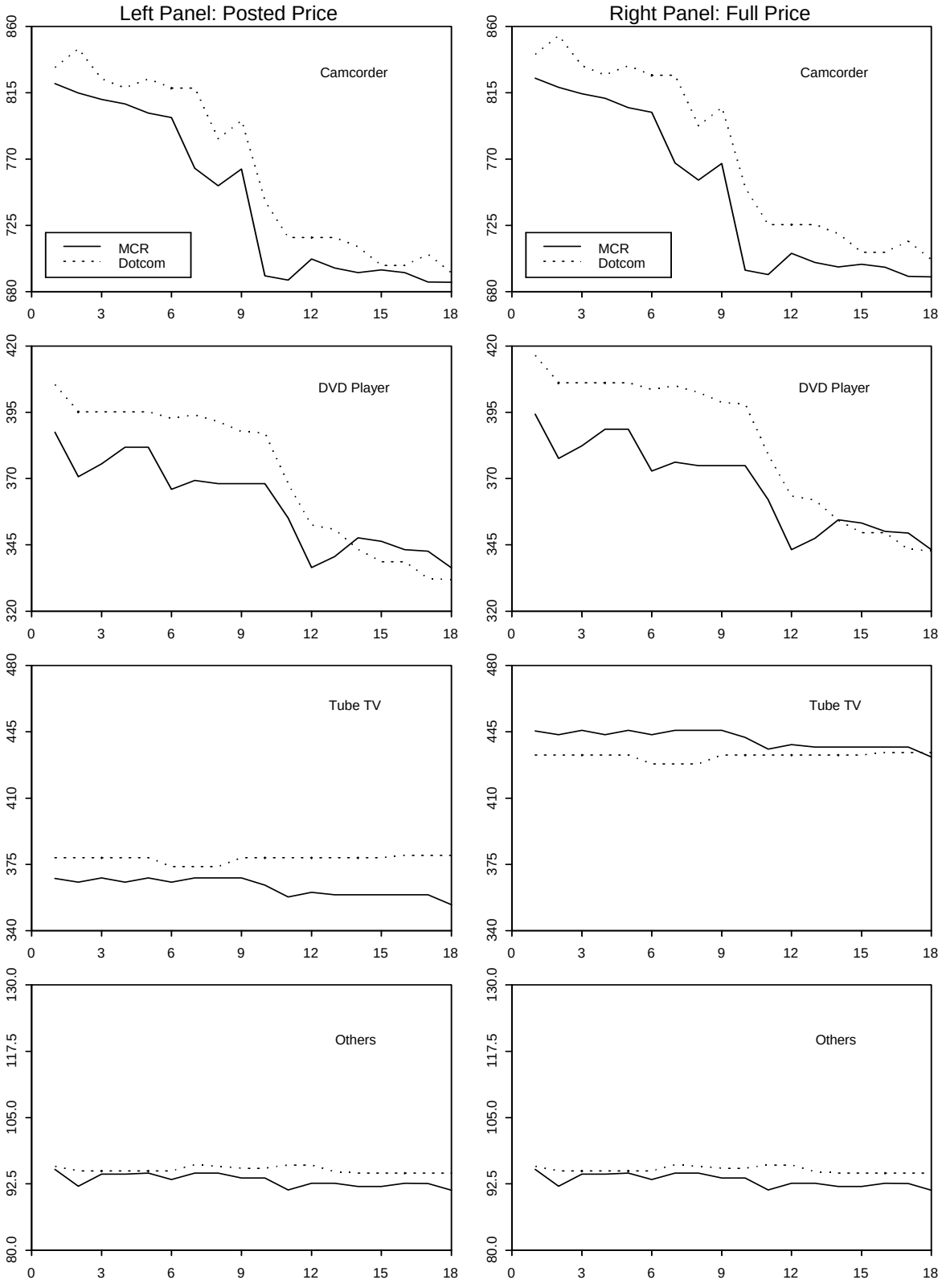

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Figure 2. Time Series Plots of Averages of Price Standard Deviations