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Abstract

Several studies have shown that frictionless e-commerce is only fictional and that online price dispersion is persistent and high (e.g., Clay, Krishnan, Wolf and Fernandes 1999; Brynjolfsson and Smith 2000; Pan, Ratchford and Shankar 2002a, 2002b). Pan, Ratchford and Shankar (2002b) show that that such a phenomenon is mainly due to e-tailer characteristics such as shopping convenience, reliability and consumer awareness, and market characteristics such as number of competitors and consumer involvement. Baye, Morgan and Sholton (2001) show that there is very little evidence to show that prices on the Internet are converging over time to the law of one price. Ratchford, Pan and Shankar (2003) show that online price dispersion decreased significantly from November 2000 to November 2001, but is still persistent. We extend this stream of research by empirically examining whether the drivers of online price dispersion change as online markets mature over time. Our analysis is based on data collected during November 2000 and 2001 on several price dispersion measures covering price quotes for a total of 13,501 products from 194 e-tailers in a variety of product categories including books, CDs, DVDs, desktop computers, laptop computers, PDAs, computer software, and consumer electronics. Specifically, we examine through regression analysis, whether the key drivers of online price dispersion remained the same and whether their importance in explaining dispersion changed between 2000 and 2001. The results show that the key e-tailer characteristics did not change, while the positioning of some e-tailers, including Amazon.com and Barnes&Noble, changed over time. The drivers of online price dispersion, in particular, e-tailer service attributes, largely remained stable over time. However, as online market grew, variation in timing of online market entry no longer had a significant effect and the number of competitors had a weaker effect on online dispersion. E-tailer, market and product characteristics explain a greater percentage of online price dispersion over time.

Keywords: *Pricing, E-Commerce, Information economics, Internet marketing, E-Tailing*

Introduction

The emergence and explosive growth of online markets, in particular, online retailing (e-tailing), has spawned a fast growing stream of research on online price dispersion. Online price dispersion is defined as the distribution of prices of an item (such as range and standard deviation) with the same measured characteristics across sellers of the item on the Internet at a given point in time. Since online price dispersion has significant implications for modeling consumer and producer behavior, and has potentially key policy implications, it is an important topic to study.

Online price dispersion has generally been found to be substantial, suggesting that frictionless economy on the Internet is only fictional (e.g., Baye and Morgan 2001; Brown and Goolsbee 2000; Clay, Krishnan, Wolf and Fernandes 1999; Ellison and Ellison 2001; Morgan, Orzen and Sefton 2001; Morton, Zettelmeyer, and Risso 20001; Pan, Ratchford and Shankar 2002a, 2002b; Sholten and Smith 2002; Smith and Brynjolfsson 2000, 2001). Several reasons or drivers for this dispersion have been proposed. Because online markets have been growing over the past few years, it is of interest to study whether online price dispersion has narrowed or remained the same. A few studies suggest that online price dispersion remains persistent over time (e.g., Baye, Morgan and Sholten 2001; Ratchford, Pan and Shankar 2003). If online price dispersion is persistent, do drivers of this dispersion remain stable over time? To determine whether the drivers of online price dispersion change over time, it would be useful to study online price dispersion and its drivers across a number of different items sold by e-tailers as online markets grow over time. That is the major purpose of this study.

Many drivers of price dispersion have been proposed in the offline context, including, incomplete information (Stigler 1961), staggered price setting due to menu cost (Fishman 1992), demand uncertainty, costly capacity and presetting of price (Dana 1999), price discrimination (Giulietti 1999) and inertial brand loyalty (Wernerfelt 1991). Despite the large amount of theoretical discussion on the potential drivers of price dispersion, there exist only a few empirical studies on the drivers of online price dispersion (for a detailed review, see Ancarani and Shankar 2002).

These studies show different types of drivers of online price dispersion. Clemons, Hann, and Hitt (1998) attribute online price dispersion to price discrimination by marketers. Shankar, Rangaswamy and

Pusateri (2001) show that differences in information content may lead to lower price sensitivity and thus different prices. Smith, Bailey and Brynjolfsson (2000) suggest that online price dispersion is primarily due to heterogeneity in e-tailer service attributes. Pan, Ratchford and Shankar (2002b) show that e-tailer characteristics, market characteristics and product differences explain much of online price dispersion.

Price dispersion appears to be persistent even as online markets grow. Baye, Morgan and Shulton (2001) show that there is very little evidence to show that prices on the Internet are converging to the law of one price. In a study of 1000 best-selling electronic items at price comparison site Shopper.com over an eight-month period, they found that average price range was about 40% and the average gap between the two lowest prices remained stable at around 5 percent. Ratchford, Pan and Shankar (2003) analyzed dispersion in e-tailer prices using data from 2000 and 2001 and found that although price dispersion decreased substantially, it was still significant. They also found that measured differences in e-tailer services bear little relation to e-tailer prices, suggesting that market and product factors explain a significant amount of online price dispersion, consistent with Pan, Ratchford and Shankar (2002b).

In summary, different explanations for online price dispersion have been proposed, but there is a lack of a comprehensive empirical work on whether these drivers change as online markets grow. Such work could make a substantial contribution to the understanding of the online price dispersion phenomenon as online markets grow over time. The research objective of this study is thus to extend prior research by focusing on changes in the drivers of price dispersion across e-tailers as online markets grow over time.

In the next section, we review and discuss the potential drivers of online price dispersion. In section 3, we explain the data and the measurement. In section 4, we present the model formulation. In the subsequent section, we present and discuss the results. We close by discussing the limitations and directions for future research and offer our conclusions.

Conceptual Framework

In their review of competition in digital markets, Smith, Bailey, and Brynjolfsson (2000) summarize the possible drivers of price dispersion in online markets as product heterogeneity, convenience of shopping, consumer awareness of the seller's existence, e-tailer's branding and trust which reduces consumer risks, lock-in due to consumer switching costs, and price discrimination. Broadly speaking, we can classify these

sources and other additional drivers of online price dispersion into two sets of factors, namely, (1) e-tailer characteristics and (2) market characteristics, after controlling for product category differences (Pan, Ratchford and Shankar 2002b). In the following paragraphs, we discuss how each of these factors might affect e-tailer prices and price dispersion. We also predict the direction of effect of e-tailer characteristics on e-tailer prices. The sign in parentheses of each e-tailer characteristic refers to the direction of influence on e-tailer prices. A positive (negative) sign implies higher (lower) price. The effect of variation in each e-tailer characteristic is always positively related to price dispersion, that is, the greater the variance in an e-tailer characteristic, the greater the price dispersion. For a market characteristic, however, the sign in parentheses refers to the direction of its effect on price dispersion.

E-Tailer Characteristics

E-Tailer Service Attributes

Shopping convenience (+). Variation in shopping convenience may influence price dispersion. Ease of finding and evaluating products through better search tools, navigation and faster checkout could reduce consumer search and switching costs. Therefore, e-tailers who offer a high level of convenience may be able to charge higher prices (Smith, Bailey, and Brynjolfsson 2000). Thus, we expect variance in shopping convenience to be related to price dispersion.

Reliability in fulfillment (+). Differences in perceived reliability among e-tailers may influence the range and dispersion of prices for a product. Reliability is associated with aspects such as delivery time, whether the product was delivered as promised, and consistency of customer service. Because of the spatial and temporal separation between buyers and sellers in online markets, exchanges between money and goods are not simultaneous, so the delivery risk is a particular concern of the consumers (Smith, Bailey, and Brynjolfsson 2000). A more reliable e-tailer may command higher prices than a less reliable retailer for the same item.

Product information (+). Depth of product information on a web site reduces online price sensitivity (Shankar, Rangaswamy and Pusateri 2001). E-Tailers with deep product information may have lower price sensitivity and higher prices than those with shallow product information. Therefore, variation in product information is expected to affect price dispersion.

Shipping and handling (+/-). Shipping and handling service could be another dimension that could affect e-tailers' prices. Intuitively, e-tailers are in a position to charge higher prices for better shipping and handling services because such services may be valuable to some consumers. Whether consumers are charged higher prices for superior shipping services, however, is an empirical question that is unclear. Brynjolfsson and Smith (2000) found some of the e-tailers' superior services to be negatively correlated with price. For example, some e-tailers with better return policies have lower prices. Therefore, the relationship between an e-tailer's services and prices needs a more detailed investigation. Nonetheless, variation in shipping and handling may be an important driver of price dispersion.

Other E-Tailer Attributes

Time of online market entry (-). Early mover advantage has been extensively discussed in the context of conventional markets (Schmalensee 1982; Shankar, Carpenter and Krishnamurthi 1999). Although early mover advantage in online markets has received little attention, the rationale for such an advantage in the offline market can be applied to the online market as well. Geyskens, Gielens and Dekimpe (2001) found that early followers perform better than late followers with respect to introduction of the Internet channel. Thus, the later the market entry, the lower the expected price. Extending this reasoning to online markets, we can hypothesize that the greater the time interval between sequential online market entries, the greater the price dispersion.

E-Tailer Trust and Branding (+). An e-tailer's trust and brand equity can reduce consumers' perceived risks. Evidence from online markets also reveals that some consumers may be willing to pay a price premium for trusted e-tailers (Shankar, Urban and Sultan 2002). E-Tailer brand is an important determinant of choice among homogeneous products (Smith and Brynjolfsson 2001) and loyalty online (Shankar, Smith and Rangaswamy 2003). E-Tailers can build consumer trust and brand equity by providing a satisfying experience and through third party certification or recommendation. Therefore, variance in trust and brand equity should affect price dispersion.

Consumer awareness (+). In conventional markets, because of information scarcity, some consumers are not informed about the lowest price. In contrast, in online markets, online price comparison engines such as Bizrate.com, Shopper.com, and MySimon.com can facilitate consumers to process information and thus

locate the lowest price (Baye, Morgan and Sholton 2001). The use of these engines, however, also depends on consumer awareness of these engines. As a result, e-tailers who enjoy large consumer awareness could charge prices higher than their competitors who are “needles in the haystack.” Burdett and Coles (1997) proposed a noisy search model and pointed out that “each store changes its price as its stock of regular customers change through time,” and “smaller (younger) stores [who have less consumer awareness] announce lower prices ...” Brynjolfsson and Smith (2000) found that e-tailers with high consumer awareness, like Amazon.com and CDnow, charge 7-12% higher than those who are less famous, like Books.com and CD Universe. Consumer awareness is not an aspect of e-tailers’ service, but it is an aspect of the e-tailer characteristics that can be leveraged to command higher prices. Thus, higher the differences among e-tailers in consumer awareness, the greater the price dispersion.

Market Characteristics

Number of competitors in a market (+/-). The number of competitors in a market reflects its competitiveness and is a factor that has been examined in models of offline price dispersion (Carlson and McAfee 1983; Cohen 2000; Dahlby and West 1986). Based on their search model, Carlson and McAfee (1983) proposed that price dispersion would be less when there are more players competing in a market. However, when Dahlby and West (1986) empirically applied Carlson and McAfee’s model in the car insurance market, they found that more players in a market is associated with increased price dispersion. This conflict remains unexplained. Cohen (2000) points out that the number of alternatives in a market functions as “a double-edged sword.” On the one hand, the rivalry increases with a greater number of alternatives, so that price dispersion is reduced. On the other hand, the “DIF-ness” (distortion in information function) also increases and causes consumers to be poorly informed, hence the price dispersion is enlarged. A small survey of household beverage alternatives supported that “DIF-ness” does increase with more number of alternatives. Thus, a nonlinear relationship between number of players and price dispersion could exist. When not many players are in a market, more players would significantly increase the price competition and lessen price dispersion. For example, at the early stage of online book selling, Amazon.com significantly dropped its prices when Barnes&Noble entered the market (Bailey 1998). However, when many players are in a market (for example there are 6,219 unique book retailer sites listed by Yahoo!), consumers become

poorly informed and sellers have the opportunity to charge different prices. So, we expect that price dispersion will decrease at a diminishing rate with increase in the number of competitors in a market.

Consumer involvement (+/-). Consumer search behavior has been found to be related to the involvement level (e.g., Kujala and Johnson 1993), because consumers with high involvement may exert more search efforts than consumers with low involvement due to the differences in perceived benefits from search. In the marketing literature, the psychological term "involvement" is regarded as equivalent to the economic term "utility level," that is, "price level" or "financial outlay" (Moorthy, Ratchford, and Talukdar 1997; Cohen 1998), so consumers search more intensively in expensive product categories, as documented by quite a few studies (see review by Miller 1993). Consequently, we should expect less price dispersion in expensive product categories as the search models predict. However, the evidence is equivocal. While Cohen's (1998) findings are consistent with this prediction, those of Pratt, Wise, and Zeckhauser (1979) are the opposite. Thus, further research is required on the effect of involvement on price dispersion. In addition, all the existing studies of online price dispersion have investigated only low involvement (and price) items such as books and CDs, and little is known about more expensive items like laptop computers.

Popularity of the product item among consumers (-). Popular product items are those well accepted and purchased by many consumers. Online consumers exchange information quickly through many electronic channels such as news group, bulletin board service (BBS), and chat room. Popular product items draw more consumer attention and thus have more information conveyed to consumers relative to other products, so we expect that price dispersion for popular products should be narrower than that for non-popular products.

Product Category Differences

Differences among product categories may affect the extent of dispersion in prices. Previous empirical studies have tried to control for product heterogeneity using the hedonic price regression method. For example, Clemons, Hann, and Hitt (1998) studied variation in airline ticket prices, by controlling for several observed sources of product heterogeneity such as arrival and departure times, number of connections, and Saturday night stays. They found that price dispersion is still significant even after controlling these sources of heterogeneity. Other aspects of product heterogeneity such as meal offering and

refund policy that could potentially drive price dispersion, however, were not included in their model. Therefore, investigation of entirely homogeneous products, such as books, CDs, DVDs, electronics, computer hardware and software, is needed to eliminate potential contamination by unmeasured product heterogeneity. We allow for price dispersion to be different for different product categories.

Different product categories due to their inherent natures may be associated with different levels of price dispersion, even after controlling their price levels. For example, price dispersion may be less for those products whose consumer familiarity and knowledge are high. However, such cross category effects are beyond the focus of this study. Thus, we control for potential category differences using dummy variables.

Data and Methodology

Data

The data for this study are primarily drawn from a well-known price comparison web site, namely, BizRate.com. Product, price, and deal information for a large number of e-tailers are searched and updated by BizRate.com daily. BizRate.com lists the products that are popular in a market and also surveys e-tailers' customers and asks them to evaluate the e-tailers' services. The survey results are published on BizRate.com's web site, so we can use them to measure e-tailer service heterogeneity. Ten aspects of e-tailers' services are evaluated using a ten-point scale and an overall measure of the average of the ten measures is also provided. Table 1 lists and explains the ten measures used by BizRate.com. The ratings of the retailers by Bizrate.com are widely used in online markets. For example, shopper.com, shopping.com, and price.com, all cite BizRate.com's ratings. In addition, many e-tailers who are BizRate.com's certified sellers, also indicate this on their own websites (e.g., CircuitCity.com, Mercata.com, Motorola, CD Universe, Euclid Computers), which reflects the acceptance of BizRate.com's authority. Thus, data from BizRate.com have high validity.

(Table 1 about here)

We purposely focus on identical products to avoid the potential problem of unmeasured product heterogeneity. Such products are found in the following categories: books, CDs, DVDs, computer software and hardware, and consumer electronics. We collected 6739 (6762) price quotes for 581 (826) identical products from 105 (89) e-tailers during November 2000 (2001). Summary statistics of the price dispersion

measures for the 2000 and 2001 data appear in Tables 2a and 2b. Consistent with Pan, Ratchford and Shankar (2002a, 2002b) and Sorensen (2000), we use five price dispersion measures for the same item as the dependent variables in our regression: (1) price range; (2) percentage of price difference (price range divided by the average price charged for that product); (3) standard deviation of prices; (4) variance of prices; and (5) coefficient of variation of prices (standard deviation of prices divided by the average price charged for that product).¹

(Tables 2a and 2b about here)

We obtained information on each web site's traffic, external links, and online market entry date from Alexa.com.² An advantage of Alexa.com's measure of web traffic is that it provides data on the number of unique visitors to each web site, which is more detailed than just the ranking of sites based on web traffic.³ We use web traffic and the number of external links (how many other web sites have links to a particular web site) as measures of consumer awareness in our study.

Furthermore, we collected data on trust through third party certification for each of the e-tailer we study. There are a few third party certifications in electronic markets. We select the five most frequently adopted certifications, which are from BBB Online, BizRate.com, Gomez.com, Truste.com, and Verisign.com. We create a variable named "third party certification" based on how many certifications a web site receives from the five sources. This variable measure ranges from 0 to 5.⁴

Methodology

Our main objective is to isolate the factors that are associated with variation in price dispersion across the product markets that we study and compare them across 2000 and 2001. First, we compare the differences in the price dispersion measures between 2000 and 2001. Second, we factor analyze the BizRate ratings of e-tailer services to identify the major underlying dimensions of e-tail services during 2000 and 2001; factor scores based on these ratings provide the service measures used as independent variables in our

¹ Some of the five measures are highly related. When linear regression with the same independent variables are used, results from these different dependent measures could be quite different. However, for log linear models, results from these dependent measures will be very similar. We subsequently address the issue of functional form selection.

² If online date for an e-tailer was not available from Alexa.com, we collected the information from Allwhois.com.

³ For details on the methodology used, please see at <http://www.alexa.com>.

⁴ The data used in this paper is the same as that used in Ratchford, Pan and Shankar (2003).

analysis of price dispersion. Third, we do a cluster analysis of these factor scores to identify the competitive positioning of e-tailers on these service dimensions during 2000 and 2001. Fourth, we use a set of regressions linking price dispersion measures to variation in e-tailer and in market characteristics to investigate the drivers of price dispersion during 2000 and 2001.

Analysis, Results and Discussion

Comparison of Price Dispersion Measures

The summary statistics of the percentage price difference measure by category are shown in Tables 3a and 3b. Tables 3a and 3b show that books and CDs, the most commonly investigated categories, have the widest price differences in both samples (average price differences in these two categories are 48-49% and 39-51%, respectively), consistent with prior research (e.g., Brynjolfsson and Smith 2000; Pan et al. 2002a, 2002b). The average percentages of price difference in the other six categories range from 25.7% to 43.7% in the 2000 sample and from 15.0% to 32.3% in the 2001 sample, which are also significantly large. Except for books, all categories have lower average percentage price difference in 2001 than in 2000.

(Tables 3a and 3b about here)

A comparison of the price level, price dispersion measures and number of competitors is shown in Table 4. Price dispersion significantly decreased between November 2000 and 2001 with respect to price range, standard deviation, percentage difference, and coefficient of variation ($p < .05$). The average number of sellers also decreased significantly ($p < .001$) from 11.6 in 2000 to 8.2 in 2001. This can be mostly attributed to the bursting of the dotcom bubble that witnessed the demise of many pure play e-tailers.

(Table 4 about here)

Table 5 shows changes in price levels by category from 2000 to 2001. Differences in average price levels between the two samples are, to some extent, due to differences in the mix of items sampled. For example, our 2001 desktop computer sample included a few relatively expensive servers, while our 2000 sample included more low-end items. Similarly, our software and consumer electronics included relatively more sophisticated items in 2001. The fall in average prices for DVD's, laptops and PDA's may reflect general price trends for these categories. In general, prices are not directly comparable between the two samples because of differences in items sampled, and general market trends. However, the dispersion of

prices among sellers of physically identical items can be compared between the two periods.

(Table 5 about here)

Comparison of price dispersion measures, percentage difference and coefficient of variation in the 2000 and 2001 data are shown in Tables 6 and 7, respectively. Table 6 shows that in six of the eight categories, percentage price difference declined significantly ($p < .001$) from 2000 to 2001. The pattern is similar for coefficient of variation in these categories, as reflected by Table 7. In the other two categories, books and PDAs, the differences in percentage price differences between 2000 and 2001 were not significant. However, for books, the coefficient of variation is higher in 2001 than that in 2000. These results are consistent with Ratchford, Pan, and Shankar (2003).

(Tables 6 and 7 about here)

Factor Analysis

The results of the factor analysis of the ten measures for all the e-tailers show four underlying factors for both the 2000 and 2001 data. These four factors explain over 90% of the variance in both the 2000 and 2001 samples. Tables 8a and 8b provide the component matrix obtained using Equimax rotation, for 2000 and 2001 data, respectively⁵.

(Tables 8a and 8b about here)

The measures, on-time product delivery, product representation, customer support, and tracking of shipping status load on Factor 1. Since one of consumers' primary concerns of online shopping is the actual receipt of products after making payment (Smith, Bailey, and Brynjolfsson 2000), this factor seems to reflect the *reliability* of the e-tailers. Consumers will feel confident to buy from e-tailers with high scores on this factor. Factor 2 is highly related to ease of ordering, product selection, and the e-tailer's web site navigation. All these factors reflect the dimension of *shopping convenience*. Factor 3 is highly related to the quantity, quality and relevance of *product information* that the e-tailers provide. Factor 4 is highly related to the options and charges of *shipping and handling*. This is another tool that can be used by e-tailers to attract patronage by matching various consumers' delivery needs. Thus, e-tailers' heterogeneity in services can be

⁵ To verify if the results are similar in a smaller sample of e-tailers, we did a factor analysis in a subset of 60 randomly selected e-tailers. The results were similar.

described along four dimensions or factors, namely, shopping convenience, reliability, product information, shipping and handling, and pricing policy, and these factors are robust across the years 2000 and 2001.

Cluster Analysis

We then cluster all the e-tailers based on their scores on the four factors. We obtained three clusters for both the 2000 and 2001 data using a K-means cluster analysis. Tables 9a and 9b shows the final cluster centers for 2000 and 2001 data, respectively. The results of ANOVA indicate that the means of all the four factors are significantly different ($p < 0.05$) across the three clusters.

(Tables 9a and 9b about here)

In Table 9a, Cluster 1 is the smallest group with 17% of the e-tailers. The e-tailers in this cluster are good at shipping, but do not offer deep product information. Presumably, these e-tailers target these consumers who already clearly know what they want to buy, and focus on offering economy and flexibility of shipping. Examples of e-tailers in this cluster are Buy.com and Powells.com. Cluster 2 in the 2000 data is the largest cluster comprising 63% of the e-tailers. The e-tailers in this cluster are characterized by inconvenient shopping and poor shipping. They compensate for these drawbacks by providing the highest reliability in fulfillment. Amazon.com and Barnes&Noble, the top two online booksellers are part of this cluster. Cluster 3 in the 2000 data contains 20% of the 105 e-tailers. These e-tailers offer deep product information and convenient shopping. Their reliability, however, is perceived to be the poorest. CD Universe and PCRush.com are members of this cluster.

E-tailers in the 2001 data can also be classified into three clusters, but the clusters are somewhat different than those identified in the 2000 data. Cluster 1 in the 2001 data comprises about 32% of the e-tailers who are primarily reliable, but do not offer deep product information. Bluelight.com, the online arm of K-mart is an example of such an e-tailer. Cluster 2 has about 21% of the e-tailers who score high on shopping convenience, but are unreliable in fulfillment and poor in shipping and handling. These e-tailers include Buydig.com and PCRush.com. This cluster is closest to Cluster 3 identified in the 2000 sample. Finally, Cluster 3 is the largest comprising 47% of the e-tailers who are reliable, offer deep information and have good shipping and handling. Amazon and Barnes& Noble belong to this cluster.

In both the samples, e-tailers are not positioned to be excellent in every dimension. Instead, they seem to focus on different dimensions to differentiate themselves from competition. However, some e-tailers appear to have improved some of their service attributes over time. For example, Amazon.com and Barnes&Noble, which were in the cluster offering high reliability, but inconvenient shopping and poor shipping and handling in 2000, moved to the cluster offering very good shipping and handling and high reliability in 2001.

Price Dispersion Regression

Although the cluster analysis results are insightful about changes in targeting by and positioning of e-tailers, they do not offer insights into how the drivers of price dispersion among the e-tailers change with the growth in online markets. For example, we want to know what factors drive price dispersion for identical products and whether these factors change over time. We also want to determine the relative strength of the associations of price dispersion with service attributes and market characteristics during 2000 and 2001. To accomplish this, we do a regression analysis of the drivers of price dispersion.

Our framework suggests that variation in price dispersion across items arises from variation in e-tailer characteristics and market characteristics. Specifically, our independent variables include the following factors:

E-Tailer characteristics. Based on our earlier discussion, we include the following e-tailer variables in the regression analyses of price dispersion (PRDISP) of each item i in category j . Dispersion in (1) shopping convenience (CONV), (2) reliability (REL), (3) product information (INFO), (4) shipping and handling (SHIP), (5) pricing policy (PRPOL), (6) inventory position (INV), (7) time of online market entry (TIME), (8) trust (third party certification) (TRUST), and (9) consumer awareness (web traffic and number of referral links) (AWARE)⁶. We run two sets of regressions, one set using ranges and the other set using standard deviations in these characteristics. The letter “D” preceding each variable represents dispersion in that variable.

⁶ The variable of web traffic is highly correlated with the variable of referral links, so only one of them can be used in the regression. We report the regression results obtained by using the web traffic variable. We obtained very similar results when we used the number of referral links or a composite measure as the consumer awareness measure. We

Market characteristics. We examine the following market characteristics in the regression analyses:

(1) number of competitors in market, measured by the number of e-tailers selling an item (COMP), (2) average price level of the item, a measure of consumer involvement (INVOL), and (3) popularity with consumers, measured by a dummy variable indicating the best-selling products (POPLR).⁷ We control for product category differences using dummy variables.

We regress each of the five measures of price dispersion on these two classes of independent variables and on product category dummies (CD for CD, DVD for DVD, DTOP for desktop computer, LTOP for laptop computer, PDA for PDA, SOFT for software, and ELECT for consumer electronics). η is an error term.

$$\begin{aligned}
 PRDISP_{ij} = & \mathbf{a}_1 + \mathbf{a}_2 DCONV_{ij} + \mathbf{a}_3 DREL_{ij} + \mathbf{a}_4 DINFO_{ij} + \mathbf{a}_5 DSHIP_{ij} + \mathbf{a}_6 DPRIPOL_{ij} + \\
 & \mathbf{a}_7 DINV_{ij} + \mathbf{a}_8 DTIME_{ij} + \mathbf{a}_9 DTRUST_{ij} + \mathbf{a}_{10} DAWARE_{ij} + \\
 & \mathbf{g}_1 COMP_{ij} + \mathbf{g}_2 INVOL_{ij} + \mathbf{g}_3 POPLR_{ij} + \\
 & \mathbf{I}_1 CD_i + \mathbf{I}_2 DVD_i + \mathbf{I}_3 DTOP_i + \mathbf{I}_4 LTOP_i + \mathbf{I}_5 PDA_i + \mathbf{I}_6 SOFT_i + \mathbf{I}_7 ELECT_i + \mathbf{h}_{ij}
 \end{aligned} \tag{1}$$

For each dependent measure, we ran linear, semi logarithm and double logarithm models, compared them, and selected the double logarithm functional form based on Box-Cox (Box and Cox 1964) test.⁸ The estimated coefficients with their significance levels and model goodness of fit appear in Table 10a and 10b. Since the regression results for the double logarithm model were very similar across dependent measures, we report the results of only two dependent measures, price range and price standard deviation, in Tables 10a and 10b. The diagnostic statistics did not reveal any problems of multicollinearity. Both the White test and Breusch-Pagan test, however, detected the existence of heteroscedasticity. So we use the GMM (Generalized Method of Moment) method to obtain valid estimates of the variance and covariance matrix.

(Tables 10a and 10b about here)

Price dispersion among e-tailers is well explained by the regression models. All the models are significant ($p < 0.01$) and the adjusted R^2 of each of them is greater than 40%.

could not use the square of timing of entry as an additional variable to test for possible non-linear effect because it was highly correlated with timing of entry.

⁷ The correlation between number of competitors and the square of this variable was very high, precluding us from directly including both the variables in the regression to test for non-linear effects.

E-Tailer characteristics. Variations in e-tailer service attributes, namely, shopping convenience, reliability, product information provision, and shipping and handling explain a significant amount of variation in price dispersion across items in both the samples. In particular, in the regression of percentage price difference on range of e-tailer characteristics, all the e-tailer service attributes are significant in both the 2000 and 2001 samples.

There are some similarities and some differences with respect to the role of other e-tailer characteristics on online price dispersion. Variation in e-tailers' trust or third party certification is not significantly related to price dispersion in any of the models in either of 2000 or 2001 sample. Consumer awareness also has no relationship with price dispersion, which suggests that a dominant awareness position may not be easily leveraged by e-tailers for differential prices in both the 2000 and 2001 samples. However, time of online market entry is related to price dispersion in the 2000 sample but not in the 2001 sample. Evidently, time of online market entry explains some of price dispersion before online markets mature, but once they mature, it does not account for any significant variance in price dispersion.

Market characteristics. An increase in number of competitors reduces price dispersion, but at a diminishing rate (from the logarithm functional form) in the 2000 sample, but in 2001 sample, the effects are weaker and somewhat mixed. For the regression of percentage price difference on the standard deviation of e-tailer characteristics, number of competitors has a positive effect on online price dispersion--that is, markets with higher number of competitors exhibit greater percentage difference in prices, consistent with Baye, Morgan and Sholten (2001). In both the samples, price dispersion decreases with price level, which is a proxy measure of consumer involvement. That is, the percentage of price difference (price range divided by mean price) and the coefficient of variation of price (price standard deviation divided by mean price) are lower when average price is higher. In other words, high involvement products exhibit less relative price dispersion than low involvement products. Contrary to our expectations, however, variation in the remaining market characteristic, namely, product popularity, does not have a significant effect on price dispersion in either sample.

⁸ Inventory position variable was highly correlated with reliability. Because inventory position was measured by a proxy variable, we dropped it from the analysis.

Product category-specific effects. For the 2000 sample, the incremental effects of every product category is negative and significant when books is the base category. For the 2001 sample, however, when books is used as the base category, only the incremental effects of desktop computer, computer software, laptop computer and consumer electronics categories are significant in some regressions. That is, after controlling for all other drivers of price dispersion, price dispersion is highest for books category for the 2000 sample, but in the 2001 sample, it is not the highest for only books.

In summary, among the e-tailer service attributes, variations in shopping convenience, reliability, product information, and shipping and handling have significant and stable effects on online price dispersion over time. Among other e-tailer variables, variation in timing of online market entry is significantly associated with dispersion in online prices during the early stage of online markets, but not so as these markets mature. Price dispersion declined with more competitors in 2000, albeit at a diminishing rate. Number of competitors, however, has weaker and mixed effects on price dispersion as online markets grow. Price dispersion decreases with greater consumer involvement or higher price levels, but also at a decreasing rate, and this result remains robust as online markets grow.

To understand how the relative effects of the different sets of drivers of price dispersion change over time, we obtained the squares of the standardized coefficients and compared their relative sizes for the 2000 and 2001 samples. The results are shown in Tables 11a and 11b, which report the percentages of variation attributable to the three types of independent variables, and to random error for the 2000 and 2001 samples, respectively. When percentage of difference and coefficient of variation are used as the price dispersion measures, that is, when price range and standard deviation are deflated by the mean price, the relative effect size of market, e-tailer and product characteristics together become larger as online markets grow from 2000 to 2001. Thus, we conclude that product, e-tailer, and market characteristics become more influential drivers of price dispersion among e-tailers over time.

(Tables 11a and 11b about here)

To summarize the empirical results, the key e-tailer characteristics remained stable over the one-year period. The number of e-tailer clusters remained steady at three, although the positioning of e-tailers changed during 2001. Variations in e-tailer service attributes were significantly associated with online price

dispersion during both 2000 and 2001. Compared to the 2000 sample, variation in timing of market entry did not have a significant effect on price dispersion in the 2001 sample. Number of competitors had a weaker association with price dispersion in the 2001 sample that it had in the 2000 sample. Relative to books, other categories exhibit a smaller amount of price dispersion in both the time periods. But relative to books, category-specific effects are fewer for the 2001 data when compared with the results for the 2000 data. E-tailer, market and product characteristics explain a greater percentage of online price dispersion in the 2001 sample than they do in the 2000 sample.

Limitations and Future Research

We outline certain limitations of our study and offer potential avenues for future research. First, theoretical discussions of price dispersion pay particular attention to equilibrium market outcomes. Patterns of online price dispersion have been consistently observed by many studies and the high price variation in online markets questions this equilibrium over time. It would be useful to have theoretical models to explain long-run price dispersion equilibrium outcomes. Second, we did not study which types of e-tailers continue to have price premium and which do not have, as online markets grow. A hedonic price analysis would be a useful way to address this issue.

Conclusion

In this study, we extend previous research on online price dispersion by empirically investigating the drivers of online price dispersion as online markets grow. With a comprehensive data set containing a total of 13,501 price observations for a total of 1,407 identical items in eight product categories from 194 e-tailers collected during November 2000 and 2001, and measures of e-tailer and market characteristics, to our knowledge, our study is the first to empirically investigate the drivers of online price dispersion over time. We examined the effects of variation in e-tailer characteristics and market characteristics on price dispersion among e-tailers across items over time. The e-tailer characteristics we studied include e-tailer service characteristics such as shopping convenience, reliability in fulfillment, product information provision, and shipping and handling, as well as other characteristics like time of online market entry, trust, and consumer awareness. The market characteristics we examined are number of sellers in market, consumer involvement, and popularity of the category among consumers.

Our analysis comprised three steps. First, we performed a factor analysis of e-tailer features to identify the underlying dimensions of e-tailer service in the two samples. The results show that four factors, namely, shopping experience, reliability, information provision, and shipping and handling are some of the key e-tailer service attributes and they are consistent over time.

Second, we did a cluster analysis of all the e-tailers based on consumers' perception of their services. Our results suggest there exist three types of e-tailers who target different consumer segments in both the samples, but the positioning, size, and composition of the clusters, change over time. In the 2000 sample, Cluster 1 is the smallest cluster, consisting of e-tailers who are perceived to good at shipping, but offering limited product information; Cluster 2, the largest cluster, comprises e-tailers who are most reliable, but offer inconvenient shopping and poor shipping; Cluster 3, which makes up about one-fifth of the sample, contains e-tailers who offer high shopping convenience, but limited product information and unreliable fulfillment. In the 2001 sample, the largest cluster comprises e-tailers who are reliable, informative and offer good shipping; the smallest cluster contains e-tailers who offer convenient shopping, but are unreliable and poor at shipping; the third cluster is made up e-tailers who are reliable in fulfillment, but do not offer deep information on their Web sites. For example, Amazon.com and Barnes&Noble, which in 2000 belonged to the cluster with poor shipping and handling, actually moved to the cluster with excellent shipping in 2001, suggesting that some e-tailers repositioned themselves by improving selected service attributes.

Third, we used a set of regressions to explicitly investigate the drivers of price dispersion over time. The regression models consistently have adjusted R^2 of over 40%. The standardized coefficients demonstrate that market characteristics and e-tailer characteristics are the main drivers of price dispersion among e-tailers. Specifically, among the e-tailer characteristics, variation in shopping convenience, reliability, product information provision, and shipping and handling are all associated with price dispersion and these remain robust over time. Variation in trust and variation in consumer awareness do not affect price dispersion, regardless of whether online markets are in the early or later stage. Variation in time of online market entry affects price dispersion in the early period, but as online markets grow, has no significant effect on online price dispersion. Among the market characteristics, an increase in number of competitors is associated with a decrease in price dispersion, but at a diminishing rate during the early period, but this effect

weakens over time. Price dispersion decreases with consumer involvement and this effect is consistent over time. Product popularity does not affect price dispersion. As for product characteristics, books have the widest price dispersion relative to the other categories even as online markets grow over time. E-tailer, market and product characteristics explain more of online price dispersion as online markets mature.

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Table 1
Explanation of Measures of E-Tailers Features by BizRate.com

<i>Measure</i>	<i>Explanation</i>
Ease of Ordering	Convenience and speed of ordering
Product Selection	Breadth/Depth of products offered
Product Information	Information quantity, quality and relevance
Price	Prices relative to similar stores
Web Site Navigation and Looks	Layout, links, pictures, images and speed
On-Time Delivery	Expected vs. actual delivery date
Product Representation	Product description/depiction vs. what was received
Level and Quality of Customer Support	Status updates and complaint/question handling
Tracking	Tracking order status
Shipping and Handling	Shipping and handling charges and options

Table 2a
Summary Statistics of Price Dispersion Measures (2000)

<i>Variable</i>	<i>N.</i>	<i>Mean</i>	<i>Std Dev</i>	<i>Minimum</i>	<i>Maximum</i>
Range (\$)	581	182.45	323.90	1.40	3452.05
Percentage Difference	581	38.50%	20.97%	0.38%	119.75%
Standard Deviation (\$)	581	55.04	95.29	0.43	941.20
Variance	581	12092.89	51511.67	0.19	885864.96
Coefficient of Variation	581	11.72	6.21	0.15	36.49

Table 2b
Summary Statistics of Price Dispersion Measures (2001)

<i>Variable</i>	<i>N</i>	<i>Mean</i>	<i>Std Dev</i>	<i>Minimum</i>	<i>Maximum</i>
Range (\$)	826	127.78	257.26	0.45	2497.95
Percentage Difference	826	28.73	18.71	0.11	117.54
Standard Deviation (\$)	826	45.33	91.17	0.17	906.75
Variance	826	10356.49	45835.62	0.03	822196.19
Coefficient of Variation	826	9.78	6.23	0.04	45.17

Table 3a
Summary Statistics of Percentage of Price Difference by Category (2000)

<i>Category</i>	<i>N</i>	<i>Mean</i>	<i>Std Dev</i>	<i>Minimum</i>	<i>Maximum</i>
Book	105	48.9%	13.8%	16.7%	94.2%
CD	43	51.0%	18.4%	20.3%	77.7%
DVD	96	43.7%	16.7%	16.9%	96.6%
Desktop	105	34.4%	27.1%	0.4%	119.7%
Laptop	78	25.7%	13.9%	1.4%	66.9%
PDA	37	37.1%	24.4%	8.2%	104.2%
Software	51	35.6%	25.9%	11.0%	106.0%
Electronics	66	31.0%	11.7%	10.3%	66.2%

Table 3b
Summary Statistics of Percentage of Price Difference by Category (2001)

<i>Category</i>	<i>N</i>	<i>Mean</i>	<i>Std Dev</i>	<i>Minimum</i>	<i>Maximum</i>
Book	134	48.08	13.02	10.23	95.85
CD	120	39.30	17.68	5.74	117.54
DVD	103	32.28	18.49	10.89	106.47
Desktop	107	15.01	10.65	0.14	56.33
Laptop	96	17.87	16.08	2.50	93.77
PDA	52	30.26	16.96	4.20	82.30
Software	120	18.95	10.52	4.01	74.43
Electronics	94	22.12	13.83	0.11	80.23

Table 4
Price Level, Price Dispersion, and Number of Sellers in Market
T-test Results: Comparison of 2001 and 2000 Samples

<i>Variable</i>	<i>Mean & Std.</i> <i>(2000)</i>	<i>Obs.</i> <i>(2000)</i>	<i>Mean & Std.</i> <i>(2001)</i>	<i>Obs.</i> <i>(2001)</i>	<i>Difference</i> <i>in Mean</i>	<i>t-value</i>	<i>Sig.</i>	<i>Change</i>
Price Level	651.99 (995.01)	581	748.75 (1476.1)	826	96.76	1.47	0.1422	NS
Price Range	182.45 (323.9)	581	127.78 (257.26)	826	-54.67	-3.39	0.0007	
Price Standard Deviation	55.04 (95.29)	581	45.33 (91.17)	826	-9.70	-1.91	0.0558	
Price Variance	12093 (51512)	581	10356 (45836)	826	-1736.4	-0.65	0.5151	NS
Price Coefficient of Variation	11.72 (6.21)	581	9.78 (6.23)	826	-1.93	-5.74	<0.0001	
Price Percentage Difference	38.50 (20.97)	581	28.73 (18.71)	826	-9.77	-8.99	<0.0001	
Number of Sellers	11.60 (3.33)	581	8.17 (2.27)	826	-3.43	-21.60	<0.0001	

Table 5
Price Level Change by Category:
Comparison of 2001 and 2000 Samples Using T-test

<i>Category</i>	<i>Mean & Std. (2000)</i>	<i>Obs. (2000)</i>	<i>Mean & Std. (2001)</i>	<i>Obs. (2001)</i>	<i>Difference in Mean</i>	<i>t-value</i>	<i>Sig.</i>	<i>Change</i>
Book	20.65 (22.89)	105	19.26 (26.04)	134	-1.39	-0.44	0.6617	NS
CD	13.51 (1.66)	43	14.64 (6.53)	120	1.13	1.74	0.0833	
DVD	26.64 (18.73)	96	22.53 (10.79)	103	-4.11	-1.88	0.0623	
Desktop*	1209.7 (1077.7)	105	2509.7 (2766.1)	107	1300	4.52	<.0001	×
Laptop*	2391.6 (653.77)	78	1981.3 (563.55)	96	-410.31	-4.38	<.0001	×
PDA*	446.86 (317.97)	37	350.70 (205.44)	52	-96.17	-1.62	0.1118	×
Software*	281.42 (685.26)	51	597.31 (1383.1)	120	315.9	1.99	0.0480	×
Consumer Electronics*	440.24 (498.74)	66	671.94 (710.78)	94	231.7	2.42	0.0165	×

* The computer hardware, software, and consumer electronics are categories with rapid innovation and short product life cycle. Therefore, for these categories, comparing the average prices in two samples of different years reflects mostly the product category trend rather than the retailers' pricing trends. In contrast, books, CDs, and DVDs are very stable product categories, thus the comparison of average prices in different years reflects mostly the retailers' pricing trends.

Table 6
Price Percentage Difference Change by Category:
Comparison of 2001 and 2000 Samples Using T-test

<i>Category</i>	<i>Mean & Std. (2000)</i>	<i>Obs. (2000)</i>	<i>Mean & Std. (2001)</i>	<i>Obs. (2001)</i>	<i>Difference in Mean</i>	<i>t-value</i>	<i>Sig.</i>	<i>Change</i>
Book	48.90% (13.78%)	105	48.08% (13.02%)	134	-0.82%	-0.47	0.6407	NS
CD	51.04% (18.41%)	43	39.30% (17.68%)	120	-11.74%	-3.62	0.0005	
DVD	43.67% (16.69%)	96	32.29% (18.49%)	103	-11.39%	-4.57	<.0001	
Desktop	34.39% (27.12%)	105	15.01% (10.65%)	107	-19.38%	-6.83	<.0001	
Laptop	25.70% (13.91%)	78	17.87% (16.08%)	96	-7.82%	-3.44	0.0007	
PDA	37.10% (24.43%)	37	30.26% (16.96%)	52	-6.84%	-1.47	0.1471	NS
Software	35.58% (25.89%)	51	18.95% (10.52%)	120	-16.63%	-4.44	<.0001	
Consumer Electronics	30.99% (11.67%)	66	22.12% (13.83%)	94	-8.87%	-4.38	<.0001	

Table 7
Price Coefficient of Variation Change by Category:
Comparison of 2001 and 2000 Samples Using T-test

<i>Category</i>	<i>Mean & Std. (2000)</i>	<i>Obs. (2000)</i>	<i>Mean & Std. (2001)</i>	<i>Obs. (2001)</i>	<i>Difference in Mean</i>	<i>t-value</i>	<i>Sig.</i>	<i>Change</i>
Book	15.29 (3.92)	105	16.63 (4.44)	134	1.34	2.47	0.0144	
CD	15.46 (5.14)	43	13.02 (5.63)	120	-2.45	-2.61	0.0108	
DVD	13.05 (6.26)	96	10.22 (6.02)	103	-2.84	-3.25	0.0014	
Desktop	10.78 (7.58)	105	5.46 (4.04)	107	-5.32	-6.36	0.0001	
Laptop	7.55 (4.15)	78	6.11 (5.44)	96	-1.44	-1.97	0.0501	
PDA	10.49 (6.59)	37	9.86 (5.33)	52	-0.62	-0.48	0.6362	NS
Software	10.55 (6.99)	51	6.51 (3.71)	120	-4.04	-3.9	0.0002	
Consumer Electronics	9.65 (3.17)	66	8.22 (4.63)	94	-1.44	-2.33	0.0211	

Table 8a
Factor Analysis of E-Tailer Services: Rotated Component Matrix (2000)

<i>Variable/Measure</i>	<i>Component</i>			
	<i>1</i>	<i>2</i>	<i>3</i>	<i>4</i>
Ease of Ordering	0.138	0.886	0.191	0.251
Product Selection	0.194	0.841	0.117	0.135
Product Information	0.230	0.365	0.075	0.896
Web Site Navigation	0.182	0.912	0.119	0.122
On-Time Delivery	0.934	0.109	0.104	0.082
Product Representation	0.872	0.240	0.135	0.229
Customer Support	0.901	0.151	0.257	0.119
Tracking	0.907	0.184	0.086	0.053
Shipping and Handling	0.300	0.287	0.904	0.075
Factor Name	Reliability in Fulfillment	Shopping Convenience	Shipping and Handling	Product Information

Extraction: Principal components. Rotation: Varimax with Kaiser normalization.
 Highly significant effects in bold.

Percentage of variance explained by the four factors: 90

Table 8b
Factor Analysis of E-Tailer Services: Rotated Component Matrix (2001)

<i>Variable/Measure</i>	<i>Component</i>			
	<i>1</i>	<i>2</i>	<i>3</i>	<i>4</i>
Ease of Ordering	0.247	0.892	0.225	0.140
Product Selection	0.278	0.838	0.023	0.282
Product Information	0.340	0.438	0.233	0.788
Web Site Navigation	0.182	0.929	0.212	0.114
On-Time Delivery	0.880	0.327	0.240	0.110
Product Representation	0.899	0.109	0.030	0.219
Customer Support	0.853	0.248	0.368	0.166
Tracking	0.860	0.325	0.295	0.120
Shipping and Handling	0.395	0.263	0.839	0.185
Factor Name	Reliability in Fulfillment	Shopping Convenience	Shipping and Handling	Product Information

Extraction: Principal components. Rotation: Varimax with Kaiser normalization.
 Highly significant effects in bold.

Percentage of variance explained by the four factors: 93

Table 9a
Cluster Analysis Results: E-tailer Positioning (2000)

<i>E-tailer Features</i>	<i>Cluster</i>		
	<i>1</i>	<i>2</i>	<i>3</i>
Reliability	0.12	0.39	-1.28
Shopping Convenience	0.24	0.01	0.60
Product Information	-1.43	0.26	0.50
Shipping & Handling	0.26	-0.09	0.04
<i>Percent of Sample in Cluster</i>	17%	63%	20%
<i>Cluster is comprised of e-tailers who are:</i>	Good at shipping, Uninformative	Reliable, Inconvenient, Poor at shipping	Convenient, Informative, Unreliable
<i>Examples</i>	Buy.com, Powells.com	Amazon.com, Barnes&Noble	CD Universe, PCRush.com

Table 9b
Cluster Analysis Results: E-tailer Positioning (2001)

<i>E-tailer Features</i>	<i>Cluster</i>		
	<i>1</i>	<i>2</i>	<i>3</i>
Reliability	0.40	-0.53	0.42
Shopping Convenience	0.15	0.49	0.13
Product Information	-1.10	0.30	0.61
Shipping & Handling	0.16	-1.12	0.30
<i>Percentage of Sample in Cluster</i>	(32%)	(21%)	(47%)
<i>Cluster is comprised of e-tailers who are:</i>	Reliable, Uninformative	Convenient, Unreliable, Poor at shipping	Reliable, Informative, Good at shipping
<i>Examples</i>	Bluelight.com, RadioShack	Buydig.com, PCRush.com	Amazon.com, Barnes&Noble

Table 10a
GMM Regression Results of Drivers of Price Dispersion (2000)

<i>Measure of variation in e-tailer characteristics</i>	<i>Range of e-tailer characteristics</i>		<i>Standard Deviation of e-tailer characteristics</i>	
<i>Measure of price dispersion (dependent variable)</i>	<i>Percentage Difference</i>	<i>Coefficient of Variation</i>	<i>Percentage Difference</i>	<i>Coefficient of Variation</i>
Adjusted R ²	41%	40%	41%	40%
Intercept	-2.81 (2.69)	-1.88 (2.52)	-1.89 (2.00)	-1.01 (1.90)
<i>E-Tailer characteristics</i>				
Shopping convenience	0.23^c (0.12)	0.14 (0.11)	0.21 (0.14)	0.13 (0.13)
Reliability in fulfillment	0.34^a (0.06)	0.33^a (0.06)	0.31^a (0.06)	0.30^a (0.06)
Product information provision	0.69^a (0.08)	0.60^a (0.07)	0.74^a (0.10)	0.65^a (0.09)
Shipping and handling	0.17^c (0.09)	0.12 (0.09)	0.27^b (0.11)	0.20^b (0.10)
Timing of online market entry	1.00^a (0.38)	0.84^b (0.36)	1.08^a (0.31)	0.89^a (0.30)
Trust/third party certification	-0.05 (0.13)	-0.06 (0.12)	0.27 (0.18)	0.22 (0.17)
Consumer awareness	-0.02 (0.03)	-0.04 (0.03)	-0.03 (0.03)	-0.04 (0.03)
<i>Market characteristics</i>				
Number of competitors	-0.58^a (0.15)	-0.79^a (0.14)	-0.01 (0.09)	-0.33^a (0.09)
Average price (consumer involvement)	-0.09^a (0.03)	-0.08^a (0.03)	-0.08^b (0.03)	-0.07^b (0.03)
Popularity of product with consumers	0.03 (0.05)	0.03 (0.05)	0.04 (0.05)	0.03 (0.05)
<i>Product category differences</i>				
CD *	-0.62^a (0.13)	-0.65^a (0.12)	-0.63^a (0.14)	-0.68^a (0.13)
DVD	-0.23^a (0.09)	-0.26^a (0.08)	-0.30^a (0.11)	-0.34^a (0.11)
Laptop	-0.50^c (0.27)	-0.61^b (0.25)	-0.46^c (0.28)	-0.57^b (0.26)
Desktop	-0.58^b (0.25)	-0.67^a (0.24)	-0.50^c (0.27)	-0.60^b (0.25)
Personal Digital Assistant	-0.49^b (0.22)	-0.61^a (0.21)	-0.43^c (0.22)	-0.55^a (0.21)
Computer Software	-0.61^a (0.20)	-0.65^a (0.19)	-0.57^a (0.20)	-0.61^a (0.20)
Consumer Electronics	-0.38^b (0.18)	-0.43^a (0.17)	-0.25 (0.19)	-0.32^c (0.18)

Dependent and non-dummy independent variables are measured in natural logs.

^a $p < 0.01$; ^b $p < 0.05$; ^c $p < 0.10$. * The base category is book.

Significant effects in bold.

Table 10b
GMM Regression Results of Drivers of Price Dispersion (2001)

<i>Measure of variation in e-tailer characteristics</i>	<i>Range of e-tailer characteristics</i>		<i>Standard Deviation of e-tailer characteristics</i>	
<i>Measure of price dispersion (dependent variable)</i>	<i>Percentage Difference</i>	<i>Coefficient of Variation</i>	<i>Percentage Difference</i>	<i>Coefficient of Variation</i>
Adjusted R ²	44%	41%	44%	41%
Intercept	2.48 (1.59)	2.64 ^c (1.56)	2.56 (1.70)	2.65 (1.67)
<i>E-Tailer characteristics</i>				
Shopping convenience	0.15 ^c (0.09)	0.17 ^c (0.09)	0.11 (0.09)	0.13 (0.09)
Reliability in fulfillment	0.27 ^a (0.08)	0.27 ^a (0.07)	0.29 ^a (0.08)	0.28 ^a (0.07)
Product information provision	0.70 ^a (0.21)	0.68 ^a (0.21)	0.71 ^a (0.22)	0.70 ^a (0.21)
Shipping and handling	0.21 ^c (0.11)	0.19 ^c (0.11)	0.18 (0.12)	0.18 (0.12)
Timing of online market entry	0.06 (0.21)	-0.01 (0.21)	0.16 (0.24)	0.09 (0.24)
Trust/third party certification	-0.06 (0.09)	-0.04 (0.09)	0.00 (0.15)	0.01 (0.15)
Consumer awareness	0.02 (0.02)	0.02 (0.02)	0.01 (0.02)	0.01 (0.02)
<i>Market characteristics</i>				
Number of competitors	-0.10 (0.13)	-0.39 ^a (0.13)	0.29 ^a (0.09)	-0.02 (0.09)
Average price (consumer involvement)	-0.09 ^a (0.03)	-0.09 ^a (0.03)	-0.08 ^a (0.03)	-0.08 ^a (0.03)
Popularity of product with consumers	-0.01 (0.06)	-0.01 (0.06)	-0.01 (0.06)	-0.01 (0.06)
<i>Product category differences</i>				
CD *	0.07 (0.19)	-0.01 (0.19)	0.01 (0.20)	-0.05 (0.19)
DVD	-0.20 (0.21)	-0.24 (0.21)	-0.34 (0.21)	-0.35 ^c (0.21)
Laptop	-0.42 (0.26)	-0.47 ^c (0.25)	-0.49 ^c (0.25)	-0.52 ^b (0.25)
Desktop	-0.51 ^b (0.23)	-0.54 ^b (0.22)	-0.60 ^a (0.23)	-0.61 ^a (0.22)
Personal Digital Assistant	0.00 (0.20)	0.00 (0.19)	-0.09 (0.20)	-0.06 (0.20)
Computer Software	-0.52 ^a (0.16)	-0.55 ^a (0.16)	-0.56 ^a (0.17)	-0.25 (0.18)
Consumer Electronics	-0.30 (0.18)	-0.24 (0.18)	-0.32 ^c (0.18)	-0.58 ^a (0.16)

Dependent and non-dummy independent variables are measured in natural logs.

* The base category is book. Standard deviations are in parentheses. ^a $p < 0.01$; ^b $p < 0.05$; ^c $p < 0.10$.
Significant effects in bold.

Table 11a
The Percentage of Variance Explained by Drivers of Price Dispersion (2000)

<i>Measure of variation in e-tailer characteristics</i>	<i>Range of e-tailer characteristics</i>		<i>Standard Deviation of e-tailer characteristics</i>	
	<i>Percentage Difference</i>	<i>CV</i>	<i>Percentage Difference</i>	<i>CV</i>
<i>Measure of price dispersion (dependent variable)</i>				
E-Tailer Characteristics	14%	10%	17%	11%
Market Characteristics	8%	8%	4%	4%
Product Characteristics	19%	22%	20%	25%
Error	59%	60%	59%	60%

Table 11b
The Percentage of Variance Explained by Drivers of Price Dispersion (2001)

<i>Measure of variation in e-tailer characteristics</i>	<i>Range of e-tailer characteristics</i>		<i>Standard Deviation of e-tailer characteristics</i>	
	<i>Percentage Difference</i>	<i>CV</i>	<i>Percentage Difference</i>	<i>CV</i>
<i>Measure of price dispersion (dependent variable)</i>				
E-Tailer Characteristics	21%	20%	18%	18%
Market Characteristics	10%	11%	8%	8%
Product Characteristics	25%	28%	30%	33%
Error	44%	41%	44%	41%