PRICE DISPERSION ON THE INTERNET: A REVIEW AND DIRECTIONS FOR FUTURE RESEARCH

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The explosive growth in Internet retailing has sparked a stream of research on online price dispersion, defined as the distribution of prices (such as range and standard deviation) of an item with the same measured characteristics across sellers of the item at a given point in time. In this paper, we review the empirical and analytical literature on online price dispersion and outline the future directions in this research stream. We address the issue of whether price dispersion is greater or smaller online than off-line, examine whether price dispersion on the Internet has changed over time, discuss multichannel retailing and measurement of price dispersion, explore why Internet price dispersion exists, and investigate the drivers of online price dispersion.

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INTRODUCTION

Price dispersion, defined as the distribution of prices (such as range and standard deviation) of an item with the same measured characteristics across sellers of the item at a given point in time, has attracted considerable research attention. Price dispersion is important from the perspectives of consumers, sellers, and the market as a whole. For consumers, price dispersion characterizes the alternative offerings in the market and affects search and purchase behavior. For sellers, it reflects the pricing strategy of competitors and their interactions. For the market, it is an important measure of information efficiency.

The emergence and explosive growth of Internet retailing has sparked a stream of research on online price dispersion, with a particular focus on comparing the efficiency of the Internet market to the traditional market and on understanding of e-tailer pricing strategy (Pan, Ratchford, & Shankar, 2003). There are several reasons for this growing body of research. First, it is difficult to obtain price quotes from conventional retailers (Sorenson, 2000), whereas price quotes of e-tailers can be found easily and unobtrusively through online price comparison engines such as BizRate.com, Shopper.com, MySimon.com, PriceScan.com, and PriceWatch.com. Second, prices can be gathered at the same time across e-tailers, providing a stronger validity for research on price dispersion (Smith, Bailey, & Brynjolfsson, 2000). Third, we can compare the pricing of identical products, such as books, CDs, DVDs, electronics, and computer hardware and software, instead of similar but somewhat differentiated products. Fourth, we can also examine price dispersion of items with varying consumer involvement levels and price levels, ranging from books to cars. Finally, and most importantly, research on online price dispersion can help us better understand whether this new retail format really does provide the gains in informational efficiency that many have predicted (e.g., Bakos, 1997).

In this paper, we review the empirical and analytical literature on online price dispersion and outline future directions in this stream of research. In the next section, we address the issue of whether price dispersion is narrower or wider online than off-line. In the section after next, we examine whether price dispersion on the Internet has changed over time. Then, in another section, we discuss multichannel retailing and price dispersion. Then we explore why Internet price dispersion exists and examine the drivers of online price dispersion. Next, we discuss the issue of measurement of price dispersion. Finally, we outline some directions for future research and conclude by highlighting the main managerial implications from this research stream.

IS PRICE DISPERSION NARROWER ONLINE THAN OFF-LINE?

There are many reasons to expect price dispersion to be lower online than off-line. Search costs are typically lower on the Internet than off-line, suggesting reduced price dispersion among e-tailers than among conventional retailers (Bakos, 1997). Online markets also involve significantly easier entry than off-line markets because the storefront is simplified to a Web site (Brynjolfsson & Smith, 2000). Because online retailing does not have some of the characteristics of traditional retailing such as high menu cost and thus staggered price setting, it is expected to have smaller price dispersion than off-line retailing. For example, Brynjolfsson and Smith (2000) observed that e-tailers have significantly more frequent but smaller price changes than conventional retailers. Thus, this line of reasoning predicts that online markets should be more competitive and witness less price dispersion than conventional markets.

Empirical research on online price dispersion, however, has reported results contrary to this theoretical prediction. The earliest empirical research on online price dispersion was conducted by Bailey (1998), who examined whether the Internet market is more efficient than the traditional market. Comparing the prices of 125 books, 108 music CDs, and 104 software titles in 1996 and 1997 sold through 52 Internet and traditional outlets (the products studied were entirely homogeneous and were matched across the two channels), Bailey found that price dispersion among e-tailers was at least as great as that among the traditional retailers. This finding is contrary to the expectation that online markets are more frictionless due to more intensive consumer search. He also found that prices of these products on the Internet were higher than those in the conventional channel. This finding, however, could be attributed to the immaturity of the Internet market at a time when there were only a few

well-known e-tailers and the competition was limited. It was expected that the maturity of Internet market would increase competition and consumer search intensity and thus reduce price dispersion. The evidence that Amazon.com cut its prices by about 10% in March 1997 to respond Barnesandnoble.com's lower entry prices provides some support for this expectation. Bailey's (1998) study was largely exploratory and comprised only low-involvement categories.

In a related study, Brynjolfsson and Smith (2000) examined prices for a matched set of 20 books and 20 CDs sold through 41 online and off-line retail outlets from February 1998 to May 1999. They found that online price dispersion was no narrower than off-line price dispersion, with an average price range of 33% and 25% for books and CDs, respectively. These results were found to be insensitive to whether shipping and handling charges and taxes were included or not. However, after weighing the retailer posted prices by their respective Web traffic (a proxy for market share), they found that price dispersion was smaller online than it was off-line. Compared to Bailey's study, Brynjolfsson and Smith found that prices on the Internet were lower than those in conventional channels, providing some evidence of the maturing of the Internet market. Like Bailey (1998), they studied only low-involvement products and they did not analyze the drivers of online price dispersion.

Lee and Gosain (2002) compared price dispersion of music CDs among nine Internet retailers and five nationally known brick-and-mortar retailers in February 1999 and January 2000. They also found that the average of percentage price difference (price range deflated by average price) was no smaller online than it was off-line. In particular, for the 22 old-hit albums they studied, the average percentage price difference was 31% online while it was only 11% off-line, and for the 21 current-hit albums they studied, the average percentage price difference was about 18–19% both online and off-line. Their results suggest that the degree of price dispersion depends on the product type, i.e., whether the product is a popular or a niche product. Consistent with Brynjolfsson and Smith (2000), Lee and Gosain found that CD prices on the Internet were generally lower than those in brick-and-mortar stores over time, although the prices for current-hit albums were comparable in the two channels. Their study, however, was restricted to a single category and also did not control for market characteristics.

Clay, Krishnana, Wolff, and Fernandes (2002) studied price and nonprice competition in the online book industry by examining the price data of 107 books sold in 13 online and two brick-and-mortar bookstores during the week of April 19, 1999. The books included 40 *New York Times* bestsellers and a random sample of 67 books from *Books in Print*. They found the same average prices online and off-line. They also found a substantial amount of price dispersion online, with the percentage price difference ranging from 27% for hardcover random books to 73% for paperback bestsellers. In particular, Amazon.com's unit prices were 5% higher than Barnesandnoble.com's unit prices and 11% higher than Borders.com's unit prices. However, their regression analyses aimed at explaining such price differences due to store differentiation did not yield conclusive results. It revealed little relationship between price and measurable store characteristics. The authors attributed this finding to the fact that the market had not yet reached equilibrium. Similarly to Lee and Gosain (2001), Clay et al. analyzed just one category and did not control for market characteristics. They also analyzed online markets before their maturity.

Clay and Tay (2001) looked at online price dispersion in a broader cross-country market. Studying prices for 95 textbooks sold in nine online bookstores in U.S., Canada, U.K., and Germany in early 2001, they found a substantial amount of price dispersion across these countries, with prices in the U.S. significantly higher than those in the other countries. Depending on which shipping method was used, they reported that price dispersion for a single textbook ranged from 23% to 42%. They also found that different branches of Amazon.com have large price differences. One limitation of this study is that the markets studied may not have been well defined.

Ancarani and Shankar (2004) compared prices and price dispersion levels in the online and traditional retail channels in Italy during early 2002 using 13,720 price quotes of books and music CDs. They reported that whether price dispersion is larger online than off-line depends on the measure used—Internet retailers had higher range of prices but lower

standard deviation compared to traditional retailers. They also reported that, although listed prices were lower online, prices adjusted for shipping costs were higher online. Although their results are partially driven by measures of price and price dispersion, the authors pointed out that their evidence still suggested inefficient online markets. They, however, did not explore the reasons for some of the conflicting results.

Erevelles, Rolland, and Srinivasan (2001) explored the pricing behavior of Internet versus traditional firms in the vitamin industry by comparing five retail formats: the Internet, drug stores, discount retailers, supermarkets, and warehouse retailers. Their examination across four multivitamin market segments showed that price dispersion among the Internet retailers was significantly higher than that among traditional retailers. In addition, the average unit price of vitamins was significantly higher for Internet retailers than for traditional retailers, even for private labels. Erevelles et al. (2001) did not offer a theoretical rationale for the observed differences in price dispersion across retail formats.

Clemons, Hann, and Hitt (2002) studied prices of airline tickets quoted by online travel agencies in 1997, using a hedonic technique to control for observable product differences such as arrival and departure times, number of connections, and Saturday night stays. They found that price dispersion was significant across the online travel agents they surveyed. Specifically, the ticket prices varied by up to 28% for the same customer request, and up to 18% even after controlling the possible sources of product heterogeneity. However, other aspects of product heterogeneity, such as meal offering and refund policy that could potentially drive price dispersion, were not included in their hedonic price model. Similarly, Bakos et al. (2000) also found significant dispersion in trading cost for online retailer brokerage service. Although these two studies did not directly compare levels of price dispersion online and off-line, they provided evidence of surprisingly significant price dispersion in these markets, presumably larger than the conventional off-line markets. Clemens et al. (2002) also did not consider some aspects of product heterogeneity.

Scholten and Smith (2002) compared price dispersion levels in traditional retail markets of 1976 with those in Internet retail markets of 2000. Examining 70 online prices covering a variety of matched products that include deodorant, hair spray, batteries, aspirin, hand cream, and expensive cameras, they found that the average of coefficient of variation was 14.5% for Internet markets in 2000—higher than the 12% figure for traditional markets in 1976. They also compared contemporaneous price dispersion online and off-line in another 11 product categories (e.g., books, flowers, fragrance, movie, printer, and scanner) in 2000. They found that the average coefficient of variation was 12.87% for the Internet markets and 12.83% for the traditional markets. Even after including transaction cost to listed price, the levels of price dispersion were only reduced by about 1% and were still similar across the two channels. The authors conclude that the information age has done little to reduce price dispersion. The products in their sample, however, were not identical over time.

Brown and Goolsbee (2002) investigated the impact of Internet comparison shopping on the life insurance market during 1992–1997. They examined prices for individual life insurance policies for a sample of 30,000 policies per year issued by 46 participating companies and used a hedonic regression model to control for individual and policy characteristics. They found that price dispersion initially increased with the introduction of the Internet search sites, but then decreased as the Internet usage spread. In addition, they reported that the growth of Internet reduced term life prices by 8–15%. Like Clemens et al. (2002), Brown and Goolsbee did not consider some aspects of product heterogeneity in their analysis.

Morton, Zettelmeyer, and Silva-Risso (2001) studied the impact of an Internet car referral service (Autobytel.com) on dealer pricing of automobiles in California during the period of January 1999 to February 2000. They observed that Internet car purchases through Autobytel.com referrals constituted 2.9% of the 360,255 purchases in their sample and the average Autobytel.com customer paid 2% less. Moreover, they found that the more cars a dealership sold through Autobytel.com, the smaller was the observed spread in the prices consumers paid at that dealership. They concluded that these results suggest that Internet referrals increased buyer information and bargaining clout. It should be noted, however, that

their measure of price dispersion is within a particular seller rather than across all sellers who compete with the same car model, thus should be interpreted carefully in comparison to other studies.

A summary of studies showing wider/narrower price dispersion online than offline appears in Table 1. In summary, substantial price dispersion has been observed on the Internet. In general, Internet markets exhibit no smaller (and in many cases larger) price dispersion than traditional markets. It appears that greater information flow and easier consumer search facilitated by the Internet has not made online markets more competitive and "frictionless" as predicted by theory. However, as cautioned by authors of many of these studies, the findings may be a result of the immaturity of Internet market and due to the lack of stable market equilibrium in prices. It is possible that the Internet market will exhibit high competitiveness and efficiency as it matures. For example, Brown and Goolsbee (2002) did find price dispersion decreased after the initial rise. Ancarani and Shankar's (2004) investigation of the more recent Italian market provided equivocal evidence. Thus, longitudinal comparison on the evaluation of online price dispersion is critical. In the next section, we review how online price dispersion has changed over time.

HOW HAS ONLINE PRICE DISPERSION CHANGED OVER TIME?

Given the earlier findings that online price dispersion is no smaller than off-line, recent research attention has shifted from comparison of online and off-line price dispersion to longitudinal analysis on how online price dispersion evolves over time.

Following up on their earlier study, Clay, Krishnan, and Wolff (2001) further investigated the price dispersion in the online book industry using data spanning from August 1999 to January 2000. They studied 32 online bookstores and 399 books in five categories—*New York Times* bestseller, former *New York Times* bestseller, computer bestsellers, former computer bestsellers, and random books. The percentage price difference ranged from 31.9% for random books to 65.2% for *New York Times* bestsellers, and the coefficient of variation of price ranged from 12.9% for random books to 27.7% for *New York Times* bestsellers. In both the measures, the *New York Times* bestsellers had the highest degree of price dispersion, followed by former *New York Times* bestsellers, computer bestsellers, former computer bestsellers, and random books. Such intracategory price dispersion was fairly consistent. It is contrary to the expectation that more advertised products should exhibit less price

TABLE 1 Online vs. Off-line Price Dispersion

ONLINE DISPERSION HIGHER (PRODUCT CATEGORIES)	OFF-LINE DISPERSION HIGHER (PRODUCT CATEGORIES)	ONLINE AND OFF-LINE DISPERSION SAME
Bailey (1998) (books, CDs, Software)	Brynjolfsson and Smith (2000) (books, CDs—market-share weighted)	Scholten and Smith (2002) (grocery products, cameras)
Brynjolfsson and Smith (2000) (books, CDs)	Morton et al. (2001) (cars—within dealership price dispersion)	
Erevelles et al. (2001) (vitamins)	Brown and Goolsbee (2002) (insurance services)	
Clay et al. (2002) (books)	Ancarani and Shankar (2004) (books, CDs—price standard deviation)	
Lee and Gosain (2002) (CDs)		
Ancarani and Shankar (2004) (books, CDs—price range)		

dispersion because of greater information flow and easier consumer search. The normalized prices, however, were in the opposite order for the five categories of books, with more advertised books having lower prices, consistent with our expectations. A possible explanation for their finding is that, for inexpensive products such as books, CDs, and grocery products, retailers usually practice a loss leader strategy by discounting prices of some popular product items to attract consumers into buying a basket of products. Since different retailers use different popular products as loss leaders, these products exhibit a larger degree of price dispersion. Clay et al. (2001) also found that interstore price dispersion was high while intertemporal price dispersion was low, suggesting the persistence of online price dispersion and the appropriateness of using cross-sectional data. Furthermore, they found that greater competition led to lower price dispersion, consistent with classical economic theory.

Baye, Morgan, and Scholten (2004a) studied the online monthly prices of 36 popular consumer electronics products listed at Shopper.com for an 18-month period from November 1999 to May 2001, with an average of 20 sellers and total of 9441 observations. They found that the average percentage difference of price was 57%,[1] the average coefficient of variation of price was 12.6%, and the average gap between the lowest two prices (as a percentage of the lowest price) was 6.2%. Although, after 18 months, the percentage price difference distinctly decreased from more than 70% to about 30%, and the coefficient of variation slightly decreased from around 13% to 9%, the gap between two lowest prices showed a slight upward trend. The authors attribute this finding to change in the product life cycle, following Varian's (1980) model, rather than Internet market maturity. They also used proxies to control for differences in costs, reputation, awareness, and trust but found those factors only explain about 17% of the observed price dispersion. Furthermore, their regressions using individual firm dummies and allowing the coefficients of these dummies to vary across multiple products offered by the same firm still left 28% of price dispersion unexplained. Baye et al. concluded that such significant price dispersion was persistent across products and across time even after controlling for differences in shipping charges and inventories. It should be noted that their data come from a single shopbot and thus may not be totally representative of all prices.

In a large-scale study, Baye, Morgan, and Scholten (2004b) examined 4 million daily price observations for 1000 best-selling consumer electronics products listed at Shopper.com from August 2000 to March 2001. They reported that the average percentage difference in price was about 40%, the average coefficient of variation of price was about 10%, and the average gap between the two lowest prices was about 5%. All three measures of price dispersion remained very stable over the 8-month sample period, reinforcing the conclusion in their previous study that online price dispersion is a persistent phenomenon. Analyzing the competition structure, they also found the levels of price dispersion were smaller for products sold by larger number of competitors and ranked as more popular among consumers.

Ratchford, Pan, and Shankar (2003) and Pan, Shankar, and Ratchford (2003b) provided the most recent evidence on online price dispersion. They compared levels of price dispersion in November 2000, November 2001, and February 2003, which spans the blooming, shakeout, and restructuring of e-business. They investigated a comprehensive sample, including products such as books, CDs, DVDs, software, desktop and laptop computers, PDAs, and consumer electronics, with more than 6,000 price observations for at least 500 product items at each period. They found that the average percentage difference in price dropped from 38.5% at November 2000 to 28.7% at November 2001 and average number of sellers for a product dropped from 12 to 8, corresponding to the shakeout following the Internet bubble. However, the average percentage difference in price remained stable at 28.8% in February 2003. The average coefficient of variation of price dropped from 11.8% at November 2000 to 9.8% at November 2001, but increased to 10.4% at February 2003. These findings are consistent with the results of Baye et al.'s (2004a) daily price monitoring on consumer electronics products.[2] They suggest that the restructuring and

[1] It should be noted that Baye et al.'s measure of percentage price difference is the range of price as a percentage of the *lowest* price, instead of the *average* price, and thus tends to be larger.

[2] Visit http://www.nash-equilibrium.com for detailed information.

maturity of Internet markets have not yet yielded a frictionless market. In their data, however, the items examined over the years are not identical.

Table 2 summarizes the results of studies of online price dispersion levels in different time periods and categories. Percentage price difference varies from a low of 15.01 for desktop computers in November 2001 to a high 65% for books during August 1999–January 2000. Consistent with this result, the coefficient of variation ranges from a low of 5.46% for books in November 2001 to a high of 27.7% for books during August 1999–January 2000. Based on the findings from these studies, we conclude that online price dispersion is a persistent phenomenon across categories and over time, regardless of the number of retailers in an online market. Although the magnitude of price dispersion has declined somewhat as Internet markets have grown over time, it continues to be substantial.

The strengths and limitations of the different studies are summarized in Table 3. Each study has made a significant contribution to the literature as reflected by its strengths. These strengths range from comparison of price dispersion online and off-line to cross-country analysis, to identification of drivers of online price dispersion. The limitations of the studies include analysis of early stage of competition, insufficient control of factors affecting price dispersion, restricted sample, and lack of compelling theoretical explanations. These limitations offer interesting opportunities for future research on online price dispersion.

MULTICHANNEL RETAILING AND PRICE DISPERSION

A noticeable trend in Internet retailing is that many brick-and-mortar retailers have folded their online channel back into their regular business (e.g., Walmart, Circuit City, and Sears) and have become multichannel retailers. One question is whether multichannel retailers consistently set higher or lower prices than do pure play Internet retailers. If it is the case, then one source of online price dispersion is the retailer type.

Although Brynjolfsson and Smith's (2000) data contain both multichannel and pure Internet retailers, they did not specifically test compare their relative price and dispersion levels. Tang and Xing (2001) compared the pricing behavior of these two types of retailers in the DVD market, with a data set containing 4,896 price observations for 51 DVD titles sold at six top pure play e-tailers and four top multichannel retailers, during the period of July–August 2000 in Singapore. They found that the multichannel retailers had significantly higher price than pure play e-tailers (14% on average). Moreover, price dispersion among pure play e-tailers was much smaller (less than a half of that among multichannel retailers). Two key limitations of their study are that they analyzed only one category and that they did not offer any theoretical explanation for their findings.

Ancarani and Shankar (2004) also compared the levels of price and price dispersion of books and CDs between the two types of retailers. Their results, based on an analysis of 13,720 price quotes, showed that multichannel retailers had higher average price than pure play e-tailers, regardless of whether listed price or full price, including shipping costs, were considered. With regard to price dispersion, multichannel retailers had higher standard deviation in price also, with or without shipping costs. However, pure play e-tailers had higher range of prices, but lower standard deviation.

Contrary to Tang and Xing (2001), Pan et al. (2003b) found that multichannel retailers generally have less price dispersion than do pure player e-tailers. This result, however, is consistent with Ancarani and Shankar (2004), when the price dispersion measure is percentage difference in price. In November 2000, multichannel retailers had larger percentage difference in price only for 10% of the product items and larger coefficient of variation in price only for about one-third of the product items. The percentages of product items for which multichannel retailers have higher price dispersion had steadily increased from November 2000 to February 2003. However, this percentage is still much less than 50% (41% for coefficient of variation and only 27% for percentage difference). Thus, pure play e-tailers still appear to have larger price dispersion than multichannel retailers. Over the same time period, both the absolute number and the proportion of multichannel retailers steadily increased, reflecting the multichannel retailing trend on the Internet. Their data, however, were only cross-sectional.

TABLE 2 Differences and Evolution of Price Dispersion Levels

		PRICE DISPERSION LEVEL				
STUDY	**PERIOD OF DATA**	**PERCENTAGE DIFFERENCE**	**COEFFICIENT OF VARIATION (%)**	**OTHER**	**CATEGORY AND NUMBER OF ITEMS**	**NUMBER OF E-TAILERS**
Clemons, Hann, and Hitt (2002)	1997	up to 28			Airline tickets	
Bailey (1998)	Feb 1997–Jan 1998		13.19		Books (125)	8
	Feb 1997–Mar 1997		17.61		CDs (108)	9
	Feb 1997–Mar 1997		7.07		Software (104)	35
Brynjolfsson and Smith (2000)	Feb 1998–May 1999	33			Books (20)	8
		25			CDs (20)	8
Lee and Gosain (2002)	Feb 1999–Jan 2000	31			CDs (22 old)	9
		19			CDs (21 current)	9
Clay et al. (2002)	Apr 1999	27–73			Books (107)	13
Clay, Krishnan, and Wolff (2001)	Aug 1999–Jan 2000	32–65	12.9–27.7		Books (399)	32
Clay and Tay (2001)	Early 2001	23–42			Books (95)	9
Baye, Morgan, and Scholten (2004a, 2004b)	Nov 1999–May 2001	57*	12.6	6.2% (gap)**	Electronics (36)	Average of 20
Baye, Morgan, and Scholten (2003)	Aug 2000–Mar 2001	40*	10	5% (gap)	Electronics (1000)	2–40
Scholten and Smith (2002)	2000		14.5		Grocery and camera	
	2000		12.87		Books, flowers, electronics	
Pan, Ratchford, and Shankar (2003)	Nov 2000	48.9	13.8		Books (105)	Average of 12
		51.0	18.4		CDs (43)	
		43.7	16.7		DVDs (96)	
		34.4	27.1		Desktop (105)	
		25.7	13.9		Laptop (105)	
		37.1	24.4		PDA (37)	
		35.6	25.9		Software (51)	
		31.0	11.7		Electronics (66)	
		38.5	11.8		Eight categories (581)	
Ratchford et al. (2003)	Nov 2001	48.08	16.63		Books (134)	Average of 8
		39.30	13.02		CDs (120)	
		32.29	10.22		DVDs (103)	
		15.01	5.46		Desktop (107)	
		17.87	6.11		Laptop (96)	
		30.26	9.86		PDA (52)	
		18.95	6.51		Software (120)	
		22.12	8.22		Electronics (94)	
		28.7	9.8		Eight categories (826)	
Pan et al. (2003b)	Feb 2003	48.90	14.21		Books (141)	Average of 9
		51.04	8.79		CDs (108)	
		43.67	10.31		DVDs (110)	
		34.39	7.03		Desktop (41)	
		25.70	7.32		Laptop (110)	
		37.10	14.13		PDA (49)	
		35.58	9.22		Software (100)	
		30.99	10.83		Electronics (110)	
		28.8	10.4		Eight categories (769)	

* Price range relative to the *minimum* price, not the *average* price.

** Gap is measured as percentage difference between the lowest two prices.

Absolute price dispersion measures and corresponding studies are not included in this table.

TABLE 3 Strengths and Limitations of the Reviewed Studies

STUDY	STRENGTHS	LIMITATIONS
Bailey (1998)	Early study in the research stream Compared online and offline prices	• Examined the early stage of online market, which is likely to be immature • Exploratory analysis • Examined only low involvement product categories
Brynjolfsson and Smith (2000)	Compared price dispersion online and offline Speculated reasons for observed price dispersion	• Examined low involvement product categories and a small number of items • No empirical analysis for the speculated reasons for online price dispersion
Lee and Gosain (2001)	Examined difference between popular and nonpopular products	• Single category analysis • Did not control for market characteristics
Clay et al. (2002)	Related price dispersion to some store characteristics	• Single category analysis • Did not for control market characteristics • Attributes inconclusive results to market immaturity
Clay and Tay (2001) Clay, Krishnan, and Wolff (2001)	Examined cross country price dispersion Examined both interstore and intertemporal price dispersion	• The markets may not have been well-defined • Counterintuitive results on the relationship of product popularity and price dispersion is not explained, which may require the analysis of loss leader strategy and shopping basket
Clemons, Hann, and Hitt (2002)	Hedonic regression to control for product heterogeneity	• Did not directly compare price dispersion online and offline • Some aspects of product heterogeneity not considered
Erevelles et al. (2001)	Examined multiple channel formats	• No theoretical explanation for the differences in price dispersion across retail formats
Brown and Goolsbee (2002)	Hedonic regression to control for product heterogeneity	• Product heterogeneity may not have been fully considered
Morton et al. (2001)	One of the early studies to show that price dispersion online may be smaller than offline	• Examined within dealer price dispersion, which is not directly comparable to other results in the literature
Scholten and Smith (2002)	Compared current level of price dispersion to historical data	• Products in different samples not identical over time
Baye et al. (2004b)	Proposed the "gap" as a new measure for price dispersion	• Data obtained from a single shopbot
Baye et al. (2002)	Related price dispersion to market structure	• Data obtained from a single shopbot
Tang and Xing (2001)	Compared price dispersion difference between pure player e-tailers and multi-channel retailers	• Single category study (DVD) • No theoretical explanation
Ancarani and Shankar (2004)	Compared all three types of retailers—pure play e-tailer, bricks-and-mortar, and multi-channel retailer	• Reasons for conflicting results with different price dispersion measures not explored
Pan et al. (2002)	Control for e-tailer service heterogeneity and compare across low involvement and high involvement product categories	• Nonservice dimensions of e-tailer heterogeneity was discussed but not empirically investigated

(*continued*)

TABLE 3 Strengths and Limitations of the Reviewed Studies (*continued*)

STUDY	STRENGTHS	LIMITATIONS
Pan et al. (2003b)	Investigated the evolution of price dispersion over a three year period	• Longitudinal comparison of price dispersion not on the exact same set of items
Ratchford et al. (2003)	Examined the impact of price dispersion on consumer welfare	• Online markets possibly immature
Pan, Ratchford, and Shankar (2003)	Proposed a comprehensive framework of drivers of price dispersion and empirically tested the framework	• Only cross sectional data was analyzed
Shankar et al. (2004)	Examined whether and how drivers of online price dispersion change as Internet market matures	• Longitudinal comparison of price dispersion not on the exact same set of items
Lal and Sarvary (1999)	Characterized conditions that Internet may reduce price competition	• Analytical results are not well supported by empirical observations
Smith (2001)	Discovered that consumers react to product price, shipping cost, and tax differently, rather than only respond to the total price	• Did not directly test whether lesser-known e-tailers adopt the random pricing strategy as proposed • Single category study (books)
Chen and Hitt (2003)	Discussed why Internet may first increase price dispersion and then decrease price dispersion	• Random pricing strategy not well supported by empirical observations
Baye and Morgan (2001, 2003)	Examined equilibrium in both information market and product market	• Assumed monopolistic information market
Carlton and Chevalier (2001)	Related price dispersion to channel management and free riding behavior	• Did not address the effects of potential channel conflict on price dispersion
Pan et al. (2004)	Examined equilibrium in both retailer service and price and analyzed cross- channel price dispersion	• Did not examine the role of multi-channel retailer
Baylis and Perloff (2002)	Empirically tested several alternative theoretical explanations for online price dispersion	• Limited measure of e-tailer service

The mixed evidence, although inconclusive on which type of retailer has larger price dispersion, does suggest that price differences exist among the different types of retailers. Pan, Shankar, and Ratchford (2002) derived an analytical model of price competition between pure play Internet retailers and multichannel retailers. They showed that multichannel retailers have a higher price in equilibrium, when they have sufficiently lower transaction cost than pure play e-tailers. This is because they provide better pick-up and return service, more convenient product inspection, and greater consumer trust. Pan et al. (2002) also empirically examined 905 retailers in eight product categories, including apparel, gifts, and flowers, health and beauty, and office supply. They found consistent evidence that multichannel retailers have higher prices, even after controlling for e-tailer characteristics.

We conclude that, in general, multichannel retailers have higher prices than do pure play Internet retailers and the retailer type is one source of online price dispersion. Furthermore, price dispersion differences across channel or retailer type depend on the measure

of prices (with or without shipping charges). The large price dispersion within multichannel retailers offers sufficient opportunities for product differentiation.

WHY DOES ONLINE PRICE DISPERSION EXIST?

Recognizing that online price dispersion is significant, persistent, and ubiquitous, researchers have attempted to understand why it exists. The theoretical explanations have been proposed from a variety of perspectives.

One argument is that, although more salient online price information increases consumer price sensitivity and discourages high prices, richer nonprice information leads to lower consumer price sensitivity and wider range of prices (Degeratu, Rangaswamy, & Wu, 2000; Shankar, Rangaswamy, & Pusateri, 2001). Pan, Ratchford, and Shankar (2003a) conjectured that greater product information might also lead consumers to believe that offers at alternative e-tailers are close substitutes and thus heighten price sensitivity. For example, Lynch and Ariely (2000) showed that, with greater product information online, wine shoppers become more price sensitive when different Web sites carry the same wine, but become less price sensitive when different Web sites carry unique wine.

Lal and Sarvary (1999) classified product attributes into "digital" attributes (those that can be easily communicated online) and "nondigital" attributes (those that need physical inspection) in their analytical model, and proposed that online price sensitivity is lower when the following conditions are met: (1) there is a large enough pool of Internet shoppers; (2) nondigital attributes are important but not overwhelming; (3) consumers have a more favorable prior about the brand they currently own; and (4) the fixed cost of a shopping trip is higher than the cost of visiting an additional store. Although their model offers some insights, it cannot explain the widely observed price dispersion for entirely homogeneous products, which consist of nearly pure digital attributes (e.g., books, CDs, and DVDs).

Chen and Hitt (2003) present an analytical model linking price dispersion to consumer awareness and sensitivity to retailer name. They showed that when consumers are sensitive (but not too sensitive) to retailers' brand names and/or not all consumers are fully aware of all available retailers and prices, retailers play asymmetric mixed strategy by randomizing their prices so that a better-known retailer has a higher price on average than a lesser-known retailer, but a lower price on some products and/or some of the time. The random pricing behavior produces online price dispersion. They also showed that an unbranded retailer has a weak incentive to improve consumer awareness even if the cost is zero, because that will increase price competition. Interestingly, the authors showed that price dispersion first rises when the proportion of informed consumers increases, but then falls after the proportion of informed consumers exceeds a certain relatively high level. This analytical result is consistent with Brown and Goolsbee's (2002) empirical observation in the life insurance market. Chen and Hitt concluded that high price dispersion does not necessarily indicate lack of competition, depending on whether the proportion of informed consumers is sufficiently large. However, it should be noted that fundamental assumptions of their model, i.e., the existence of awareness asymmetry and retailer brand name sensitivity, are by themselves indicators of market inefficiency and imperfect competition (Stigler, 1961). Moreover, random pricing theory is not supported by empirical evidence in online retail markets, as we discuss later.

Similar to Chen and Hitt (2003) but with a different approach, Smith (2001) also presented an analytical model examining how consumer awareness of Internet retailers affects their pricing strategies. He pointed out that consumer search costs in electronic markets are primarily a function of the consumer's mental awareness of different retailers, which is asymmetric and likely to be concentrated in the hands of a few retailers. In contrast, in conventional markets, consumer search costs are primarily a function of the consumer's physical proximity to retailer outlets, which is distributed relatively equally across retailers. The model showed that, on the one hand, the focus of search on a few well-known e-tailers creates their interdependence in pricing, which leads them to cooperatively set high prices. On the other hand, the lesser-known e-tailers lack strong interdependence in their strategies so they adopt random pricing strategy in equilibrium, with high price

sometimes to target consumers who are aware of them and with low price sometimes to attract shopbot consumers. Price dispersion emerges as the result of the two types of e-tailers' different pricing behavior. Smith examined price data of 24 Internet book retailers for 23,744 book titles in late 1999 and found that the well-known booksellers had very similar prices while the lesser-known booksellers did not, consistent with the analytical prediction. However, he did not directly test whether those lesser-known booksellers adopt random pricing strategy.

Baye and Morgan (2001) analyzed why online price dispersion exists by examining an information market, in addition to the product market. They examined how a gatekeeper in information market (e.g., shopbot) prices its service and how it interacts with the homogenous product market it serves. The gatekeeper charges fees to firms who advertise prices on its Internet site and to consumers who access the list of advertised prices. The authors showed that, in equilibrium, (1) the product market exhibits price dispersion, (2) all consumer subscribe the price information at sufficiently low access fees, (3) high advertising cost induces only partial firm participation to advertise their prices at the shopbot, and (4) advertised prices are lower than unadvertised prices. Interestingly, equilibrium dispersion in offer prices exists in the product market even if all consumer purchase from the lowest price retailer. Their model offers an explanation on why price dispersion is prevalent in online shopbots, where consumers can conduct head-to-head price comparison.

From a very different perspective, Baye and Morgan (2003) use bounded rationality to derive epsilon and quantal response equilibria, which lead to price dispersion in a homogeneous product market where Bertrand type competition would otherwise be expected. Their analysis of two independent laboratory experiment data sets provided statistical results consistent with the bounded rationality based explanation of price dispersion. The authors also concluded that evidence from leading Internet price comparison sites was consistent with their model. Their study suggests a new direction for understanding online price dispersion.

Carlton and Chevalier (2001) looked at online price dispersion from a manufacturer's point of view. To prevent some retailers from free riding on the sales efforts of other retailers, manufacturers need to limit the availability of their products and to control the pricing of their products. By examining data on fragrances, DVD players, and refrigerators, they showed that manufacturers who distribute their goods directly through manufacturer Web sites tend to charge very high prices for the products, consistent with the hypothesis that manufacturers internalize free rider issues. This pricing practice can be another source of online price dispersion. Carlton and Chevalier, however, did not address the impact of potential channel conflict on online price dispersion.

These studies largely focused on theoretical explanations of online price dispersion. A few studies have tested the different theoretical explanations empirically, offering some evidence for some explanations for the observed online price dispersion. Random pricing strategy is a plausible cause as suggested by theoretical analysis (Chen & Hitt, 2003; Smith, 2001; Varian, 1980). That is, retailers may use mixed strategies to set high price sometimes and low price at other times, so price dispersion is produced across sellers and across time. Baylis and Perloff (2002) empirically tested if online price dispersion is a result of retailers playing a mixed strategy. They examined whether the price-rank ordering of retailers is random or stable over time. In the digital camera market, they found that for 57% of the time, a retailer kept its rank or changed its rank by at most one position, while there was only 4% of the time that a retailer changed more than 10 ranks (out of a possible of 40). In the scanner market, they found that, for 75% of the time, a retailer kept its rank or changed its rank by at most one position, while there was only 1% of the time that a retailer changed more than 10 ranks (out of a possible of 27). The retailers were not observed to collectively raise or lower prices randomly over time nor take turns to undercut each other. Thus, the random pricing theory was not empirically supported.

Product differentiation is another plausible cause of price dispersion. Although many of the empirical studies have particularly investigated entirely homogeneous products to avoid potential contamination of unmeasured product heterogeneity, one critical aspect of heterogeneity, namely, retailer service offering, had been generally overlooked. The observed price dispersion could well be the result of retailer service

differentiation. Varian (2000) predicted that two groups of Internet retailers would emerge: one providing little service with low price and the other one providing good service at higher price. In an analysis of competition between a pure play Internet retailer and a bricks-and-mortar retailer, Pan, Ratchford, and Shankar (2004) also show that, in equilibrium, the bricks-and-mortar retailer will provide greater service at a higher price than the pure play Internet retailer, even though there is no cost of providing service for both retailers.

A number of empirical studies addressed the issue of service and price dispersion. Pan, Ratchford, and Shankar (2002) specifically examined whether online price dispersion could be explained by differences in e-tailer service quality. They compiled a data set containing 6,739 price observations for 581 product items in eight product categories and the Bizrate.com's service quality ratings for the 105 e-tailers who sell those items. They identified four service factors (reliability, shopping convenience, product information, and shipping and handling) and an additional factor of e-tailer pricing policy. Using hedonic regression, they found that better service often relates to lower prices and the dispersion of service quality adjusted price is only slightly smaller than that of the unadjusted price. Ratchford et al. (2003) and Pan et al. (2003b) replicated the analysis using similar data in 2001 and 2003 and found the same results. They concluded that e-tailer service quality difference is not the main source of observed price dispersion and it is generally safe to use unadjusted price for price dispersion research. With a similar goal, Baylis and Perloff (2002) investigated weekly price of a digital camera and a scanner in late 1999. They regressed prices on various e-tailer characteristics, shipping and other fees, and time dummies. They also found that better service was often offered with lower prices while lower service tended to have higher prices. Brynjolfsson and Smith (2000) provided consistent anecdotal evidence as well. Baylis and Perloff draw the same conclusion as Pan and his colleagues in that the observed online price dispersion is not due to service differentiation.

Brynjolfsson and Smith (2000) and Pan et al. (2002) both hinted that other aspects of e-tailer characteristics, such as consumer trust and retailer brand, may lead to different prices. Building on that suggestion, Pan et al. (2003a) presented a broad framework of drivers of online price dispersion, which includes service and nonservice e-tailer characteristics, market characteristics, and product category uniqueness shown in Figure 1. Specifically, they considered factors such as timing of online market entry, third-party certification, consumer awareness, number of competitors, consumer involvement, and product popularity. Using

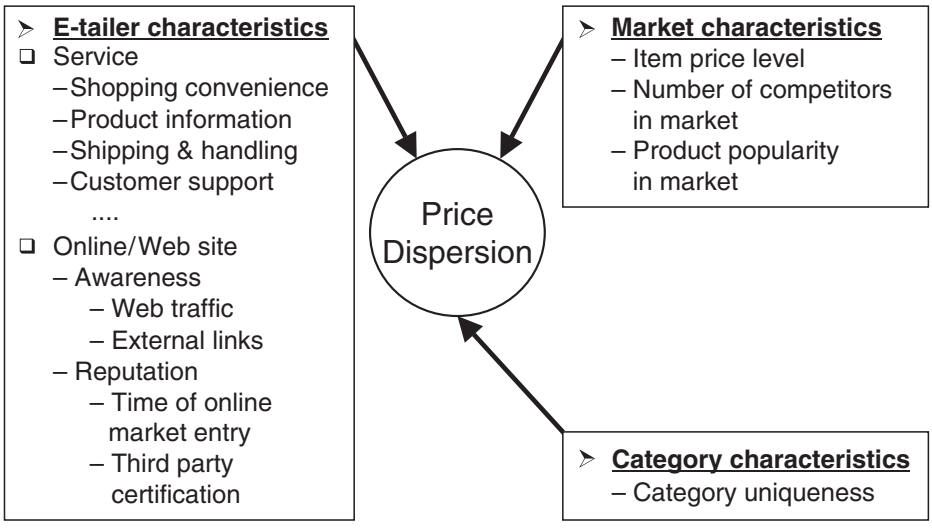

FIGURE 1

Drivers of Online Price Dispersion (Source: Pan, Ratchford, and Shankar, 2003)

two sets of related regression analysis, they found that a significant portion of online price dispersion is due to non-e-tailer characteristics. In particular, online price dispersion relative to price level was lower for items with higher average prices and decreased as the number of competitors is greater, but at a diminishing rate. Early online entrants appeared to command higher prices. Interestingly, e-tailers with deeper product information charged lower prices. Moreover, those e-tailers with superior services did not necessarily command higher prices, similar to Baylis and Perloff's (2002) findings of the existence of "good firms" (offering high service but low price) and "bad firms" (offering low service but high price). This appears to be consistent with Salop and Stiglitz's (1977) price discrimination theory that high price retailers sell to high search cost "tourists" while low price retailers sell to low search cost "natives."

Following up on their comprehensive model in an earlier work, Shankar, Pan, and Ratchford (2004) further studied whether the drivers of online price dispersion changed as Internet markets are maturing. They analyzed differences between the drivers of online price dispersion during the period of 2000 and 2003. They found that, in general, the drivers remained consistent over time and that only the effects of timing of online market entry and competitive intensity on online price dispersion weakened over time.

MEASUREMENT OF PRICE DISPERSION

The price dispersion construct, although clear in theory as the distribution of prices of an item with the same measured characteristics across sellers of the item at a given point in time, has been measured in various ways in empirical studies. The absolute measures used in empirical literature include variance, standard deviation, range, difference between two lowest prices (price gap), and difference between the average price and lowest price (value of price information). Accordingly, deflating the absolute measures by mean price generates the relative measures. Price range considers only the two extreme observations and ignores all other prices, thus it may not appropriately capture the competitive structure of the market. The gap between two lowest prices, proposed by Baye et al. (2004b), emphasizes that the lowest prices are what really matters in a competitive market, but completely ignoring higher prices may neglect the brand equity of some sellers. Difference in the average price (a completely uninformed consumer expects to pay) and lowest price (a completely informed consumer pays) measures the value of price information and it has similar results of price range (Baye, Morgan, & Scholten, 2003; Pan et al., 2003b; Ratchford et al., 2003). Standard deviation and variance consider every price observation and they are highly similar in statistical nature. However, they may also yield different results when used as dependent variables in linear regression models such as the investigation of drivers of price dispersion (Pan et al., 2003a).

These measures could also be calculated after giving each price a different weight. For example, if the objective is to determine the impact of price dispersion of consumers' actual purchasing behavior, one might weight prices by sales volume. However, a practical problem is that the needed sales data are rarely available. Brynjolfsson and Smith (2000) used e-tailer web traffic as proxy for market share to weight prices, arguing that more observable prices should be weighted more. However, since Web traffic may be related to factors that affect prices, such as reputation, the appropriateness of using this proxy is not clear.

Other than the measures described earlier, price rank order is another measure of price dispersion and is particularly useful in examining whether retailers play a random pricing strategy as discussed earlier.

The different measures of price dispersion have exhibited different results (e.g., Ancarani & Shankar, 2004; Baye et al., 2004b; Brynjolfsson & Smith 2000), and it is not theoretically clear why they have such differences. Future research should investigate the relationships among these measures and how to better measure price dispersion empirically.

Another important issue regarding the measurement of price dispersion is whether shipping cost (and/or tax) should be included to calculate "full price." Theoretically, a retailer can set low product price but high shipping cost, or high product price but low shipping cost. Thus price dispersion can be observed, even

though the full prices that consumers pay are indeed equal. Despite such possibility, empirical studies have generally found very similar results using prices with and without shipping cost (e.g., Baye et al., 2004a; Brynjolfsson & Smith, 2000; Scholten & Smith 2002). For example, Baye et al. (2004a) and Scholten and Smith (2002) found that adding shipping cost to price only reduces price dispersion by about 1%. An exception is Ancarani and Shankar (2004), who found that the levels of price dispersion could be different if prices are measured with and without shipping costs.

We note that adding shipping cost directly to product price might be based on strong assumptions on the shipping method, consumer basket size, and consumer geographic location. Smith and Brynjolfsson (2001) found that consumers evaluate product price, shipping charge, and tax differently in comparison-shopping, rather than simply adding these parts together to compare the total monetary cost. It suggests that directly adding shipping cost to product price may be inappropriate in comparison of price dispersion.

As an alternative approach, Pan, Ratchford, and Shankar (2002, 2003) treated shipping and handling as one aspect of retailer service using consumer survey data and looked at its effect on retailer price. Baylis and Perloff (2002) adopted a similar strategy by regressing retailer price on their shipping fees. Using the Hausman (1978) test, Pan et al. (2003) also found that shipping fees are not endogenous in a model of price, suggesting the appropriateness and advantage of their approach.

Existing empirical research has primarily examined list prices rather than transaction prices because of data availability. A concern is that some retailers might "bait and switch"; i.e., they strategically advertise a low/high price but do not honor that price. Pan et al. (2002, 2003) studied products that are all indicated as in stock to avoid this problem. Baye et al. (2004b) discussed an information gatekeeper's (e.g., shopbot) fee structure to show that it is not optimal for retailers to do so, because retailers who post a high price but have no sales cannot pay off for the fixed cost of listing price, while retailers who post low price but have no sales cannot pay off for the variable cost (fee paid to information gatekeeper for each consumer click on the posted price). Baylis and Perloff (2002) also reported that they did not find an obvious pattern between stock-outs and price. Future research on this issue would be useful.

DIRECTIONS FOR FUTURE RESEARCH

The topic of online price dispersion offers interesting opportunities for further research. Although there are several empirical studies each investigating a specific aspect of online price dispersion using a particular methodology, a comprehensive theory that integrates these different aspects and findings is needed. By the same token, although theoretical models have offered explanations for online price dispersion from different perspectives, empirical tests of these models are needed. There are many areas that are worthy of deeper theoretical and empirical examination.

The Role of Shopbots in Online Price Dispersion

Information economics theory suggests that the proportion of consumers who are aware of all alternative e-tailer offerings affects the level of price dispersion. Online shopbots (e.g., shopper.com) search and list all sellers' prices, shipping, and inventory information and thus allow head-to head comparison of e-tailer offerings on the same product. The use of shopbots and search engines is more widespread today than before, and there is a significant segment of the online browsing population that uses them (e.g., Chen & Sudhir, 2001; Iyer & Pazgal, 2003). In theory, shopbots should lead to lower price dispersion because they reduce search costs and the opportunities for e-tailers to charge higher prices. However, there may still be possibilities for e-tailers to differentiate themselves through price discrimination, bait and switch, and obfuscation strategies (Ellison & Ellison, 2001; Smith, 2002). While shopbot consumers are price-sensitive, they also prefer branded e-tailers or e-tailers with whom they had experience (Smith & Brynjolfsson, 2001). E-tailers who charge high prices tend to provide less product information on their Web sites to obfuscate consumer search, so consumers cannot easily compare their products with those sold at other e-tailers (Pan et al., 2003a). For example, the Bizrate survey data of November 2000 showed that Bestbuy.com provided relatively low product

information, but commanded higher prices than those of most of its competitors.

Baye and Morgan's (2001) model challenges the view that shopbots should lead to lower price dispersion. In addition to the traditional product market, they also considered the information market which has a monopolistic gatekeeper who charges fees for sellers to list their prices and for consumers to access such information. Baye and Morgan showed that even if all consumers purchase from the lowest price retailer identified by the shopbot, dispersion of offer prices still exists in equilibrium. They further demonstrated that the equilibrium price dispersion at an online shopbot will still exist even if e-tailers can price discriminate among consumers based on their usage of the shopbot.

More research is still needed to better understand the role of shopbots in online price dispersion. For example, Baye and Morgan's model assumed monopolistic information gatekeeper, while in the real world a number of well-established online shopbots or comparison engines, such as shopper.com, mysimon.com, pricegrabber.com, and bizrate.com, coexist in the online market. It will to be interesting to investigate how price dispersion changes when the market for shopbots or information is also competitive. The underlying random pricing strategy of these models has not been well supported empirically. Further research can empirically test how e-tailers' price ranking changes over time and compare how it differs in markets with and without shopbots.

Price Matching Guarantees and Online Price Dispersion

Related to the ease of head-to-head price comparison on Internet shopbots, another promising area of research is price matching guarantees. It is common for retailers to offer price matching guarantees in traditional markets. On the Internet, the effect of price matching guarantees may be more significant and complicated. It would be useful to study the impact of price matching guarantees on online price dispersion.

First, many e-tailers offer more than a 100% price match. Thus consumers have a stronger incentive to find lower prices online, while it is also less difficult to find lower prices at shopbots than it is in conventional markets. Such guarantees could strongly push prices of competing retailers to the lowest market prices and lead to Bertrand competition where prices are close to marginal costs and thus lower price dispersion.

Second, price matching guarantees could serve as a signaling device for rival retailers to maintain high but different prices because they could still price discriminate by charging higher prices for uninformed consumers. Whether signaling is effective may depend on the market structure—whether the market consists of a few dominant players or many smaller competitors. Signaling models are largely at a theoretical level and empirical tests are sparse. Monitoring longitudinal price changes of price matching e-tailers is one way to test the signaling theory. It is worth mentioning that e-tailers may compete in multiple separate segments and signaling may only occur within some segment of e-tailers. Smith's (2001) model highlights this aspect, and empirical studies should be cautious.

Third, future research should focus on the impact of these guarantees in both online and off-line environments on price dispersion both online and off-line. It is interesting to note that not all e-tailers have adopted price matching guarantees. Moreover, among those who adopted, the price matching policy varies. For example, Staples.com is offering a price match policy whereby it would match a lower advertised or Web site or catalog price at a rival retailer, plus 10% of the price difference. Circuitcity.com also has 110% price match but only matches prices from bricks-and-mortar retailers. Buy.com, in contrast, only matches prices of online retailers. It is important to understand issues such as what firms adopt price matching strategy and what firms do not; why they have different price matching guarantees; what are the online, off-line, and cross-channel impacts of the price matching policy on the competition structure.

Cross-Category Differences in Online Price Dispersion

Many studies have revealed differences in the degree of online price dispersion across product categories. Pan et al. (2003a) show that product category uniqueness is a significant driver of online price dispersion.

Ratchford et al. (2003) and Shankar et al. (2004) show that books have the widest price dispersion among eight categories that include CDs, desktop and laptop computers, hardware, software, PDAs, and consumer electronics. In these studies, some of these differences remain even after controlling for price level, a proxy for consumer involvement. These findings suggest that books, although investigated in most studies of online price dispersion due to the convenience of data collection, is not a representative category. The particular focus on books tends to overestimate the level of online price dispersion. Thus, further empirical investigation of other homogeneous products is encouraged.

Yet, not much is known about the theoretical reasons behind these differences. Pan et al. (2004) developed a two-dimensional differentiation model, in which retailers horizontally differentiate on retail channels (Internet vs. bricks-and-mortar) and vertically differentiate on retail services. They argued that the magnitude of consumer heterogeneity on demand for service and the retail channel substitutability determine the level of cross-channel price dispersion. Because these two factors vary across categories (e.g., books vs. apparel), cross-channel price differences are different for these categories. Their study suggests the need for investigating the intrinsic product category characteristics, in addition to general consumer search behavior. Their study, however, does not analyze within-channel price dispersion. Future research should further investigate the theoretical reasons for differences of price dispersion among categories. One direction could be analyzing the relationship of within-channel and cross-channel price dispersion, and its interaction with product categories.

Volume Sold at Different Price Levels and Online Price Dispersion

In general, the empirical analyses discussed in this paper are based on posted prices, because data on how many sales take place at each price are not readily available. Although economic search models predict that lower price sellers have a larger market share, inconsistent evidence is generally observed in online markets. E-tailers such as Amazon.com have successfully generated the Web traffic and sales, while enjoying a high price premium. There is a need to further investigate the relation between price dispersion and retailer sales.

In addition, information on sales associated with each price level may be crucial to evaluate the impact of price dispersion on consumer welfare: If most sales in online markets take place at relatively low prices, and high price sellers have relatively low volumes, price dispersion could cost consumers much less than if a high share of sales takes place at relatively high prices. Obtaining the sales data and studying the relation between online prices and sales volume is meaningful.

Furthermore, with the emergence and growth of multichannel retailing, it is important to understand the interactions and dynamics of price and sales between the online and offline markets. Channel cannibalization and equity building are the main concerns of multichannel retailers. Pan et al.'s (2002) model analyzed how a bricks-and-clicks retailer manages self-cannibalization in a competition with a pure play e-tailer. However, their empirical analysis is only cross-sectional and could not capture the dynamics of the effect. Biyalogorsky and Naik (2003) proposed a particularly useful econometric model to systematically incorporate the contemporaneous correlation and temporal dynamics of online and offline sales and to account for cross-channel cannibalization. Their model can be extended by incorporating online and off-line prices as independent variables, which allows the appropriate estimation of within and across channel price elasticities and helps understand the differences in optimal prices set by e-tailers. These differences in e-tailer price elasticity and price are likely to be related to competitor factors and product category and consumer characteristics similar to the case of offline retailing (Shankar and Bolton, 2004). Again, cross-category analysis on price dispersion is needed to better understand the differences.

Bundling, Versioning, and Online Price Dispersion

E-tailers and direct marketers bundle product offerings to differentiate themselves and follow a price discrimination strategy (Varian, 1980). For example, e-tailers may offer two books as bundle or a book and CD as bundle, or hardware and software as a bundle.

Some retailers waive shipping charges for offerings purchased as a bundle. For example, Amazon is offering free shipping on any bundle worth $25 or more. On the one hand, bundling makes price comparison for component items difficult for consumers and may lead to greater price dispersion. On the other hand, bundled products may not be considered to be part of identical product comparison, so omitting them may lead to a narrower set of competing component items, leading to lower price dispersion. Empirical research on this issue could shed greater insights into the impact of bundling on price dispersion.

Versioning is a process by which digitizable products such as books, music, and software are offered as distinct offerings with distinctly different benefits aimed at different consumers (Shapiro and Varian, 1998). For example, Turbotax, the tax preparation software, is offered in multiple versions by type (software package vs. Web-based service), operating system (Windows vs. Macintosh), tax agency (state vs. federal), entity (home vs. business), and level of complexity (ultimate vs. premier vs. deluxe vs. basic). For Windows-based PCs, Turbotax Ultimate ($99.95), Turbotax Premier Home & Business ($79.95), Turbotax Premier ($59.95), Turbotax Deluxe ($39.95), Turbotax Basic ($29.95), and Turbotax State ($29.95) are the offerings. As a Web-based service, Turbotax Home & Business ($74.95), Turbotax Premier ($64.95), Turbotax Deluxe ($44.95), Turbotax Basic ($34.95), and Turbotax EZ ($14.95) are the offerings. The prices of these versions are lower when bought through intermediaries such as banks, mutual fund companies, and brokerage houses. Similarly, the *Wall Street Journal* offers three versions of annual subscriptions for its content: (1) a hard copy newspaper version for $189, (2) an online version for $79, and (3) a combination of the two for $228. The prices for these versions are different, although the functionality and content are virtually the same for these versions. When comparing the prices of rival offerings (e.g., H&R Block vs. Turbotax, *Wall Street Journal* vs. *Investors' Business Daily*), some consumers may just compare the prices within a version, while others may compare both within and across versions. Accordingly, measures of price dispersion may be different and the extent of price dispersion may also be different. We need a theoretical framework to understand price competition and dispersion in a versioning environment. Empirical studies can also enhance our understanding of this issue.

MANAGERIAL IMPLICATIONS

Research on online price dispersion to date has generated several useful implications for pricing strategy. First the finding that online markets are not perfectly competitive, and that price dispersion is expected to persist, suggests that e-tailers can avoid head-to-head Bertrand price competition with one another. Differentiation is an effective strategy to avoid price competition and it can be achieved through service and non-service differentiation. Service differentiation helps e-tailers to target consumers segments with different needs. Nonservice differentiation, such as third-party certification, can help e-tailers to create better consumer awareness and trust. Although the cost of providing better service and creating higher awareness could be nontrivial, it may still be in the interest of the e-tailers to differentiate themselves from others.

Product information provision, one service dimension on the Internet, helps to attract Web traffic, but may also heighten consumer price sensitivity and promote free-riding. This suggests a segmentation strategy based on information provision. Thus, providing great information with low prices is a useful strategy to attract and lock in consumers who are inclined to search extensively, while providing low information with high prices is helpful to obfuscate consumer search and to win the loyal and uninformed consumers. Different online sellers commonly appear to adopt one or the other of these strategies.

E-tailers can also engage in a number of practices to soften direct price competition. They can practice a random pricing strategy (offer sales and deals at unpredictable intervals) to discriminate against uninformed consumers while occasionally attracting those who shop extensively. If all e-tailers in a market adopt this strategy, direct price competition will be softened. E-tailers can also limit competition by obfuscating consumer search through offering product bundles and different product versions. In markets with a few major players, price-matching guarantees can serve as signals to maintain high prices and limit direct competition.

The findings from the literature offer important pricing implications for multichannel retailers that go beyond pricing strategies practiced by off-line

retailers. The findings that price dispersion is high and different across the different retailer types suggest that multichannel retailers can price suitably to differentiate themselves not only among other multichannel retailers, but also from other types of retailers. In general, integration of the online and off-line channels enhances the reliability of the multichannel retailer and enables it to command premium prices. Online and off-line prices should be appropriately coordinated based on cross-channel price elasticity to avoid cannibalization and promote customer trust.

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