INTRODUCTION

The development of an electronic marketplace on the Internet promises to reduce transaction costs, thereby increasing price competition among Internet retailers. Information technology facilitates the bringing together of buyers and sellers and the exchange of price and product information. Using high-speed inter-networks and common communication and data protocols, market participants can increase coordination or remove information asymmetries that exist in physical markets. Internet-based electronic marketplaces may lead to more efficient, friction-free markets by reducing the search cost associated with matching buyer demand and seller offerings (Bakos 1997). The resulting lower transaction costs due to the introduction of information technology will then move some market structures from hierarchies to markets (Malone et al. 1987, Wigand and Benjamin 1996).

A growing number of studies indicate that Internet retailers may not converge to the lowest price. Prior research focusing on homogeneous goods shows that a significant amount of price dispersion still exists among Internet firms (Baye et al. 2004b, Baylis and Perloff 2002, 2004d, Brynjolfsson and Smith 2000a, Chen and Hitt 2001, Clay et al. 2002, Clemons et al. 2002, Smith and Brynjolfsson 2001). One explanation for their findings is that Internet transaction costs may not be as low as first suspected. As Bakos (1997) points out, retailers may seek to avoid the unprofitable state of Bertrand competition by making their products or the transaction more differentiated. When firms differentiate themselves from their competitors they may be able to sustain higher prices for their products. Several differentiation strategies have been identified in the Internet commerce environment. They include: providing convenience, improving shopping experience, exploiting asymmetrically informed customers, building brand equity and trust (Alba et al. 1997, Chen and Hitt 2001, Lee 1998, Smith et al. 2000). These studies have focused on aggregate market effects but have not explored the link between firms' strategies and price dispersion, including the importance of web traffic. However, a growing number of research articles show that evidence of frictionless markets is mixed. Prices are not converging. In spite of the increased maturity and high degree of competition in Internet markets of homogeneous goods, there is little evidence of reduced price dispersion among these retailers affects pricing and web traffic. We present empirical results from two homogeneous goods markets, software and personal digital assistants, using price data for a basket of goods from Internet retailer websites. Based on data collected from 90 different retailers and 1,847 product prices, we find that high traffic is associated with lower market prices. However, Internet retailers can mitigate the tendency to compete on price by relying on external linkages from other websites. Furthermore, Internet retailers may use economies of scale and participation with shopbots in conjunction with charging lower prices. Surprisingly, Internet retailer use of economies of scope is associated with higher prices. This indicates that firms may be in a position to avoid price competition by selling a wider product variety.

Keywords: Internet commerce, ecommerce strategy, Internet retailing, price dispersion

Abstract

The Internet is perceived to increase market efficiency, and thus reduce price dispersion. Yet the empirical evidence to support this proposition is mixed. Internet retailers of homogeneous products may choose to actively differentiate their stores and offerings in order to avoid competing just on price. We explore how differentiation among these retailers affects pricing and web traffic. We present empirical results from two homogeneous goods markets, software and personal digital assistants, using price data for a basket of goods from Internet retailer websites. Based on data collected from 90 different retailers and 1,847 product prices, we find that high traffic is associated with lower market prices. However, Internet retailers can mitigate the tendency to compete on price by relying on external linkages from other websites. Furthermore, Internet retailers may use economies of scale and participation with shopbots in conjunction with charging lower prices. Surprisingly, Internet retailer use of economies of scope is associated with higher prices. This indicates that firms may be in a position to avoid price competition by selling a wider product variety.

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Internet commerce does not mean perfect competition

The Internet may reduce transaction costs and lead to competition among retailers that resembles Bertrand competition (Bakos 1997). One way to perceive how markets are organized is to understand the transaction costs that exist within a market. Transaction costs exist because exchanges in market transactions are subject to various sources of inefficiency including: coordination and search costs, governance, opportunism, asset specificity and incomplete contracting (Demsetz 1968, Williamson 1975, 1979). When transaction costs are eliminated, the market is said to be ‘frictionless’ or ‘friction-free’, a situation where buyers and sellers have complete information about each other, the market-clearing price and product characteristics. Elimination of transaction costs in markets for homogeneous goods may lead to Bertrand competition. Bertrand competition exists when customers are unable to differentiate products from at least more than one supplier and, therefore, will always choose the low-price supplier. As a result, suppliers focus on reducing their price to their marginal cost to attract all consumers. Otherwise, firms are unable to sustain sales if they set prices higher than their competitors’ (Tirole 1988). At these prices, suppliers do not make economic profit just as if they participated in a perfectly competitive market. Thus, Bertrand competition is pure price competition where prices converge to the marginal cost assuming that the product is homogeneous and any one firm can supply the whole market.

The Internet may reduce price dispersion among Internet retailers. This follows from the fact that the Internet market is likely to have less friction resulting from a reduction in transaction costs. Specifically, consumers may be price sensitive on the Internet because of the reduction in search costs (Bakos 1997, Baye et al. 2006). The markets where the Internet is likely to have the greatest impact are those with homogenous goods. Because homogeneous goods are, by definition, non-differentiated goods, consumers value them equally across all suppliers. The suppliers, in this case the Internet retailers, are forced to set a price equal

THEORY AND HYPOTHESIS DEVELOPMENT

In this section, we will describe the theory surrounding competition in Internet retail markets and develop a number of hypotheses. We start with a discussion about the possibility for the Internet to allow for perfect competition and explain why there is consensus that the perfect competition models are not appropriate. The second subsection discusses how alternative competition models that are not specific to the Internet may be more appropriate. In the third subsection, we extend the alternative competition models to the Internet context and use relevant citations in the literature on e-commerce business models. Finally, we develop nine hypotheses.
to marginal cost otherwise they will have no sales. Thus price dispersion – the distribution of prices across sellers – will be reduced as prices converge to marginal cost.

Therefore the existence of price dispersion on the Internet is an indication that the market is not under Bertrand competition, perhaps because of market friction. There may be several reasons why this is the case. First, in most markets when buyers and sellers do not know about each other, transaction costs may include a significant cost of gathering information. In other words, imperfect information leads to higher search costs. Prior research indicates that search costs and imperfect price information are primary causes for price dispersion (Salop 1979, Salop and Stiglitz 1977, 1982, Stahl 1989). Second, products may be significantly differentiated, perhaps through versioning or branding (Chen and Hitt 2001, Clay et al. 2002, Clemons et al. 2002). When products are differentiated, consumers have different reservation prices and are unable to perfectly substitute one product with another. Products may also be vertically differentiated through the quality of shipping services offered where a price premium may be charged to signal a high shipping quality (Dinlersoz and Li 2006).

A growing number of studies have characterized competition among Internet firms. Many studies have empirically shown that although price competition among retailers exists, there is still ample evidence that not all firms are pricing at marginal cost (Bailey 1998, Baye et al. 2004a, 2004b, 2004c, 2004d, Baylis and Perloff 2002, Brynjolfsson and Smith 2000a, Clay et al. 2001, 2002, Clemons et al. 2002). All of these studies focused on measuring how much price dispersion exists among firms in retail markets ranging from music CDs, books and consumer electronics to airline tickets. In fact, some studies have shown that price dispersion is larger on the Internet than for physical markets (Bailey 1998, Brynjolfsson and Smith 2000a). These two studies had different results with respect to prices. Bailey (1998) showed higher Internet prices in the book and music markets for 1997 while Brynjolfsson and Smith (2000a) showed lower prices for the same two markets using 1999 data. While Bailey’s findings could be explained as reflecting the nascent stage of Internet commerce development when Internet markets had not yet stabilized, both studies indicate that transaction costs still exist on the Internet. However, findings are not limited to books and music; airline tickets also appear to have a fair amount of price dispersion as well (Clemons et al. 2002). Furthermore, there are a growing number of papers that have characterized competition from the consumer perspective (Keeney 1999, Torkzadeh and Dhillon 2002). These studies give us some insight into the many heterogeneous criteria of consumers when they are comparing price and service offerings among Internet retailers. However, a gap still exists between these two streams of research. Namely, how do Internet retailers provide valuable services to the customer so that they can avoid price competition? This research helps bring these streams of research together so that we may address this question.

**Retailer positioning and price dispersion**

Price dispersion often results from market imperfections and retailer positioning. For a market to work perfectly, consumers must have full information about products and prices. Unfortunately, this is often not the case. Consumers arriving at the first price they see may not search for any additional information about competitor prices. The result of this effect, as described in the article by Varian (1980), is that retailers can charge prices higher than their competitors and still generate some sales from the consumers who do not search. One market imperfection, lack of full information resulting from a positive cost of searching, is therefore likely to increase price dispersion. The second source of price dispersion results from retailer positioning. For example, firms use differentiation to avoid a pure price competition. The price for a product is better understood by hedonic pricing (Griliches 1971, Rosen 1974) whereby differences in the product or service can sustain differences in prices and, therefore, price dispersion. The question remains of whether these two sources of price dispersion are likely to exist in electronic markets.

Although electronic markets may have fewer market imperfections than traditional markets, price dispersion may persist if Internet retailers can continue to differentiate themselves. Building on the hedonic pricing literature, if a consumer is not just buying a homogeneous good, but is in fact buying a bundle of a good plus service, then firms that offer higher quality service can charge higher prices. Variables such as the quality of the website and the quality of product delivery should both be positively correlated with the price a retailer will charge. This is the underlying argument of Baylis and Perloff (2002) and Clay et al. (2002). If retailers can differentiate themselves based upon the service they offer to customers, they can avoid the ‘law of one price’ (Baylis and Perloff 2002). An example of this is if Amazon.com can offer faster delivery times or better customer service (Clay et al. 2002).

Finally, although the market may have fewer imperfections, it is unlikely that there will be no imperfections. Internet retailers have an incentive to take advantage of the fact that markets are not efficient and, therefore, they can set a price above marginal cost to increase their profits. Therefore, retailers will likely try to increase the search costs for consumers to take advantage of the fact that consumers do not have full information so the Varian (1980) result still holds. For example, Internet retailers may not link to their competitors because they do not want consumers to easily gain access to their
competitors’ websites. If the consumer is undergoing a serial search for the best possible price they will likely stop searching when estimated benefits of searching are equivalent to the cost of searching (Diamond 1985). Even though search costs may approach zero in electronic markets, Bakos (1997) recognizes that even minimal differences in search cost may provide opportunities for differentiation. This may be especially true of some highly visible Internet retailers such as Amazon.com – customers may go to their website and buy there without searching anywhere else because they believe that Amazon.com has either the lowest prices or prices that are only marginally higher than the competition. Baye and Morgan (2002) use this argument to explain price dispersion in Internet retailing.

Extending retail competition models to the Internet

Questions about the strategic uses of market inefficiencies to gain a pricing advantage over a competitor have not yet been fully explored in the Internet space. Specifically, this paper addresses questions of how an Internet retailer uses these sources of ‘inefficiency’ in the market to charge higher prices relative to their competitors.

One reason for why price dispersion is still sizable is that Internet retailers have an incentive to keep search costs high. While visiting another website is still only a proverbial ‘click’ away, retailers may make price comparison difficult and time demanding in order to avoid pure price competition (Zettlemeyer et al. 2006). This is one reason why Virtual Vineyards chooses to sell wine with unique labels even though the contents of the wine bottle may be exactly the same as a bottle with a different label. This also underlines an Internet retailer’s strategy to create sticky websites in order to reduce the likelihood of a consumer visiting a competing website (Brynjolfsson and Smith 2000b).

However, if firms do become price takers, they can still sustain profitability by reducing costs and increasing the volume of transactions. Since most of the marginal cost of selling a good from an Internet retailer comes from the cost of the good itself, it is possible that an Internet retailer can sustain greater economies of scale than its physical counterpart. For example, a physical retailer has some short-run costs such as multiple physical locations and their affiliated sales staff that effectively increase the marginal costs of a sale. An Internet retailer does not have these additional costs in the short run. Rather, an Internet retailer must pay significant fixed costs in order to establish itself but its marginal operating costs may approach zero.

Alternatively, a firm may achieve a cost advantage by taking advantage of the economies of scale and scope of Internet retailing. There may be larger economies of scale for Internet retailers relative to physical retailers because so much of the Internet investment is a fixed cost. Therefore, the firm will see a declining average cost curve over a larger volume of transactions. Furthermore, the firm may take advantage of economies of scope, which it can realize by increasing the number of markets they participate in. Amazon.com has continually tried to take advantage of the economies of scope in Internet retailing by expanding from its initial market position in book retailing into music, electronics, gifts, and other markets.

While an Internet retailer may be led in the direction of more efficient markets where firms are price takers, the actual price a firm charges may depend upon the firm’s strategy to be profitable. An understanding of these strategies then leads to an understanding of why price dispersion exists among Internet retailers and why the Bertrand equilibrium of the ‘law of one price’ may not hold.

Hypothesis development

In this section we develop nine hypotheses that link Internet retailer strategy with prices. Five of the hypotheses are associated with direct relationships of firm strategy with higher or lower prices. The additional four hypotheses examine the relationship between firm strategy and web traffic.

Volume of sales and price per sale determines a firm’s revenue. The overall volume of sales is a function of the number of potential customers a firm attracts multiplied by the conversion rate, the percentage of potential customers who actually conduct transactions. For an Internet retailer, traffic measures the visits attracted to a website. More traffic on a firm’s website leads to a greater potential of sales volume for a given conversion rate. Conversion rate measures the number of visitors who go to a particular website within a particular period, divided into the number of people who take action on that site (purchase, register and so on). A strong conversion rate provides competitive advantages to the firm, and is determined by many aspects of a website. Price can go down and the firm can still make profit because they are able to overcome lower profit margins with a larger sales volume.

Internet retailers are often pursuing a high volume strategy in the form of encouraging visits (Business Week 1998). Because of the scalability of Internet retailers’ websites, the short-run marginal cost of hosting an additional visitor approaches zero. Internet retailers can encourage more visits without incurring large costs. Then they may use low prices to transform a greater number of visits into a larger quantity of transactions. Internet retailers may actually benefit from lowering their prices if they believe the increase in revenue from a volume of transactions is larger than the revenue they lose from reducing their profit margin on each product.
sold. By increasing the quantity of transactions, Internet retailers are also able to grow their market share and lock in loyal customers (Shapiro and Varian 1998). If an Internet retailer pursues a volume strategy by emphasizing traffic then they are likely to charge a low price. Therefore, we propose the following hypothesis:

**Hypothesis 1:** Greater web traffic is associated with lower prices.

Internet retailers who are able to attract consumers who value the products at their website more than those of their competitors are able to maintain higher prices. Because retailers do not want to set prices equal to marginal cost, a point where they make zero economic profit, they try to differentiate their offering as much as possible. To the extent that retailers can differentiate themselves from their competition they are able to develop more market power and thus charge higher prices.

Internet retailers may also increase their market power by increasing the number of links between other websites and their own. A link into the Internet retailer’s website represents a source of highly interested users that can more easily be converted into a customer. These links consist of both formal contractual agreements, such as affiliate programmes, and informal non-contractual links by third parties who aim to convey some value associated with the retailer. Recent research in economics has recognized the importance of reciprocity and cooperation in exchange settings (Fehr and Fischbacher 2002). Individuals who followed web links from a trusting site were shown to have transferred some trust from the referring site to the target site (Stewart 2003). These links result in higher brand perception and increased trustworthiness, factors that may allow the retailer to sustain higher prices. Therefore, we propose the following hypothesis:

**Hypothesis 2:** Greater number of external links is associated with higher prices.

Reducing average costs through economies of scale allows Internet retailers to lower prices while maintaining profitability. The Internet may increase economies of scale because Internet retailers may have lower variable costs associated with the operations of their business. Unlike traditional retail markets, Internet retailing probably has a greater percentage of the operating costs on the fixed cost component of the total cost function. Therefore, as a firm increases the quantity of products sold, they are more likely to benefit from economies of scale. Thus we propose the following hypothesis:

**Hypothesis 3:** Greater economies of scale are associated with lower prices.

Internet retailers who share their operational costs among more product categories result in economies of scope that allow Internet retailers to lower prices while maintaining profitability. As the number and variety of products and markets increase, the Internet retailer can distribute development costs across a variety of product categories – effectively reducing the cost of participating in any one category. This is especially true with web development because of the flexibility of computer code and the scalability of telecommunications technology (Gabel and Kenet 1994). Therefore, we propose the following hypothesis:

**Hypothesis 4:** Greater economies of scope are associated with lower prices.

As Internet retailers participate with shopbots, there is increased competitive pressure on them to lower prices. Consistent with the work of Porter (2001), a firm wishes to avoid competition since this increased rivalry may force an Internet retailer to price closer to marginal costs. Furthermore, as consumers encounter higher search costs to collect prices from retailers, the ability of competitors to charge higher prices decreases as the sales model by Varian (1980) predicts. The introduction of a shopbot in an electronic market effectively increases competition by juxtaposing an Internet retailer with their competitors on the same site. This increases the awareness of alternative retailers and lowers the price search costs to consumers. Therefore, we propose the following hypothesis:

**Hypothesis 5:** Greater shopbot participation is associated with lower prices.

As a firm raises its visibility by increasing the number of external links, it will probably generate more traffic to its website. Greater visibility will increase the awareness of firms in the consciousness of web users. Since users are likely to visit a retailer’s website directly by typing in a universal resource locator (URL), selecting a website from their bookmarks, or they may follow a link on a third-party’s website (such as a portal), firms try to increase their visibility regardless of how a user finds their website. Therefore, we propose the following hypothesis:

**Hypothesis 6:** Greater number of external links is associated with more web traffic.

As a firm increases its operations they give consumers more choices and, therefore, are likely to have more traffic on their website. Since retailers carry many products, consumers benefit from being able to compare features and prices without leaving the retailer’s website. This benefit is derived not only from carrying more products within a specific retail category but extends to other retail categories as well. For example, a retailer who sells books and music might give consumers who
are looking to buy a gift some choices across product categories. Furthermore, consumers are able to bundle products from multiple categories for a suitable purchase. For these reasons, consumers will probably value retailers with larger operations than with smaller operations because they are more likely to find a better fit with their preferences. Therefore, we propose the following hypothesis:

**Hypothesis 7:** Greater economies of scale are associated with more web traffic.

As a firm enters new markets and expands its product variety it is more likely to attract customers to its website. Whether a customer is searching the web for a particular item or is browsing different shopping sites, Internet retailers who carry a greater product variety are likely to attract more visitors to their website. Therefore, we propose the following hypothesis:

**Hypothesis 8:** Greater economies of scope are associated with more web traffic.

Finally, a firm may also increase its visibility by listing its product and price offerings on an intermediary’s website. In Internet retailing there are a number of shopbots that list the products and price offerings of many different retailers. If a consumer decides to go to one of these intermediaries first instead of going directly to a retailer, firms that list their price and product offerings are more visible to the consumers. Therefore, firms may want to participate in the listings of these intermediaries to increase their visibility to increase the traffic on their website. In light of this we propose the following hypothesis:

**Hypothesis 9:** Greater shopbot participation is associated with more web traffic.

**RESEARCH MODEL AND METHODOLOGY**

In this section we will describe the model that we use to test the nine hypotheses and explain the method used to collect and analyse the data. We employ an empirical approach using data collected from Internet retailers’ websites in addition to third-party data sources.

**Research model**

Our model begins with a theoretical and empirical examination of our two dependent variables, price and traffic, because of the endogenous nature of their relationship. Consistent with the development of Hypothesis 1, as firms see an increase in the number of visitors to their website, they are able to reduce price because they can increase the volume of sales to increase profitability. However, there is some causal ambiguity about the relationship between price and traffic because as firms charge lower prices, they are likely to see an increase in the number of visitors to their website. The interrelated nature of these two variables suggests that the model to test the hypotheses should be a system of equations that accounts for the endogeneity of this relationship. In addition to the theoretical reasons to think these two variables are endogenous, we performed a Durbin-Wu-Hausman test for endogeneity (details for this test may be found at www.stata.com/support/faqs/stat/endogeneity.html). The F-statistic for this test was 40.78, which is highly significant, confirming the fact that price and traffic are endogenous.

Therefore, we use a system of equations to account for the endogeneity of the price and traffic dependent variables. A three-stage least-squares regression allows us to estimate simultaneously the price and traffic equations that include price as an explanatory variable in the traffic estimation and traffic as an explanatory variable in the price estimation (Greene 1997). Using this approach will correct for potentially biased parameter estimations from ordinary least squares (OLS).

The additional variables in the model consist of independent variables and control variables. The independent variables follow directly from the hypothesis development. Our control variables are identified because of their relationship in affecting Internet retailer’s prices and/or web traffic. In both equations we add a dummy variable, MARKET, to control the effect of which market we are examining (software or PDAs) and a dummy variable, MULTI, to control for firms that sell in both of these markets. These two independent variables are important because we examine two different markets and some firms participate in both markets. In the traffic equation, we use a dummy variable, PUB, to control for the effect of whether or not the firm is a publicly traded company and a continuous variable, TIME, that controls for the length of time the retailer has been on the Internet. Firms that are publicly traded may have more traffic to their website because they may tap into external funding sources to promote traffic – perhaps through external advertising. Firms that have been on the Internet longer may generate more traffic to their website because they have developed a set of loyal customers or greater time for word-of-mouth to propagate on the Internet. In the price equation we use a dummy variable, ADV, to control for whether or not a firm uses banner ads on its website and a continuous variable, SHIP, to control for the shipping costs for an item. When firms have banner ads on their website, or if they collect higher shipping costs, they can use this additional revenue to offset lower profit margins resulting from lower prices.
The resulting model is shown in the following two equations:

\[
\text{TRAFFIC} = \gamma_0 + \gamma_1 \text{PRICE} + \gamma_2 \text{LINK} + \gamma_3 \text{SCALE} + \gamma_4 \text{SCOPE} \\
+ \gamma_5 \text{PART} + \gamma_6 \text{MARKET} + \gamma_7 \text{MULTI} + \gamma_8 \text{PUB} + \gamma_9 \text{TIME} \\
\text{PRICE} = \beta_0 + \beta_1 \text{TRAFFIC} + \beta_2 \text{LINK} + \beta_3 \text{SCALE} + \beta_4 \text{SCOPE} \\
+ \beta_5 \text{PART} + \beta_6 \text{MARKET} + \beta_7 \text{MULTI} + \beta_8 \text{ADV} + \beta_9 \text{SHIP}
\]

Where:

- Traffic (TRAFFIC) is the natural log of the number of visits as measured by Alexa, a third-party agent that monitors websites' visits and operations (www.alexa.com).
- Price (PRICE) is the overall average price surcharge or discount for a firm that is computed first by normalizing the price for each product and then by averaging for each firm.
- External Links (LINK) is the average of two measurements (one from Alexa and one from Altavista) of the natural logs of the number of external links to a firm's website. The two measurements do not include search engines' results and ranks. (NOTE: We also tried two other metrics to measure the LINK variable and did not find any difference in our results. The first alternative of measuring LINK involved taking the natural log of the average instead of the average of the natural logs. The second alternative took the maximum number of links as reported by Alexa and Altavista because these search engines may have overlap in the counting of their links. The search engine that reported the larger number of links may be more accurate).
- Scale of Offerings (SCALE) is the number of products within our market basket that are offered by a firm.
- Scope of Offerings (SCOPE) is a dummy variable coded 1 when the firm participates in other markets than software and PDAs and 0 otherwise.
- Participation Level (PART) is the product of: (1) the percentage of titles the firm carries within the market basket and lists on a shopbot's website; and (2) the percentage of shopbots with which the firm shares its information.
- Multiple Markets (MULTI) is a dummy variable coded 1 when the firm sells both PDAs and software, and 0 otherwise. In our data set, there are 60 firms that participate in both the PDA and software markets, which means that 30 firms only participate in one market or the other. Therefore, we use this variable to control for firms that participate in both markets.
- Market (MARKET) is a dummy variable coded 1 when the observation is taken from the PDA market, and 0 otherwise. Since we are combining two markets here, the PDA market and the software market, we control for the source of the observation. As an alternative model we randomly selected only one firm observation if the firm participated in both the PDA and software markets. We did not find any significant difference in the model results even though the number of observations shrank from 150 to 90.
- Advertising (ADV) is a dummy variable coded 1 when a firm allows banner advertisements on its website, and 0 otherwise.
- Shipping Cost (SHIP) is normalized shipping cost for sending the most popular product in our market basket to the location of the authors' institute via UPS ground service.
- Public (PUB) is a dummy variable coded 1 when a firm is publicly traded and 0 otherwise. As an ex-post analysis to our model, we went back and reassessed whether the firm was public or private to fill in some of the missing values at the time of this study. We gained 8 more observations and did not see any difference in results.
- Time Online (TIME) is the natural log of the number of days the firm’s website has been in existence.

\[\beta's\ and \gamma's\ are\ the\ coefficients\ to\ estimate.\]

Data collection

We designed our study to analyze an industry that was competitive and fragmented so we selected the retail computer industry. Although prior studies have explored books and CDs (Brynjolfsson and Smith 2000a) these markets are greatly affected by the relatively large market share of Amazon.com. By selecting a market with more fragmentation we were able to avoid a dominant firm and allow for more heterogeneity of Internet retailer strategies. Furthermore, we were able to select an industry that had many more firms in it.

We then turned to the selection of firms in this industry. We conducted an exhaustive search of shopbots, business directories, and business rating sites including Bizrate.com (www.bizrate.com) and Shopper.com (www.shopper.com) to find as many computer retailers as possible. Then we visited each of these retailers to make sure the firm actually sold at least one product on our list. By casting as wide a net as possible we found 90 computer retailers – substantially more than any prior study. Finally, we turned to the selection of products. We used a list of the 15 most popular software titles using the PC Data research site, a leading online retail research firm at the time of data collection. For PDAs, we used Shoppers.com’s list of the most popular computer items and selected from it the top 16 PDAs.

The actual data collection resulted in 1,847 observations. We collected 1,027 observations in the PDA
An examination of the descriptive statistics indicates that the data is suitable for use in our research model. Table 1 presents the means, maximum and minimum values and standard deviations for all the variables in both the PDA and the software markets. Further examination of the skewness and kurtosis measures show that they are within the acceptable range. Table 2 presents the correlation matrix of the variables. Low bivariate correlations in addition to low variance inflation factor (VIF) scores for an OLS variant of our model suggest that multicolinearity is not an issue with our model.

### RESULTS

We observed price dispersion in this data set. Consistent with Brynjolfsson and Smith (2000a) and Bailey (1998), we computed the dispersion of prices in these two markets by 13.2% (the percentage surcharge or discount per firm, the standard deviation across firms and then averaged across titles) for software and 9.5% for PDAs.

Table 3 presents the results of the three-stage least square regressions used to test the hypotheses. The first column presents the price results and the second column presents the traffic results. For each variable we present both the unstandardized coefficients and their standard errors. Estimation of the price model shown in column 1 explains a fair amount of the variance ($R^2 = .27$). Estimation of the traffic model explains an even larger portion of the variance ($R^2 = .54$). A two-stage least squares variation of our three-stage least squares model shows consistent results.

The model supports five of the nine hypotheses as summarized in Table 4. Perhaps the most interesting findings come from Hypotheses 1 and 2. Our data show that as firms increase traffic to their website, they will...

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### Table 1. Descriptive statistics

<table>
<thead>
<tr>
<th>Variables</th>
<th>Mean</th>
<th>SD</th>
<th>Min</th>
<th>Max</th>
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</thead>
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<td></td>
</tr>
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<td>2.08</td>
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<tr>
<td><strong>Independent variables</strong></td>
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<td></td>
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</tr>
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<td><strong>Control variables</strong></td>
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<td>-2.09</td>
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<td>0.85</td>
<td>3.66</td>
<td>7.69</td>
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</tbody>
</table>

*Note: N=150*

### Table 2. Correlation matrix

<table>
<thead>
<tr>
<th></th>
<th>PRICE</th>
<th>TRAFFIC</th>
<th>LINK</th>
<th>SCALE</th>
<th>SCOPE</th>
<th>PART</th>
<th>MARKET</th>
<th>MULTI</th>
<th>ADV</th>
<th>SHIP</th>
<th>PUB</th>
<th>TIME</th>
</tr>
</thead>
<tbody>
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<td>PRICE</td>
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<td></td>
<td></td>
<td></td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>TRAFFIC</td>
<td>-0.17*</td>
<td>1</td>
<td></td>
<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>LINK</td>
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<td>0.71**</td>
<td>1</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>SCALE</td>
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<td>0.03</td>
<td>0.13</td>
<td>1</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SCOPE</td>
<td>0.16</td>
<td>0.38**</td>
<td>0.40**</td>
<td>0.02</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PART</td>
<td>-0.50**</td>
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<td>0.16*</td>
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</tr>
<tr>
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<td>-0.01</td>
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<td>1</td>
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<tr>
<td>MULTI</td>
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<td>0.21**</td>
<td>0.22</td>
<td>0.54</td>
<td>0.11</td>
<td>0.12</td>
<td>-0.21*</td>
<td>1</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>ADV</td>
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<td>-0.07</td>
<td>-0.08</td>
<td>0.07</td>
<td>-0.18*</td>
<td>-0.09</td>
<td>0.05</td>
<td>-0.01</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SHIP</td>
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<td>-0.12</td>
<td>-0.29**</td>
<td>0.00</td>
<td>-0.22**</td>
<td>0.09</td>
<td>-0.02</td>
<td>-0.07</td>
<td>-0.04</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>PUB</td>
<td>0.00</td>
<td>0.44**</td>
<td>0.33**</td>
<td>0.01</td>
<td>0.46**</td>
<td>-0.09</td>
<td>0.00</td>
<td>0.01</td>
<td>0.14</td>
<td>-0.18*</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>TIME</td>
<td>-0.03</td>
<td>0.19*</td>
<td>0.42**</td>
<td>-0.09</td>
<td>0.21*</td>
<td>-0.03</td>
<td>0.05</td>
<td>-0.03</td>
<td>0.02</td>
<td>-0.05</td>
<td>0.12</td>
<td>1</td>
</tr>
</tbody>
</table>

*Notes: *p<.05  **p<.01; the shaded area represents correlation among independent variables
probably have lower prices. However, as firms increase the number of links, they will have higher prices. Both of these results are significant at the 0.05 level. Support for Hypotheses 1 and 2 means that not all traffic is the same for an Internet retailer. Increasing the number of external links helps a firm increase its price.

The model also has very strong statistical significance for Hypotheses 3 and 5. Both hypotheses are significant at the 0.01 level. This means that Internet retailers charge lower prices as they increase the number of offerings (Hypothesis 3). This also means that participation with shopbots will probably lead to lower prices (Hypothesis 5). Both are consistent with a firm strategy of selling high volume at low prices.

The last hypothesis for the price estimation, Hypothesis 4, indicates that greater economies of scope are associated with higher prices – a finding that is opposite of the hypothesized direction. Perhaps this is because any scope economies that an Internet retailer may achieve are not passed on to the consumer. Because this study analyses prices, not costs, we cannot be sure of any scope economies. Rather, we can only be sure that if there are scope economies, then the savings are not passed on. This may be explained by the value of bundling from the consumer’s perspective. Customers may value a bundle of products across multiple categories more than the value of each product individually. This gives the customer ‘one-stop shopping’ and may even help spread shipping costs over multiple items in a bundle. Retailers who offer a greater scope of products increase the likelihood of offering bundles that consumers value even if the products are not inherently complementary (Bakos and Brynjolfsson 2000). Another possible explanation may come from a well-known retailing strategy of selling ‘loss leaders’. These are products that have very competitive prices that attract consumers into the store. Once the consumers are in the store, retailers may actually lose money on the loss leaders, but make profit on the other items they are selling. Although the Internet may give customers the ability to ‘cherry pick’ the loss leaders, perhaps there is an Internet corollary to the traditional loss leader strategy. In this research, it is possible that the market basket of goods contains the products that are not loss leaders. The retailers with greater scope use their presence in other markets to sell loss leaders and drive customers to items sold at higher prices relative to their competitors.

Of the four hypotheses that examine the traffic portion of the model, only Hypothesis 6 is significant at the 0.05 level. Greater number of external links is associated with more web traffic. This finding is not surprising, given the importance of external links in increasing visibility and traffic to an Internet retailer.

### Table 3. Regression results for traffic and price

<table>
<thead>
<tr>
<th>Variables</th>
<th>Price</th>
<th>Traffic</th>
</tr>
</thead>
<tbody>
<tr>
<td>Constant</td>
<td>1.81** (.45)</td>
<td>6.23** (1.14)</td>
</tr>
<tr>
<td>Endogenous variables</td>
<td></td>
<td></td>
</tr>
<tr>
<td>TRAFFIC</td>
<td>-0.21* (.09)</td>
<td></td>
</tr>
<tr>
<td>PRICE</td>
<td></td>
<td>0.78 (3.09)</td>
</tr>
<tr>
<td>Independent variables</td>
<td></td>
<td></td>
</tr>
<tr>
<td>LINK</td>
<td>0.15* (.07)</td>
<td>0.64** (.07)</td>
</tr>
<tr>
<td>SCALE</td>
<td>-0.05** (.02)</td>
<td>-0.05 (0.12)</td>
</tr>
<tr>
<td>SCOPE</td>
<td>0.35* (.15)</td>
<td>-0.07 (0.98)</td>
</tr>
<tr>
<td>PART</td>
<td>-0.33** (.07)</td>
<td>0.78 (1.26)</td>
</tr>
<tr>
<td>Control variables</td>
<td></td>
<td></td>
</tr>
<tr>
<td>MARKET</td>
<td>-0.11 (0.11)</td>
<td>-0.01 (0.43)</td>
</tr>
<tr>
<td>MULTI</td>
<td>0.16 (0.17)</td>
<td>0.63 (0.41)</td>
</tr>
<tr>
<td>ADV</td>
<td>-0.13 (0.17)</td>
<td></td>
</tr>
<tr>
<td>SHIP</td>
<td>0.06 (0.06)</td>
<td></td>
</tr>
<tr>
<td>PUB</td>
<td>1.43 (0.77)</td>
<td></td>
</tr>
<tr>
<td>TIME</td>
<td>-0.41 (0.47)</td>
<td></td>
</tr>
</tbody>
</table>

**Model summary**

| N  | 150   | 150   |
| R² | 0.27  | 0.54  |

*Notes: *p<.05  **p<.01*

### Table 4. Hypothesis test results

<table>
<thead>
<tr>
<th>Hypotheses</th>
<th>Expected sign</th>
<th>Empirical sign</th>
<th>Conclusion</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Greater web traffic is associated with lower prices</td>
<td>–</td>
<td>–*</td>
<td>Supported</td>
</tr>
<tr>
<td>2. Greater number of external links is associated with higher prices</td>
<td>+</td>
<td>+*</td>
<td>Supported</td>
</tr>
<tr>
<td>3. Greater economies of scale are associated with lower prices</td>
<td>–</td>
<td>–**</td>
<td>Supported</td>
</tr>
<tr>
<td>4. Greater economies of scope are associated with lower prices</td>
<td>–</td>
<td>+*</td>
<td>Not supported</td>
</tr>
<tr>
<td>5. Greater shopbot participation is associated with lower prices</td>
<td>–</td>
<td>–**</td>
<td>Supported</td>
</tr>
<tr>
<td>6. Greater number of external links is associated with more web traffic</td>
<td>+</td>
<td>+**</td>
<td>Supported</td>
</tr>
<tr>
<td>7. Greater economies of scale are associated with more web traffic</td>
<td>+</td>
<td>–</td>
<td>Not supported</td>
</tr>
<tr>
<td>8. Greater economies of scope are associated with more web traffic</td>
<td>+</td>
<td>–</td>
<td>Not supported</td>
</tr>
<tr>
<td>9. Greater shopbot participation is associated with more web traffic</td>
<td>+</td>
<td>+</td>
<td>Not supported</td>
</tr>
</tbody>
</table>

*Notes: *p<.05  **p<.01*
Internet retailer’s website. However, it is surprising that economies of scale, economies of scope, and participation with shopbots did not yield any statistically-significant results.

DISCUSSION

This research on price dispersion among Internet retailers indicates that information technology has an impact on the markets and, hence, how firms may use information technology to develop competitive strategies within these markets. Our strong empirical findings about firm differentiation explain almost 30% of the observed price dispersion in the software and PDA markets. Although information technology may increase the level of price competition among Internet retailers, they can use new techniques to differentiate themselves from their competitors. Two such strategies, increasing the scope of the firm and increasing the number of links into a firm’s website, help firms increase their prices relative to their competitors.

Another finding from this study relates to the emergence of a number of differentiated strategies for online retailers. The model presented here contributes to the Internet economics literature by linking strategy posture and price. Rather than compete just on price, retailers have developed a number of strategies to counter the powerful pull of Bertrand competition.

The strong finding regarding the role of external links as a predictor of both traffic and price has implications for online strategy formulation. We confirm that individual alliances and linkages between external sites and the focal firm contribute a new conduit of information and guides visitors to the focal site and thus generates greater market power for the retailer. In addition, this finding supports the nascent strategy perspective regarding alliances as a form of social capital that a firm can leverage to improve performance (Koka and Prescott 2000, Powell et al. 1996, Shan et al. 1994).

Similarly, the study contributes to the literature by empirically linking online traffic to price charged by the retailer. Traffic is a key driver of electronic commerce success (Hanson 1999) and our findings indicate that traffic allows retailers to pursue a volume strategy. Online retailers that enjoyed high traffic were the ones who chose to price their goods most economically. Conversely, other retailers with lower traffic volume chose to pursue a higher price position. This conscious strategic positioning may be a key reason why price dispersion remains high on the Internet and seems unlikely to drop. Some retailers resist the trend of Bertrand pure price competition and strategically decide to compete in other dimensions. Whether retailers can sustain this avoid-competing-on-price strategy successfully in the long run remains an open research question.

Contrary to our stated hypotheses of a negative relationship between the scope of the firm and price, we found a positive one. One explanation is that firms that sell products in multiple markets are actually providing a bundling service to consumers. This may increase the value of the retailer in the consumer’s eye and effectively reduce the price sensitivity of the consumer. It could also provide a price discrimination strategy by the retailer by bundling (Bakos and Brynjolfsson 2000, Varian 1985). A second explanation is that firms that operate in multiple markets may seek higher prices through a multimarket contacts and coordination (Bernheim and Whinston 1990, Evans and Kessides 1994, Gimeno and Woo 1999). In this case, firms that participate in more than one market have greater opportunity to signal and coordinate with firms so they can raise prices.

CONCLUSIONS

This study investigated price dispersion among Internet retailers selling homogeneous goods. We collected price data on two consumer goods markets, software and personal digital assistants, as well as data on the retailers and their website characteristics. We developed useful metrics for the study of prices and retailer strategies. Our findings indicate that price dispersion continues to exist on the Internet even for homogeneous consumer goods and even under conditions of intense competition. The research model provides an initial assessment of why price competition is not as severe as expected and identifies economic factors that may explain such a state of affairs. Our findings are consistent across the two goods markets.

References

Incentives to Participate in Electronic Marketplaces’, *Journal of Marketing* 61(3): 38–53.


