Price Dispersion Then and Now: Evidence from Retail and E-tail Markets

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July, 2002

Abstract

This paper uses two datasets to examine price dispersion spanning a 24-year period. The first dataset permits us to compare levels of retail price dispersion in 1976 and 2000, while the second allows for a comparison of retail dispersion in 1976 with dispersion in e-tail markets in 2000. Our results indicate that price dispersion in 2000 for both retail and e-tail markets is comparable to that observed in 1976 retail markets. This suggests that, for the products in our sample, the Information Age has done little to reduce price dispersion in retail or e-tail markets.

JEL Numbers: D4, D8, M3, L13.

Keywords: Internet, Law of One Price, Price Dispersion.

I. INTRODUCTION

Since Nobel Laureate George Stigler's 1961 seminal article noted the ubiquity of price dispersion, it has become one of the most widely replicated findings in the economics literature. Indeed, many empirical studies have focused on documenting the presence of or identifying the causes of price dispersion in homogeneous product markets. Yet, no study has explicitly compared levels of price dispersion over a 24-year time horizon. This is the primary purpose of this paper. We compare the results from a previous study documenting price dispersion in retail markets in 1976 with a dataset of similar products collected from retailers in 2000.

While nonexistent in 1976, electronic retail markets – henceforth, e-tail markets – are serving an increasingly important role in shaping in how consumers make purchases. Given e-tail markets' growing stature, we also compare price dispersion in 1976 with the dispersion observed in the e-tail markets of 2000. To describe relative price dispersion in retail and e-tail markets over this 24-year period, we assemble two datasets that are described in greater detail in Section II: the first data is used to compare the level of retail price dispersion in 1976 with that in 2000, while the second is used to compare price dispersion at the retail level in 1976 with that in e-tail markets in 2000. Our general finding is that price dispersion in both retail markets and e-tail markets is at least as large in 2000 as it was in 1976.

Stigler's 1961 seminal article stimulated an important theoretical literature on equilibrium price dispersion. The rationales offered in this literature vary. One strand shows that equilibrium price dispersion arises when it is costly for consumers to observe individual prices (e.g., Reinganum, 1979; Burdett and Judd, 1983; and Gatti, 2000). In

these models, consumers weigh the cost of obtaining additional price information with the expected benefits.

An alternative approach assumes that some consumers can view the entire distribution of prices from a clearinghouse. The leading theoretical justifications driving the dispersion in these models stems from asymmetries among consumers, or that it is costly to list or view prices posted at the clearinghouse.[1] Identical firms, in these models, sell to two types of consumers: those who consult the clearinghouse to obtain the entire distribution of prices, and those who do not. Both approaches illustrate the importance that information plays in consumers' optimal purchasing decisions.

Price dispersion has been empirically documented in an array of seemingly homogeneous product markets. Early studies using descriptive statistics to document price dispersion for a variety of products are found in Pratt, Wise and Zeckhauser (1979) and Carlson and Pescatrice (1980) – henceforth PWZ and CP. These and other empirical studies use a variety of statistics to measure price dispersion. For instance, PWZ use the price range and find considerable dispersion in 39 retail product markets in the Boston area. They find price ranges (in 1979 dollars) between \$0.04 to more than \$400.[2] In contrast, CP use the coefficient of variation (s/μ) to measure price dispersion for 34 retail products in the downtown central business district in New Orleans and the surrounding neighborhoods. They report coefficients of variation ranging from 3.27 to 41.4 percent. While the estimates of price dispersion reported in PWZ and CP are not directly comparable and vary considerably across products, these two studies illustrate that price dispersion in the 1970s and 1980s was a pervasive phenomenon.

In the present paper, we use the coefficient of variation to summarize the levels of price dispersion observed in both e-tail and retail markets in 2000.[3] Our rationale for using this measure is two-fold. First, we wish to compare price dispersion in our dataset with that reported in earlier studies. Since the coefficient of variation is invariant to multiplicative changes in prices, like inflation, this methodology permits us to compare the dispersion in our data for 2000 with that reported for 1976 by CP. Second, the coefficient of variation can be meaningfully compared across products to test, among other things, the Stigler Hypothesis which is discussed in detail below.

The Information Age has renewed researchers' interest in price dispersion, as many in the popular press speculate that the Internet will lead to more competitive retail markets and e-tail markets. As a result, a host of academic papers have emerged documenting the levels of price dispersion observed in a wide array of e-tail markets, and a few papers that explicitly compare dispersion between retailers and e-tailers.

Empirical estimates of price dispersion among e-tailers vary widely. Brynjolfsson and Smith (2000) were among the first to document price dispersion in e-tail markets. The average price range for books in their study is about 33 percent, while that for CDs is slightly lower than 25 percent. Moreover, Brynjolfsson and Smith (2000) find that, compared to retailers, price dispersion among e-tailers selling books is larger. However, they also find that dispersion among e-tailers selling CDs is comparable to the levels observed in retail markets. Thus, their results suggest that the Internet, at least to date, has not led to lower price dispersion. For another study comparing prices in retail and e-tail markets, see the chapter by Pan, Shankar, and Ratchford (2002) in this volume.

In contrast to Brynjolfsson and Smith (2000), Ellison and Ellison (2001) provide evidence of significant price competition among e-tailers selling computer memory modules. Despite e-tailers' best obfuscation strategies, these researchers find an average price range of $4.33 among the 12 lowest-prices; a narrow price distribution for products that sell for over $100. The findings in Brynjolfsson and Smith (2000) and Ellison and Ellison (2001) are representative of the results that examine price dispersion in e-tail markets.[4]

The primary focus of the present paper is on whether price dispersion in 2000 is greater or less than it was in 1976. The results from our first dataset suggest that price dispersion in retail markets was 18 percent in 2000, compared with only 13 percent in 1976. Results from our second dataset reveal that prices are actually more dispersed in the e-tail markets of today than the retail markets of the 1970s. More specifically, we find price dispersion of 14.5 percent for e-tail markets in 2000, which is slightly higher than the 12 percent dispersion observed in retail markets during 1976. Thus, our primary finding is that price dispersion is at least as now as it was then.

The remainder of this chapter is organized as follows. Section II discusses the methodology used to collect the two datasets and provides a description of the datasets. The main results of the paper are presented in Section III, which presents a descriptive analysis of intertemporal price dispersion in retail markets and e-tail markets. Section IV discusses the results and provides additional insights about how price dispersion differs between e-tail markets and retail markets in 2000. Section V concludes.

II. METHODOLOGY AND DATA

Our datasets are motivated by CP, who analyze price dispersion for each of 34 products collected in the downtown central business district in New Orleans during the fall of 1976. To ensure that products were differentiated only by seller and location, they selected a particular brand and size of each product. We adopt the same methodology. In the following subsections, we describe the datasets used to compare 2000 levels of price dispersion with that observed by CP in 1976.

A. Retail Markets

Our retail dataset consists of 136 price observations on 20 retail products. Price data were collected by visiting several retail outlets in Bloomington, Indiana between February 1, 2000 and February 4, 2000. Limiting our data collection to a four-day span reduces the likelihood of introducing systematic variations that may occur over time.

<TABLE 1 ABOUT HERE>

Table 1 provides summary statistics for the retail products common to this study and the CP study. At first blush, it appears that the average nominal prices of these 20 items declined over the past 24 years, from $30.95 to $23.81. However, even a casual look at Table 1 reveals that this is driven almost entirely by changes in camera technology over the past 24 years. In particular, comparing these 20 products in 1976 and 2000, the two products most likely to be differentiated over time – expensive and inexpensive cameras – account for the dramatic intertemporal price decline. Excluding these two products from our data and the CP data, the average price of the items actually

increased from $2.44 in 1976 to $6.25 in 2000 – roughly a four percent annual inflation rate for these items over the 24 years.

The non-inflation adjusted prices make meaningful intertemporal price comparisons difficult. Therefore, Table 1 also shows the relative position of price in the list of products. In 1976, batteries were the least expensive product (position rank = 1) and by 2000 became the seventh most expensive product in the retail sample (position rank = 7). In contrast, expensive cameras remained the most expensive product in both samples.

The relative position of four products in Table 1 remained unchanged between 1976 and 2000. The relative position of seven products increased and the remaining nine products experienced relative position declines. Of the 16 products experiencing a relative position change, nine changed positions by only one or two positions. Interestingly, the product experiencing the most dramatic relative position decline was hair spray[5], while the relative position of male contraceptives increased the most[6]. Despite a few large changes, Table 1 illustrates that the relative position of most products in our sample changed very little over 24 years.

While the original CP sample consists of 34 products, we chose to limit our retail sample to the 20 products listed in Table 1. There are two primary reasons for this decision. First, our empirical study is broader in scope than the CP study, as we estimate relative dispersion measures for both retail markets and e-tail markets. Limiting the number of products to 20 significantly reduced the cost of acquiring data. Second, and most importantly, some products that were popular at the time of the CP study were not generally available at retail outlets in 2000. For instance, black and white televisions

were popular in the 1970s and 1980s, but by 2000 were virtually obsolete. Similarly, by the year 2000 disposable cameras and relatively inexpensive cameras with built-in flashes eliminated he need for disposable flash bulbs (and the cameras that required them).

While the composition of products between the CP study and our study differ, we made several attempts to maintain the salient features of the products in their study. In particular, their study consists of products that vary with respect to consumer search costs. They conjectured that products like batteries, thermometers, and male contraceptives would be purchased by two types of consumers: those with an urgent need and consumers who anticipate their needs. The cost of an additional search to urgent-need consumers will likely be substantial. Consumers anticipating their needs, on the other hand, might be more willing to engage in additional searches to find lower prices. CP speculated that products with these characteristics would exhibit substantial dispersion among prices. In contrast, they hypothesized that products repeatedly purchased typically without great necessity – like deodorant, hand cream, and aspirin – would lead to a relatively narrow distribution of search costs and hence, prices. Their sample also includes both relatively expensive and inexpensive products. Products from the CP study exhibiting these characteristics were also included in the retail (and e-tail) dataset assembled for this study.

The relative position in the price list for most of the retail products in our dataset change very little over time. The products included in our sample retain the essential features of the CP sample and permit us to offer some insight about how price dispersion has changed over 24 years for both products that, a priori, might be expected to exhibit

large price dispersion and for those expected not to exhibit much dispersion. A discussion of the methodology and data in e-tail markets follows in the next subsection.

B. *E-tail Markets*

We assembled a second dataset to compare price dispersion in e-tail markets in 2000 with the dispersion observed in 1976 retail markets. The e-tail dataset consists of 70 price observations for 11 products. In addition to reasons noted above, the relative immaturity of some e-tail markets forced us to analyze a smaller set of products than CP examined in their study of 1976 retail markets. Data collection occurred concurrently with retail markets – February 1, 2000 to February 4, 2000.

One advantage of acquiring price data from e-tail markets is that price quotes from several e-tailers can be obtained in a single search by using a price comparison service or shotbot. We adopted this strategy. Specifically, we utilized the services of mySimon.com to obtain the initial price quotes, and crosschecked a random sample of these prices with the e-tailers' site. In every case, the price quoted by mySimon.com corresponded with the price quoted on the e-tailers' site.

<TABLE 2 ABOUT HERE>

Summary statistics of the 11 products common to our data on 2000 e-tail markets and the CP data on 1976 retail markets are provided in Table 2. Excluding cameras, the average nominal price of these products increased from $3.63 in 1976 retail markets to $9.59 in 2000 e-tail markets.

The relative position of the price of hair spray experienced the largest decline. In 1976, hair spray was the ninth most expensive product in the sample and became the second least expensive product by 2000. Similarly, the relative position of male

contraceptives increased the most over 24 years. In 1976, male contraceptives were the second most expensive product and increased to the seventh most expensive by 2000. For 4 of the 11 products in our sample the relative position in the price list did not change. The relative price for 3 of the 11 products declined, while the remaining 4 products experienced relative position increases. In contrast to our retail dataset, the magnitudes of the relative position changes in e-tail markets were large. This, however, is in part due to the smaller sample of products. The next section discusses our results

III. RESULTS

A. Retail Markets

<TABLE 3 ABOUT HERE>

Using the coefficient of variation (s/μ), Table 3 compares relative price dispersion in retail markets in 1976 and 2000. The average coefficient of variation across all products was 18.19 percent in 2000, compared to 13.25 percent in 1976 – a 37 percent increase. In 1976, the coefficient of variation ranged from 3.27 percent to 41.38 percent. The smallest coefficient of variation in the 2000 retail sample of products was 1.63 percent, while the largest was 42.0 percent. Thus, the distribution of coefficients of variation is narrower for the 1976 retail data than the 2000 retail data.

Strikingly, the coefficient of variation for over half of the products in the 1976 sample is *less* than 10 percent. In contrast, 80 percent of the products in the 2000 retail sample exhibit a coefficient of variation that is *greater* than 10 percent. This suggests that retail price dispersion is actually more prevalent today than in was in 1976. Indeed, of the

20 products common to our data and the CP data, 12 had higher coefficients in 2000 than in 1976.

A coefficient of variation of zero indicates that prices are consistent with the "law of one price." The results in Table 3 suggest that prices in these markets were generally inconsistent with the law of one price in both 1976 and 2000. Moreover, in retail markets, price dispersion was at least as large in 2000 as it was in 1976.

B. *E-tail Markets*

<TABLE 4 ABOUT HERE>

Table 4 compares the levels of price dispersion in 2000 e-tail markets with that observed by CP in 1976 retail markets. On average, price dispersion in e-tail markets was 14.48 percent, compared to only 12.22 for retail markets in 1976. While the average coefficient of variation is larger in 2000 than 1976, unlike our retail dataset, the distribution of coefficients of variation across products is narrower in 2000. In 1976, the coefficient of variation ranges from just over 3 percent to over 41 percent and in 2000 ranges from slightly less than 6 percent up to about 28 percent. The distribution of coefficients of variation across products has shifted upward, despite its narrowing. Indeed, the coefficients of variation in the e-tail markets of 2000 are larger for all but two products compared to the products in 1976 retail markets.

Across all products, the average change in the coefficients of variation is over 80 percent from 1976 to 2000. While, on average, the magnitude of the intertemporal change is large, the relative rankings of coefficients of variation changes little. For 5 of the 11 products in this study, the coefficient of variation rank changed by 1 position or less.

Similarly, the coefficient of variation rank for 4 of the 11 products changed by only 2 or 3 positions, while the rank of the remaining 2 products changed by 5 and 8 positions.

The results we presented in Table 3 revealed that retail price dispersion was at least as large in 2000 as it was in 1976. Similarly, Table 4 indicates that despite many of the predictions that e-tail markets will lead to more competitive product markets (and less price dispersion), the evidence suggests that price dispersion is just as prevalent in the e-tail markets of 2000 as it was in the retail markets of 1976.

Based on the results in Tables 3 and 4, one might be tempted to conclude that price dispersion in 2000 e-tail markets was slightly lower compared to 2000 retail markets. This would be misguided, however, as the sets of products in these two samples are different. In the following section, we do offer insight on contemporaneous price dispersion in e-tail and retail markets, but the reader interested in a more formal analysis is referred to Pan, Shankar, and Ratchford (2002) in this volume, or Brynjolfsson and Smith (2000).

IV. ANALYSIS

This section highlights a few potential explanations for the change in intertemporal price dispersion over the 24-year time span that this study covers and some potential determinants of contemporaneous price dispersion. In addition, we offer insight about the nature of contemporaneous price dispersion in retail markets and e-tail markets.

While the potential explanations for price dispersion are voluminous, systematic differences between the Carlson and Pescatrice's (1980) study and this study *may* explain some of the intertemporal change in price dispersion. The first and most obvious is the difference in the physical locations where data were collected. These geographical

differences are likely to lead to structural differences. The downtown central business district and the immediately surrounding neighborhoods of New Orleans are more concentrated than the more suburban area of Bloomington. The demand curve retailers face for the products in these markets is likely to be very different. Moreover, given the more concentrated area where price data were collected in New Orleans, consumer search costs may be lower in New Orleans compared to Bloomington.

Another important difference between the two studies is the composition of products. For each study, we recognize that homogeneity within each product is tenuous. Indeed, it is arguable whether products like lettuce, celery, and roses are of identical quality across retailers. Within each study, however, every attempt was made to limit product differentiation by collecting identical brand and size of each product. But, between studies the composition of products is very different. CP use generic labels to describe the products in their study rendering it impossible to identically replicate the products in their study. Furthermore, even if the information about the brand and size of products in 1976 were available, it is unlikely that many of those products would exist in 2000. Using the coefficient of variation to study price dispersion makes this point mute, since it is a relative measure of price dispersion and is invariant to inflation. The important point is that a consumer who purchases, say, contact lens solution in 2000 faces at least as much price dispersion as the consumer who purchases contact lens solution in 1976.

While systematic differences between this study and CP are likely to account for some of the intertemporal differences in price dispersion, it is naïve to dismiss systematic differences as the sole source. If the intertemporal changes stem solely from a systematic

component, then we would observe similar changes in intertemporal dispersion across all products. This clearly contradicts the results in Tables 3 and 4. In particular, products like lettuce and contact lens solution in Table 3 exhibit increases in price dispersion on the order of 2 percent, while other products like roses, inexpensive cameras and auto polish experience increases of about 30 percent. Changes in price dispersion of this large a magnitude suggests a more general structural change in the market. These changes may stem from technological advancements, consumer preferences or other ways in which the retailers in these markets compete.

In his seminal 1961 article, Stigler conjectured that the expected savings to consumers who purchase an expensive product will be large, leading to a greater number of searches. As a result, contemporaneous price dispersion among expensive products will be *less*. Using Spearman's rank correlation, CP find support for Stigler's conjecture; namely, that there exists a statistically significant negative relationship between the rank of the average price and the rank of the coefficient of variation.

<TABLE 5 ABOUT HERE>

Table 5 replicates this test for the retail products common to this and the CP study and the e-tail products common to both studies. A casual comparison of columns 2 and 3 does not reveal the systematic relationship conjectured by Stigler. This observation is confirmed by Spearman's rank correlation at the bottom of Table 5 in columns 2 and 3. Specifically, we fail to reject the null hypothesis that the rank of the average price is independent of the rank of the coefficient of variation for the 2000 retail price data.

Similarly, columns 4 and 5 of Table 5 indicate that we reject the null hypothesis of independence between the average price rank and the coefficient of variation rank in 2000 e-tail markets; however, the sign of Spearman's rho is negative.

In contrast, as shown in CP, 1976 retail markets tend to show support for Stigler's hypothesis in Table 5. In this case, we reject the null hypothesis and conclude that a negative and statistically significant relationship between price and the coefficient of variation exists.

The evidence presented in Tables 3 and 4 suggest that prices in 2000 are less dispersed in e-tail markets compared to retail markets in Bloomington. As previously mentioned, this comparison may be misleading since the composition of products in these two samples is different. While the focus of this paper is to describe intertemporal price dispersion, next we offer some insight on contemporaneous price dispersion in 2000 between e-tail markets and retail markets in Bloomington. To do this we assembled a third dataset consisting of an array of products that are popular in both e-tail markets and retail markets. These products consist of popular (at the time) book titles, music titles (CDs), movie titles, cameras and other computer-related items. These data were collected according to the same methodology and at the same time as data described in sections II.A and II.B.

< TABLE 6 ABOUT HERE >

Table 6 presents the average coefficient of variation in list prices for each product category in our third dataset that contemporaneously compares price dispersion in e-tail markets and retail markets. The average coefficient of variation among list prices in e-tail markets is remarkably similar to those in retail markets; 12.87 percent in e-tail markets

and 12.83 percent in the retail markets of Bloomington. About half of the product categories in this sample – 5 of 11 product categories – have an average coefficient of variation that is greater in e-tail markets compared to retail markets.

The Spearman rank correlation tests presented in Table 5 provide conflicting evidence on whether price dispersion is negatively related to the average price of a product. The results presented in Table 6, however, seem to provide casual support for this hypothesis. The average coefficient of variation for product categories with an average price that is greater than $100 is just over 5 percent in e-tail markets and about 3.5 percent in retail markets. In contrast, when the average price is less than $100, the average coefficient of variation is about 17 percent in e-tail markets and about 18 percent in retail markets. Thus, while price dispersion is, on average, about the same magnitude in e-tail markets and retail markets, there appears to be some casual support for Stigler's hypothesis that price dispersion will be *less* in markets for relatively expensive items.

Our Table 6 results are consistent with previous studies comparing price dispersion in e-tail markets and retail markets. Like Brynjolfsson and Smith (2000), we find that book prices are generally more dispersed among e-tailers than retailers, but that for CDs dispersion in e-tail markets is approximately the same, and perhaps slightly lower. However, while differences in the level of price dispersion are observed in e-tail markets and retail markets across product categories, on average, these results suggest that price dispersion is about the same among e-tailers and retailers.

Two fundamental and competing differences are readily observable between e-tail markets and retail markets.[7] First are taxes. To encourage the development and use of e-tail markets, and Internet markets in general, the U.S. government enacted the *Internet*

Tax Freedom Act in 2001 that extends a 1998 moratorium on "new, special, and discriminatory Internet taxes." Thus, e-tail markets allow consumers to avoid paying taxes on purchases. There is a caveat. To take advantage of tax-free purchases a consumer must purchase from an e-tailer located outside of the state in which the consumer resides. In the analysis that follows, we assume that consumers purchasing from e-tailers deliberately avoid paying taxes by adhering to the caveat, but that retail purchases incur a 5 percent sales tax; the rate prevailing at the time when and in the state – Indiana – where data were collected.

The second observable difference is the cost of acquiring products. E-tailers typically charge shipping costs that consumers pay. Shipping costs often vary from e-tailer to e-tailer. However, to obtain actual shipping costs consumers often have to enter their shipping address and credit card information. Since doing this is an extremely time intensive process, we instead utilized the shipping cost schedule posted by the e-tailer that was most representative of the observable shipping costs in the sample – Amazon.com. Depending on the product category, shipping costs may exhibit economies of scale when multiple items are purchased during a single shopping episode, as illustrated in Table 7. For most of the products in the sample, shipping costs consist of a base fee and either a per-unit or per-pound fee. Thus, for certain products purchasing multiple items during a single shopping episode may lower shipping cost compared to purchasing items individually.

<TABLE 7 ABOUT HERE>

For example, Table 7 illustrates that the base shipping cost associated with purchasing a book is $3.00 and the per-unit shipping cost is $0.99. Therefore, purchasing

a single title results in a total shipping cost of $3.99, and drops to $1.99 and $1.59 when purchasing three or five books, respectively.

In contrast, consumers purchasing a product from a local retailer incur a transportation cost. To calculate the transportation cost of purchasing from a retailer, we use the government standard reimbursement rate of $0.32 per mile and the average number of miles to each retailer (from one of the author's homes, which is centrally located in Bloomington). These results are presented in Table 7. A typical consumer in Bloomington travels, on average, between 5 and 7 miles to visit a retailer in our sample. Consumers can reduce their transportation costs by purchasing multiple units from the same retailer in a single shopping episode.

Neither shipping costs nor transportation costs fully capture the exact transaction cost; however, they at least serve as a proxy. These (proxies for) transaction costs are likely to change the full cost (listed price + (proxies for) transaction costs) of acquiring products from e-tailers and retailers and may have a profound impact whether price dispersion is observed in e-tail markets and retail markets. In fact, to the extent that price dispersion is observed among e-tailers and retailers, some have argued that accounting for transaction costs will explain away dispersion. The following analysis offers some insight on this conjecture.

<TABLE 8 ABOUT HERE>

Table 8 illustrates that contemporaneous price dispersion persists among e-tailers and retailers even if (proxies for) transaction costs are taken into consideration. On average, the coefficient of variation that accounts for transaction costs in e-tail markets is about 11 percent and almost 12 percent in retail markets. Compared to the average

coefficient of variation among only list prices, including transactions costs slightly reduces the average coefficient of variation by about 1 percent.

For each product category, transaction costs lower the coefficient of variation. The magnitude of transaction cost effects on the coefficient of variation ranges from about 0 percent to about 5 percent. As transaction costs are spread over multiple-item purchases within the same shopping episode, the coefficient of variation monotonically increases. The efficiency gains from multiple-item purchases tend to increase the coefficient of variation. Thus, on average, transaction costs do not appear to materially impact price dispersion.

These results are perhaps not surprising given the methodology we adopt to account for transaction costs. Indeed, it is the differences in transaction costs that may lead to a decline in price dispersion. In particular, evidence provided by Ellison and Ellison (2000) suggest that e-tailers may engage in obfuscation strategies in attempt to conceal its price. Shipping costs (transaction costs in general) are but another variable that e-tailers can use to conceal the true purchase price of a good. Since we are not able to fully address this issue with these data, this area is left for future research.

V. CONCLUSIONS

The primary purpose of this paper is to explore the persistence of price dispersion over time. Along the way, ancillary information about price dispersion was presented. In particular, our dataset comparing contemporaneous price dispersion in e-tail markets and retail markets suggests dispersion is about the same in each of these markets: prices are dispersed by about 13 percent, although the level of price dispersion depends on the

products in the sample. Our results for books and CDs are consistent with previous research; namely, that book prices in e-tail markets tend to be more dispersion than in retail markets while CD prices are about equally dispersed among e-tailers and retailers. Moreover, transaction costs were found to reduce the amount of dispersion observed among prices, but the magnitude of these effects were on average relatively small – on the order of 1 percent in both e-tail markets and retail markets.

More importantly, we find evidence that price dispersion in 2000 is at least great as it was in 1976, regardless of whether 2000 e-tail or retail markets are used to compute measures of relative dispersion. This finding is fairly remarkable given the evolution of markets over the past 24 years. Indeed, by 2000 the Internet has changed the way in which many consumers purchase products. Many pundits predict that the Internet will lead to more informed consumers resulting in greater competition among and between e-tail markets and retail markets. This suggests that price dispersion should diminish. The data presented in this paper indicates that the Information Age has yet to reduce the levels of price dispersion. Using 1976 as a benchmark, we conclude that levels of retail price dispersion "then and now" are roughly the same.

ACKNOWLEGEMENTS

We are especially grateful to our mentor, Michael Baye, for the many helpful discussions and his guidance throughout the stages of this project. We gratefully acknowledge Indiana University's financial assistance during this project. Furthermore, we would like to thank Josh Altschuler and Scott Bartfield for their valuable assistance in collecting data.

NOTES

[1] See Salop and Stiglitz (1977), Shilony (1979), Varian (1980), Rosenthal (1980), Narasimhan (1988), Stahl (1989), Stahl (2000), Baye and Morgan (2001), and Janssen and Moraga (2001) for examples of this literature.

[2] As a percentage of the average price, these ranges were between 10 percent and 198 percent.

[3] More recently, Baye, Morgan and Scholten (2001a) offer a third measure of price dispersion – the price gap – that measures the difference between the two lowest prices in the market.

[4] See Brown and Goolsbee (2000); Clemons, Hann, and Hitt (2000); Morton, Zettlemeyer, and Risso (2000); Smith (2000); Baye, Morgan, Scholten (2001a, 2001b, 2003, 2004); Baylis and Perloff (2001); Clay, Krishnan, and Tay (2001); and Pan, Ratchford, and Shankar (2002).

[5] A potential explanation for the large relative price decline for hair spray during this period was an international agreement calling for a worldwide ban on the primary chemical used in hair spray, and many other aerosol products, chlorofluorocarbons (CFCs). In response, many aerosol manufacturers abandoned aerosols altogether opting instead for cheaper alternatives such as pump-based spray bottles or aerosols containing carbon dioxide or other hydrocarbons.

[6] The spread of AIDS and other sexually transmitted diseases is consistent with the large relative price increase experienced in male contraceptives.

[7] Unobservable differences also exist. For instance, e-tail markets offer consumers the convenience or searching and purchasing products 24-hours a day from any location with Internet access. Consumers valuing this convenience are typically willing to pay higher prices. Thus, compared to retailers, e-tailers may be able to charge relatively higher prices. In contrast, marginal selling costs to e-tailers are likely to be lower since fewer sales personnel are required. Thus, whether prices in e-tail markets will be lower compared to retail markets will depend on which of these two effects dominates. Another unobservable is the true search costs and transaction costs. The marginal cost of search is presumably less in e-tail markets compared to retail markets, but by how is unknown. Similarly, the true transaction cost is unknown since it varies with each consumer's opportunity cost of time.

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Table 1: Summary Statistics for Matched 2000 Retail and 1976 Retail Data

Products	2000 E-tail				1976 Retail			
	Number of Firms	Average Price*	Standard Deviation	Position Rank	Number of Firms	Average Price*	Standard Deviation	Position Rank
lbs. Potatoes**	4	$0.36	0.03	1	9	$0.29	0.04	2
Lettuce	4	1.02	0.21	2	9	0.37	0.07	3
Stalk Celery	4	1.22	0.09	3	8	0.37	0.07	3
Tea	9	2.38	0.26	4	10	0.44	0.11	5
Deodorant	7	2.53	0.40	5	9	1.36	0.10	10
Dozen Lemons	4	2.92	0.37	6	7	1.06	0.22	6
Batteries	7	3.08	0.34	7	8	0.16	0.41	1
Hair Spray	6	3.24	0.44	8	9	2.47	0.11	17
Antacids	7	4.06	0.59	9	7	2.44	0.14	15
Auto Polish	6	4.18	1.67	10	11	1.33	0.18	9
Film	8	4.25	0.83	11	9	1.54	0.09	12
Aspirin	7	5.43	0.72	12	9	1.30	0.08	8
Hand cream	7	5.68	0.71	13	8	1.60	0.09	13
Razor Blades	7	6.58	0.75	14	8	2.46	0.18	16
Male contraceptives	13	6.74	2.51	15	7	1.13	0.47	7
Contact lens Solution	8	7.22	0.71	16	8	2.34	0.17	14
Thermometer	6	8.87	1.79	17	9	1.44	0.30	11
Inexpensive Camera	7	10.48	3.04	18	10	34.70	2.59	19
Dozen Roses	12	42.65	15.48	19	11	21.91	1.41	18
Expensive Camera	3	353.30	5.77	20	7	540.20	17.68	20
Average (all products)	6.80	$23.81	1.84		8.65	$30.95	1.22	
Average (excluding inexpensive and expensive cameras)	6.88	$6.25	0.91		8.59	$2.44	0.32	

* Prices are not adjusted for inflation.

** 2000 price data available in 10 lbs bags only. To obtain the per-pound price, we simply divided by 10.

Table 2: Summary Statistics for Matched 2000 E-tail and 1976 Retail Data

Products	2000 E-tail				1976 Retail			
	Number of Firms	Average Price*	Standard Deviation	Position Rank	Number of Firms	Average Price*	Standard Deviation	Position Rank
Deodorant	5	$2.74	0.29	1	9	$1.36	0.10	4
Hair spray	3	2.86	0.23	2	9	2.47	0.11	9
Batteries	2	3.34	0.92	3	8	0.16	0.41	1
Antacids	4	4.44	0.42	4	7	2.44	0.14	7
Aspirin	4	5.07	0.94	5	9	1.30	0.08	3
Hand cream	4	5.85	0.73	6	8	1.60	0.09	6
Male contraceptives	13	6.58	1.44	7	7	1.13	0.47	2
Razor blades	5	6.61	0.65	8	8	2.46	0.18	8
Thermometer	4	8.74	0.50	9	9	1.44	0.30	5
Dozen roses	14	9.68	14.11	10	11	21.91	1.41	10
Expensive camera	12	385.67	25.16	11	7	540.20	17.68	11
Average (all products)	6.36	$43.78	4.13		8.36	$52.41	1.91	
Average (excluding cameras)	5.80	$9.59	2.02		8.50	$3.63	0.33	

* Prices are not adjusted for inflation.

Table 3: Retail Dispersion in 2000 Compared to Retail Dispersion in 1976

Products	2000 Retail			1976 Retail		
	Number of Firms	Coefficient of Variation (Percent)	Position Rank	Number of Firms	Coefficient of Variation (Percent)	Position Rank
Expensive Camera	3	1.63	1	7	3.27	1
Stalk Celery	4	7.51	2	8	18.35	15
lbs. Potatoes	4	8.34	3	9	14.94	13
Contact lens Solution	8	9.50	4	8	7.27	9
Tea	9	11.10	5	10	23.97	18
Batteries	7	11.50	6	8	26.21	19
Razor Blades	7	12.60	7	8	7.42	10
Dozen Lemons	4	12.80	8	7	21.08	16
Hand cream	7	12.90	9	8	5.63	4
Aspirin	7	13.50	10	9	5.84	5
Hair Spray	6	13.70	11	9	4.47	2
Antacids	7	14.60	12	7	5.55	3
Deodorant	7	16.80	13	9	7.01	8
Film	8	19.70	14	9	5.94	6
Lettuce	4	20.30	15	9	18.24	14
Thermometer	6	20.70	16	9	21.15	17
Dozen Roses	12	36.10	17	11	6.44	7
Male contraceptives	13	37.30	18	7	41.38	20
Inexpensive Camera	7	41.30	19	10	7.48	11
Auto Polish	6	42.00	20	11	13.34	12
Average (all products)	6.00	18.19		8.65	13.25	
Average (excluding inexpensive and expensive cameras)	6.83	17.83		8.44	14.12	

Table 4: E-tail Dispersion in 2000 Compared to Retail Dispersion in 1976

Products	2000 E-tail			1976 Retail		
	Number of Firms	Coefficient of Variation (Percent)	Position Rank	Number of Firms	Coefficient of Variation (Percent)	Position Rank
Thermometer	4	5.72	1	9	21.15	9
Expensive camera	12	6.53	2	7	3.27	1
Hair spray	3	8.08	3	9	4.47	2
Antacids	4	9.47	4	7	5.55	3
Razor blades	5	9.89	5	8	7.42	8
Deodorant	5	10.49	6	9	7.01	7
Hand cream	4	12.45	7	8	5.63	4
Aspirin	4	18.53	8	9	5.84	5
Male contraceptives	13	22.17	9	7	41.38	11
Batteries	2	27.52	10	8	26.21	10
Dozen roses	14	28.40	11	11	6.44	6
Average	6.36	14.48		8.36	12.22	

Table 5: Comparison of Price Ranks and Coefficient of Variation Ranks

Products	2000 Retail		2000 E-tail		1976 Retail	
	Position Rank	Coefficient of Variation Rank	Position Rank	Coefficient of Variation Rank	Position Rank	Coefficient of Variation Rank
Antacids	9	12	4	4	15	3
Aspirin	12	10	5	8	8	5
Auto Polish	10	20			9	12
Batteries	7	6	3	10	1	19
Contact lens Solution	16	4			14	9
Deodorant	5	18	1	6	10	20
Dozen Lemons	6	13			6	8
Dozen Roses	19	8	10	11	18	16
Expensive Camera	20	17	11	2	20	7
Film	11	1			12	1
Hair Spray	8	14	2	3	17	6
Hand cream	13	11	6	7	13	2
Inexpensive Camera	18	9			19	4
lbs. Potatoes*	1	19			2	11
Lettuce	2	3			3	13
Male contraceptives	15	15	8	9	7	14
Razor Blades	14	7	7	5	16	10
Stalk Celery	3	2			3	15
Tea	4	5			5	18
Thermometer	17	16	9	1	11	17
Hypotheses Tests	**2000 Retail Markets**		**2000 E-tail Markets**		**1976 Retail Markets**	
H_0: μ and CV are independent.	Fail to Reject		Fail to Reject		Reject	
H_1: μ and CV are not independent.						
Spearman's rho	0.0947		-0.0727		-0.4814	
Pr > | *t* |	0.6912		0.8317		0.0316	

Table 6: Contemporaneous Dispersion Among List Prices

Products	2000 E-tail	2000 Retail
	Average Coefficient of Variation	Average Coefficient of Variation
Books	20.27%	10.83%
Cameras	5.56%	1.33%
Compact discs	9.56%	10.69%
Computers	2.82%	2.71%
Flowers	28.40%	36.30%
Fragrance	15.98%	21.84%
Movies	11.66%	14.84%
Personal items	13.68%	16.63%
Printer	8.51%	10.11%
Scanner	3.76%	0.14%
Software	21.41%	15.72%
Average (all products)	12.87%	12.83%
Average (Average Price < $100)	17.28%	18.12%
Average (Average Price > $100)	5.16%	3.57%

Table 7: Summary Statistics for Shipping Costs and Transaction Costs, 2000

Products	Shipping Cost in E-tail Markets					Transportation Cost in Retail Markets			
	Base Shipping Cost	Per-unit Shipping Cost	Per-unit Shipping Cost 1 Item	Per-unit Shipping Cost 3 Items	Per-unit Shipping Cost 5 Items	Average Miles (round trip)	Per-unit Transportation Cost 1 Item	Per-unit Transportation Cost 3 Item	Per-unit Transportation Cost 5 Item
Book titles	$3.00	$0.99/item	$3.99	$1.99	$1.59	5	$1.60	$0.53	$0.32
Cameras	4.95	$0.50/lbs	6.20	--	--	6	1.92	0.64	0.38
Compact discs	2.00	$0.99/item	2.99	1.66	1.39	5	1.60	0.53	0.32
Computers	4.95	$0.50/lbs	22.45	--	--	6	1.92	--	--
Flowers	8.00	--	8.00	2.67	1.60	7	2.24	0.75	0.45
Fragrances	3.95	--	3.95	1.32	0.79	7	2.24	0.75	0.45
Movie titles (VHS)	3.00	$0.99/item	3.99	1.99	1.59	5	1.60	0.53	0.32
Movie titles (DVD)	2.00	$0.99/item	2.99	1.66	1.39	5	1.60	0.53	0.32
Personal care items	3.75	$0.47/item	4.22	1.72	1.22	7	2.24	0.75	0.45
Printers	4.95	$0.50/lbs	12.45	--	--	6	1.92	--	--
Scanners	4.95	$0.50/lbs	10.95	--	--	6	1.92	--	--
Software	4.00	$0.99/item	4.99	2.33	1.79	6	1.92	0.64	0.38

Table 8: Contemporaneous Price Dispersion Including Transaction Costs

Products	E-tail Markets in 2000			Retail Markets in 2000		
	Average Coefficient of Variation Including Shipping Costs			Average Coefficient of Variation Including Transportation Costs		
	1 Item	3 Item	5 Item	1 Item	3 Item	5 Item
Books	16.8%	18.3%	18.7%	10.1%	10.6%	10.7%
Cameras	5.5%			1.3%		
Compact discs	7.7%	8.5%	8.6%	9.7%	10.3%	10.5%
Computers	2.7%			2.7%		
Flowers	24.5%	27.0%	27.5%	34.6%	35.7%	35.9%
Fragrance	14.1%	15.3%	15.6%	20.3%	21.3%	21.5%
Movies	9.3%	10.3%	10.5%	13.8%	14.5%	14.6%
Personal items	7.6%	10.2%	11.0%	11.4%	14.4%	15.2%
Printer	7.8%			9.9%		
Scanner	3.5%			0.1%		
Software	19.2%	20.3%	20.6%	15.1%	15.5%	15.6%
Average (all products)	10.8%	15.7%	16.1%	11.7%	17.5%	17.7%
Average (Average Price < $100)	14.2%	15.7%	16.1%	16.4%	17.5%	17.7%
Average (Average Price > $100)	4.9%			3.5%		