The Propensity to Advertise Prices Online: Evidence from Shopper.com[*]

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Abstract

Price dispersion in online markets is well documented. However, an open empirical question is how frequently do firms advertise prices in online markets? The current paper addresses this question by examining the frequency with which firms advertise price information at one of the leading Internet price comparison sites, Shopper.com. The results are consistent with many of the predictions in Baye-Morgan (2001). Specifically, the empirical results suggest that firms advertise price information about 69 percent of the time. In addition, firms are 13 percent less likely to advertise price information in markets with few consumers. While these results are supportive of the Baye-Morgan model, I find little empirical evidence supporting the prediction that firms' propensity to advertise prices varies inversely with market structure. I speculate that this result is mainly driven by asymmetries in firms' advertising propensity. This suggests that Baye-Morgan has provided a very good starting point, but that additional theoretical models are needed to see if relaxing the assumption that firms' propensity to advertise is symmetric leads to equilibrium outcomes more consistent with the data.

1   Introduction

Online markets have revolutionized the way consumers gather price information.

With a few "clicks" of a mouse, a consumer can obtain a list of advertised prices

for a homogenous product. The benefits are that consumers can avoid incurring a search cost for acquiring each advertised price and can easily purchase from the low-price firm. Some argue that these benefits are not mutually shared by firms. According to this view, better informed consumers will lead to greater price competition among firms until profits are competed away and the "law of one price" prevails. To date, there is little empirical evidence supporting this view.

Instead, price dispersion is frequently observed in online markets. This paper is, to the best of my knowledge, the first to empirically examine firms' advertising behavior in online markets controlled by a "gatekeeper". Baye and Morgan (2001) show that when it is costly for firms to advertise prices at a "gatekeeper's" site, firms randomly advertise prices and the level of advertised prices. When firms randomly select the frequency of advertising price information in a costly environment and randomize prices, the resultant equilibrium is dispersed prices. The main force driving equilibrium price dispersion in this environment is that if all firms advertised prices at the gatekeeper's site everyday, Bertrand competition ensues resulting in zero profits. However, when *all* firms randomly advertise prices with the same probability, as in the Baye-Morgan model, firms can earn positive expected profits.

This paper builds on the previous empirical literature exploring the nature of price dispersion at an Internet price comparison site owned by the "gatekeeper", Shopper.com. Contrary to many pundits' predictions, the idealized environment at Internet price comparison sites – like Shopper.com – has not led to the "law of one

price." For instance, Baye, Morgan, and Scholten (2002) find no empirical evidence that the level of price dispersion is declining over their eight-month sample. Instead, price dispersion remains remarkably stable at about 10 percent. Moreover, they find evidence that the nature of price dispersion at Shopper.com is consistent with the class of theoretical "clearinghouse" models, including Baye-Morgan (2001), predicting equilibrium price dispersion.[1] While the underlying assumptions leading to equilibrium price dispersion in these clearinghouse models are different, there is one common prediction: the level of price dispersion varies with the number of competitors. The empirical evidence in Baye, Morgan and Scholten (2002) is consistent with this prediction: average price dispersion is high in markets with few firms and low in markets with many firms. Their results suggest that further research is needed to discriminate among the various clearinghouse models.

Baye-Morgan is the only clearinghouse model where firms endogenously make decisions to advertise prices, so their model provides an interesting dimension and starting point for attempting to distinguish between clearinghouse models. To examine firms' advertising strategies and the implications of the Baye-Morgan model, I assemble a dataset consisting of over 500,000 observations from the price comparison site, Shopper.com. Figure 1 provides a snapshot of the Shopper.com environment. A consumer wanting to purchase a Samsung SyncMaster 151s flat panel monitor on 01/15/03 would observe 23 firms advertising 17 distinct prices. Notice that these

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[1]Other's that have modelled clearinghouse type environments include Shilony (1979); Varian (1980); Rosenthal (1980); and Narasimhan (1988).

firms are advertising prices for a homogenous product: products with an identical manufacturer part number. With a "click of the mouse" advertised prices for this flat panel monitor can be sorted from lowest to highest, as in Figure 1. The lowest price for this monitor is $289.50, while the highest price is $499 – a difference of over 72 percent of the lowest advertised price. While the price dispersion predicted by the Baye-Morgan model has been confirmed by a host of empirical studies, several additional testable implications remain.[2]

This paper examines three additional testable implications of the Baye-Morgan model. I first test the prediction that firms' propensities to advertise prices are less than unity – that is, firms only intermittently advertise prices over any given period. For example, would a consumer visiting the Shopper.com site to obtain price information for the flat panel monitor in Figure 1 always observe the same set of 23 firms advertising prices, or would consumers observe a random subset of these (and possibly other) firms? Econometric results, based on a probit specification, suggest that firms do not always actively advertise price information. For a given product, firms' propensity to advertise prices is about 69 percent. That is, firms advertise prices about seven of 10 days. This provides some support for one prediction, that $\alpha < 1$, in Baye-Morgan. In addition, the econometric evidence tends to support a second

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[2]For studies on price dispersion in retail Internet markets see Baye, Morgan and Scholten (2001, 2002, 2003); Bryjolfsson and Smith (2001); Ellison and Ellison (2001); Ratchford, Pan and Shankar (2002); Baylis and Perloff (2002); Brown and Goolsbee (2002); Clay, Krishana, Wolff (2001); and Clemons, Hann and Hitt (2000).

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prediction of the Baye-Morgan model: that firms advertise prices less frequently in markets where the fraction of consumers using the gatekeeper's site is relatively small.

While the data provide some support for the Baye-Morgan model, the econometric analysis suggests that the model does not capture some features of firms' decisions to advertise prices at Shopper.com. Specifically, Baye-Morgan predict that firms advertise prices more frequently in markets with few competitors than in markets with many competitors. The econometric evidence presented in the current paper, however, reveals no systematic relationship between firms' advertising propensities and the number of competitors. This finding is robust to a variety of controls for potential heterogeneities in the data not modeled in Baye-Morgan. For instance, since Baye-Morgan assume that firms sell a single homogenous product it is important to control for cross-section variation among products that may influence the frequency with which firms advertise price information. This is done by introducing product-specific fixed effects. Also, Baye-Morgan model an environment where firms' costs are symmetric and that no firm has a reputation or brand advantage. These potential variations in the data are controlled for by introducing variables capturing observable differences between firms, as well as unobservable heterogeneities by introducing firm-specific fixed effects. Finally, to capture any dynamic changes and the potential "weekend" effect observed in other retail markets I introduce date-specific fixed effects.[3]

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[3] See Warner and Barsky (1995).

The main implication of my findings is that, even controlling for potential hetero-geneities among firms selling identical products, firms' advertising propensities are quite asymmetric. Although the average firm advertises its price on about seven out of every 10 days, some firms rarely advertise while others advertise on almost everyday. These differences cannot be explained by observable differences in firms' characteristics.[4] This suggests that a potentially useful line of future research is to relax the symmetry assumption of the Baye-Morgan model to see if this leads to predictions more consistent with the data.

The remainder of the paper is organized as follows. Section 2 provides a descrip-tion of the Baye-Morgan model and derives some testable implications about firms' advertising behavior. Section 3 begins by providing an overview of the Shopper.com environment and the data. Then, continues by providing a preliminary look at some of the testable implications of Baye-Morgan. Section 4 describes the econometric model. Section 5 concludes.

2   Theoretical Foundations and Predictions

The value of Internet price comparison sites depends critically on the frequency with which firms advertise price information. Baye-Morgan consider a homogeneous prod-uct environment where identical firms choose whether or not to advertise their prices at an Internet price comparison site owned by a "gatekeeper". They show that the

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[4]The results are robust to controlling for unobservable firm heterogeity as well.

gatekeeper has an incentive to induce the profit-maximizing level of price dispersion by setting firms' advertising fees sufficiently high to induce less than full-firm participation; thus, preserving the value of information provided to consumers visiting the gatekeeper's site. Suppose to the contrary that the gatekeeper does not charge advertising fees. Then, firms will always have an incentive to advertise price information at the gatekeeper's site and price dispersion would disappear resulting in marginal cost pricing. Rational consumers would, therefore, have no incentive to visit the gatekeeper's site to find the best deal. Intuitively, profit-maximization by the gatekeeper leads to "noisy" advertising and pricing behavior by firms. By randomizing both the timing and level of advertised prices , firms can prevent their rivals from systematically undercutting their price.

It is well documented that the price dispersion predicted by the Baye-Morgan model is consistent with the pricing of many products on the Internet. To date, however, no studies have examined whether firms vary their advertising decisions in the manner predicted by their model. More specifically, in a symmetric equilibrium to the Baye-Morgan model, each firm i advertises with propensity

$$\alpha = f\left(n, \pi, \phi, \mu\right),$$

where n is the number of potential competitors, π is monopoly profit, ϕ is the advertising fee paid by firms to list a price at the price comparison site, and μ is the fraction of consumers utilizing the Internet price comparison site.

In this paper I seek to estimate the determinants of firms' advertising propensities

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by testing three previously unexamined predictions of the Baye-Morgan model. The first prediction is that a profit-maximizing firm will never advertise its price on every date ($\alpha < 1$). Expressed differently, there is a positive probability that, say, a firm advertising a low price today will not advertise any price tomorrow. This prediction stems from the fact that the only symmetric equilibrium entails randomized advertising strategies. A firm could otherwise profitably deviate if a rival systematically advertised its price on particular dates. A key implication is that price dispersion will not be driven by, for example, one firm persistently advertising the lowest price and other firms persistently advertising higher prices.

A second prediction is that a firm's propensity to advertise systematically varies with the number of consumers utilizing the gatekeeper's site. Less participation by consumers (μ) in the market for information decreases firms' advertising propensity. The intuition is straightforward: as the fraction of consumers, μ, acquiring price information from a price comparison site decreases, the expected profits from being the low-price firm decreases. This results in lower advertising propensities by firms.

Finally, as shown in Figure 2, the Baye-Morgan model predicts that a firm's advertising propensity decreases as competition for consumers becomes more intense.[5] When firms' expect to compete against a few rivals, the propensity to advertise is high and declines as the number of potential rivals increases. This result stems from the fact that as the number of potential rivals increases, it becomes less likely that

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[5]This relationship relies on $\phi < \frac{n-1}{n}\pi\mu$ and $\mu > 0$.

any given firm will be charge the lowest price. Firms, therefore, find it less attractive to pay to advertise their prices on the gatekeeper's site.

To summarize, the Baye-Morgan model of Internet price competition predicts that (1) firms rationally choose to randomize the timing of their advertising decisions, (2) advertising propensities are lower in online markets with relatively few consumers, and (3) the propensity for firms to advertise prices is inversely related to the number of relevant competitors.

3   Data

To test these predictions, I collected data from the price comparison site, Shopper.com. I first describe the institutional features of the Shopper.com site. Then, I provide summary statistics and a preliminary look at some of the predictions in the Baye-Morgan model.

3.1   Overview of Shopper.com

Testing the predictions of the Baye-Morgan model requires data from an environment where firms sell identical products, pay a fixed fee to advertise prices on the Internet site, and can frequently change their advertising and pricing decisions. The price comparison site, Shopper.com, has all of the features. Moreover, according to Nielsen/Netratings, Shopper.com's parent company – Cnet Networks – consistently ranked in the top most visited web property over the past several years.

As shown in Figure 1, Shopper.com site provides consumers with a list of firms' prices for a homogeneous product identified by the manufacturer part number. That consumers can sort prices from lowest to highest is an important feature of the Shopper.com site. It allows consumers to identify the low-price firm at virtually no cost. This is an important institutional feature of the Shoppper.com site since in the Baye-Morgan model all consumers purchase at the lowest price. The site also lists shipping costs, so consumers can easily determine which firm offers the best "delivered" price.[6]

Before discussing some of the additional information provided by the site, it is important to note that Shopper.com is a price information database. This means that, in contrast to the "shopbot" technology where computer programs are written to "grab" price information directly from Internet retailers' websites, firms must pay to advertise price information at Shopper.com.[7] Not only is this consistent with the environment modelled by Baye-Morgan, but it also provides a financial incentive for firms to advertise accurate price information.[8] Firms paying to advertise price

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[6]Elsewhere, Baye, Morgan, and Scholten (2003) demonstrate that there is comparatively little variation in shipping costs and that the levels of dispersion for list prices are comparable to dispersion for list prices plus shipping costs.

[7]To advertise prices at Shopper.com, firms must pay a one-time set-up fee of $1,000 to establish an account. Furthermore, firms also pay $100 per month. This fixed monthly fee entitles firms to receive up to 250 "qualified leads," where a qualified lead is defined as a consumer "click through" to a firm's site from the Shopper.com site to obtain information about purchasing a product from a particular firm. Firms acquiring more than 250 qualified leads must pay an additional $0.50 per lead up to 50,000 leads. For leads beyond 50,000, firms must pay $0.60 per lead.

[8]Baye, Morgan, and Scholten (2003) have documented that there is little evidence of bait-and-

information at Shopper.com update their decision to advertise price information for products and the level of prices twice each day.[9], [10] Thus, Shopper.com is a costly environment where firms simultaneously make advertising and pricing decisions, as in Baye-Morgan.

While all firms are selling physically identical products – consistent with the Baye-Morgan model – there are some institutional features of the Shopper.com site that may allow firms to differentiate themselves from their rivals. Since Baye-Morgan is a homogeneous product and symmetric firm model, it will be important to control for these potential heterogeneities in the econometric analysis. Firms attempting to attract brand loyal consumers, for instance, can pay an additional fee to display its company logo next to its advertised price. One advantage of displaying a banner-logo is that these firms are placed at the top of the opening price list making it potentially easier for loyal consumers to locate their preferred firm.[11] While firms paying to display a banner logo to potentially capitalize on brand recognition and

switch or other obfuscating tactics Shopper.com.This is not true of other price comparison sites. For example, see Ellison and Ellison (2001).

[9]These daily updates occur at 2 a.m. and 3 p.m. daily. Firms update new advertising and pricing decisions by uploading a self-generated file to the Shopper.com server.

[10]Casual evidence suggests that the average firm's decision horizon for updating advertising price information and the level of prices is about one week; although there is considerable variation among firms.

[11]Narasimhan (1988) shows that price dispersion consistutes an equilibrium even in the presence of brand-loyal consumers. Alternatively, consumers viewing products at Shopper.com as homogeneous can simply sort prices to identify the low-price firm.

position in the price list may have an incentive to advertise price information more frequently, this affect will be partially offset by the number of other firms paying to display banner logos. Figure 3 suggests there is no systematic relationship between firms' advertising propensities and the percentage of firms displaying banner logos. Nonetheless, controlling for the presence of banner logos will be important in the econometric specification.

At the time these data were collected, Shopper.com also had a program that may allow firms to signal high reputation. The Cnet Certified Merchant program allowed firms adhering to a set of seven criteria to display the Cnet Certified Merchant emblem.[12] Firms voluntarily meeting these seven criterion might be able to distinguish themselves from non-certified rivals. Thus, firms could potentially build a positive reputation by investing in providing service levels necessary to maintain its Cnet Certification status, which may influence firms' propensity to advertise price information. Indeed, Figure 4 illustrates a positive association between the percentage of certified merchants and advertising propensity. This suggests that failing to control for certified merchant status may lead to a misspecified econometric model.

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[12] These criterion include 1) providing a secure transaction environment for consumer transactions; 2) providing Shopper.com with a consumer service policy and posting the policy on its website for consumers; 3) honoring advertised prices; 4) providing Shopper.com with up-to-date price, shipping cost and product availability information; 5) processing orders promptly and provide shipping confirmation within one business day; 6) provide professional packaging; and 7) respond to consumer telephone calls and emails within two business days.

Shopper.com also provides consumers with information about the popularity of 1000 products listed at its site. The rankings are based on the number of unique consumer requests for product information. On any given date, Shopper.com's most popular product receives a rating of "1", while the least popular product receives a ranking of "1,000". Thus, products with relatively low popularity rankings have a greater fraction of consumers requesting information than products with high popularity rankings. Since product popularity rankings may change daily, as discussed below, these rankings may be used as a proxy for the number of consumers utilizing the site to purchase each product. That is, as a proxy for μ in the Baye-Morgan model.

3.2 Data Collection and Summary Statistics

As indicated in Figure 1, Shopper.com provides information on firms' advertised prices for a product on a given day. There is no historical information about the timing of firms' advertising decisions or of firms' advertised prices. To examine advertising behavior, therefore, requires a dataset consisting of the information displayed in Figure 1 over time. To assemble such a dataset, daily data on 317 products at Shopper.com were downloaded using a "spider" written in the PERL programming for the two-month period from October 1, 2001 to November 30, 2001. There are 527,586 advertising observations over this period, where an observation in this dataset consists of whether a firm advertised a price on a particular date or not. If price information

were advertised by a firm, then the remaining information displayed in Figure 1 were coded into the dataset. As mentioned, this decision environment corresponds to that in the Baye-Morgan model.

Table 1 provides summary statistics for each of the 317 products in the sample. Column 2 shows considerable variation in the total number of observations for each product. While there were only 122 observations for the Nexian GPS, several products had over 4,000 observations. The differences in the number of observations reflects the fact that product characteristics are likely to play an important role in determining how many competitors choose to advertise prices.

Since firms in Baye-Morgan randomly choose to advertise prices, firms cannot observe the number of rivals it may face on any given day prior to making its advertising and pricing decisions. A firm must, therefore, base these decisions on the number of potential rivals it may face on any given date.[13] Column 3 of Table 1 captures the notion of potential rivals by reporting the number of firms that actively advertised prices over the two-month period. The idea is that on each date in the sample, a rival could have faced any combination of these firms. The smallest number of active firms across all products was 2 firms, while the largest was 71 firms. On average, there were about 27 active firms that advertised price information for a given product sometime over the two-month period.

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[13]The Baye-Morgan model describes behavior in markets where multiple firms advertise prices. Therefore, observations were dropped for products where only a single firm advertised prices over the two-month period.

Collectively, the firms at Shopper.com placed 334,809 price advertisements for these 317 products. The number of price advertisements ranged from a low of 70 over the two-month period, to a high of 3,064. There were, on average, about 1,053 price advertisements for a given product in the sample. Since, on average, there were 1659 total observation for each product, this suggests that firms are only advertising prices only 60 percent of the time. While this observation is consistent with a prediction of the Baye-Morgan model, $\alpha < 1$, it fails to control for many factors.

Compared to some of the existing studies on the Internet, the average price of products at Shopper.com is relatively expensive. While the sample of prices at Shopper.com range from an average of $15.50 to an average of $4392.43, the average price across all products is about $475. This is important for several reasons. A high average price suggests that consumers will be less likely to purchase several products in a single shopping episode to take advantage of economies of scale in shipping cost. Thus, expensive products reduce the likelihood that economies in scale for shipping costs, in contrast to advertising behavior, is responsible to price dispersion.[14]

The average number of price advertisements by firms for each product is listed in Column 7 of Table 1. While, on average, the average firm placed about 17 price advertisements for a randomly selected product, there is considerable variation from product to product. Over the two-month sample, the product with the smallest average number of advertisements by firms was 1.15 per day. In contrast, firms placed

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[14]Baye, Morgan and Scholten (2003) find little evidence that shipping costs explain price dispersion observed in online markets.

an average of about 50 price advertisements for the Nikon Coolpix 995. Again, this suggests that controlling for product effects on advertising behavior will be important.

Column 8 of Table 1 also shows the average propensity to advertise price information. Across all products, the average firm advertises prices 60 percent of the time, or six out of 10 days. This empirical fact is consistent with Baye-Morgan: firms, generally, do not advertise prices everyday. Again, across all products, there is considerable variation in the average firm's propensity to advertise prices. Firms advertising prices in the market for Canon Canoscan 656U had the lowest propensity to advertise: on average firms advertised prices on 26 percent of the dates. In contrast, firms advertising prices for Nikon Super Coolscan advertised price on each date.

The average product popularity rank for each product is shown in the last column of Table 1. Across all products, the average popularity rank is about 339 out of the 1000. Baye-Morgan predict that less popular products (proxied by low product ranks) will have firms that display price advertisements less frequently.

3.3   Preliminary Analysis

Before turning to a formal test of some of the predictions of the Baye-Morgan model, it is useful to provide a preliminary look at the data to see how it stacks up to the predictions of the Baye-Morgan model.

As shown in Table 1, averaged across all products, firms, and dates, firms advertise price information about 60 percent of the time and do not advertise prices 40 percent

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of the time. While this is consistent with Baye-Morgan, an important issue is whether firms are randomly advertising price information or the 60 percent propensity is due to a relatively high turnover rate among firms at Internet price comparison sites. Recall that the Baye-Morgan model predicts that the advertising propensity stems from firms randomly varying the timing (and level) of their advertised prices.

To examine this issue, Table 2 provides a at look individual firms' advertising decisions for two products at three dates. At first blush, it might appear that Table 2 supports the notion that the 60 percent propensity to advertise is driven by a high turnover rate among firms. Indeed, neither 2Buystore.com nor 42nd Street Photo advertise prices October 1 for the Palm m500, but then advertise prices on the two remaining dates. Similarly, TheNerds.net advertises price information on November 1, but neither of the other two dates. These observations are, however, consistent with the random advertising strategies in Baye-Morgan. While 42nd Street Photo did not advertise price information for the Palm m500 on October 1, it did advertise a price for a Sony memory stick. Thus, 42nd Street Photo could have advertised a price for both products, if it so chose. This suggests that 42nd Street Photo endogenously decided not to advertise a price for the Palm m500 on October 1. Similarly, TheNerds.net actively advertised prices for the Sony memory stick on each date, but advertised a price only on November 1 for the Palm m500. These observations suggest that firms 60 percent advertising propensity is driven by firms choosing to randomly advertise prices for some product and not others.

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Figure 5 illustrates the average propensity for firms to advertise prices over time. The average propensity to advertise is about 60 percent on October 1 and increases to over 65 percent on the last date in the sample. This upward trend is consistent with the idea that more consumers are using Internet price comparison sites to obtain price information. As the fraction of consumers using Shopper.com increases, Baye-Morgan would predict an increase in the propensity for firms to advertise price information. It will be important to control for this trend in advertising propensity in the econometric model.

The pattern in Table 2 suggests that average propensity to advertise price information is consistent with Baye-Morgan: the average propensity to advertise prices is 60 percent. Moreover, the upward trend in advertising propensity would also be consistent with Baye-Morgan if the fraction of consumers using Shopper.com were increasing. Thus, at least on the surface, the data is somewhat consistent with the predictions by Baye-Morgan. However, as Figure 6 illustrates, the raw data do not exhibit the inverse relation between advertising propensity and number of firms predicted by the Baye-Morgan model. In fact, not controlling for many potentially important factors, there appears to be no systematic relationship between the number of firms and advertising propensity.

In short, the relationship shown in Figure 6 does not control for a number of other factors that might contribute to firms' propensities to advertise prices. As shown in Figure 5, the average propensity to advertise generally increased during the sample.

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This would be consistent with a growing number of consumers utilizing the site over time (since α is increasing in μ). Likewise, the data suggests that products in which there are a greater fraction of certified merchants tend to be associated with higher advertising propensities (see Figure 4). It is therefore necessary to control for all of these factors before rejecting the hypothesis that advertising propensity is inversely related to the number of firms. The next section lays out the econometric model for doing this.

4   Econometric Model

Recall that firms' advertising propensity, α, in the Baye-Morgan model is related to the number of potential competitors (n), the number of consumers using the price comparison site (μ), and advertising fees (ϕ). Since a firm's decisions' to advertise a price is binary, the probability that a firm i advertises a price for product k at date t can be estimated by

$$\alpha_{ikt} = \Pr\left(A_{ikt} = 1 \,|\mathbf{x}\boldsymbol{\beta}\right) = \Phi\left(\mathbf{x}\beta\right)$$

where $\Phi\left(\cdot\right)$ is the standard normal distribution and $\mathbf{x}$ is a matrix of dummy variables controlling for market structure, product popularity, and observable heterogeneities among firms. The market structure dummy variable divides the sample is into "few-firm markets" and "many-firm markets," where few-firm markets consistent of markets where between two and four firms advertise prices sometime over the entire

sample. Many-firm markets have more than four firms advertising prices.

Shopper.com's product popularity rankings serve as a proxy for the fraction of consumers using the site for price information. In less popular product markets (those with a high Shopper.com ranking), the propensity to advertise should be small relative to more popular products. To capture this idea, I introduce a dummy variable for products ranked between 901 and 1000 ("Less popular products"). The marginal effect on this dummy variable will indicate the change in firms' propensities to advertise in less popular product markets compared to more popular product markets, holding other variables at their means.

To examine the robustness of the relationship between firms' advertising propensity and the number of firms and number of consumers using the Shopper.com site, I model the error component in several ways. The most general error component specification in the probit regression model takes the following form:

$$e = \eta_k + \xi_t + \mu_i + \epsilon_{ikt},$$

where η_k is a product-specific effect controlling for unobservable differences in firms' advertising propensity across products, ξ_t is a time-specific effect controlling for unobservable changes in firms' advertising propensity over time, μ_i is a firm-specific effect controlling for unobservable heterogeneity in firms' costs or advertising fees, and ϵ_{ikt} is white noise. The results of the more formal analysis are presented in the next section.

5 Results

The results, summarized in Table 1 and Figure 5, suggest that on average firms advertise prices only about 60 percent of the time ($\alpha = .60$) and that firms' advertising propensity, α, is lower in less less popular product markets. These results are consistent with the prediction in the Baye-Morgan model. While not controlling for several factors that may influence firms' advertising propensity, the preliminary analysis provided in Figure 6 suggests that advertising propensity (α) was independent of the total number of competitors. Thus, the preliminary analysis provides mixed support for Baye-Morgan. A more rigorous analysis follows to formally test the predictions of the Baye-Morgan model using the models described in the previous section.

Table 3 reports the results of four probit regression models. In each model, the binary dependent variable, indicating whether firm i advertised a price for product k at date t, is regressed on a dummy variable for few-firm markets and dummy variable for less popular products. To illustrate robustness of the results, different error component structures and observable difference among firms are introduced. Table 3 reports the marginal effect of changes in the dummy variable from 0 to 1, holding other variables at their mean values. Robust standard errors are reported in parentheses.

Model 1 is the simplest specification. Using a dummy variable to indicate "few-firm markets" (that is, market with between two and four firms), pooling across all products, dates and firms reveals no significant relationship between advertising

propensity and markets with few competitors. Similarly, the dummy variable "less popular products" (products with Shopper.com product ranks between 901 and 1000) reveals an insignificant relationship with advertising propensity. Model 1, however, illustrates that the average firm advertises prices about 64 percent of the dates. In view of Table 1 and Figure 5, the results of Model 1 are perhaps not surprising. Table 1 illustrates that the average propensity to advertise prices varies dramatically across products. Moreover, the average propensity to advertise prices is increasing over time. These observations suggest that product and date effects will be important controls.

Model 2 uses the same specification as Model 1, but adds product-specific and date-specific effects. The results of Model 2 suggest that the propensity to advertise in few-firm markets is 20 percent higher than in markets with many firms. In addition, advertising propensity is 10 percent less in markets with fewer consumers. These relationships are consistent with Baye-Morgan, but fail to account for observable differences among firms.

To control for observable difference among firms, Model 3 includes dummy variables for firms with certified merchant status and banner logos. Including these variables in the probit regressions changes the sign of the few-firm market dummy variable. The results of Model 3 suggest that the propensity to advertise is 13 percent lower in few-firm market compared to many firm markets. This result is inconsistent with Baye-Morgan. However, the effect of the less-popular product dummy variable

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is robust: firms advertise price information about 11 percent less frequent in markets with fewer consumers compared to markets with many consumers.

Finally, Model 4 includes firm-specific effects and illustrates the robustness of the less-popular product effect. In markets were relatively few consumers obtain price information, the propensity to advertise is about 13 percent less than in more popular product markets. However, firms are about 11 percent less likely to advertise price information in products markets with between two and four firms.

The econometric results provide mixed support for the Baye-Morgan model. Specifically, that firms' propensity to advertise price information is about 69 percent and firms are about 13 percent less likely to advertise prices in less popular product markets are consistent with Baye-Morgan. In contrast to Baye-Morgan, however, firms advertise about 11 percent less frequently in markets with few competitors.

One assumption of the Baye-Morgan model is that firms' propensity to advertise is symmetric. The results of Model 4 can be used to test the hypothesis of the significance of firm effect on advertising propensity. The hypothesis that firm-specific effects are jointly zero is rejected, suggesting that asymmetries in advertising behavior may explain the lack of relationship between advertising propensity and market structure.

6   Conclusions

The results provide some support for the Baye-Morgan model. First, consistent with Baye-Morgan, the average propensity with which a firm advertise is about 69 percent. That means that over a 90-day period firms will advertise prices on only 63 of these days. Second, there is evidence that the propensity to advertise is lower in product markets where few consumers obtain price information.

However, a key implication – that firms advertise more in markets with few competitors, is not consistent with Baye-Morgan. Even after controlling for heterogeneities in firms' costs and levels of service, I find that firms' propensity to advertise in markets with few competitors is 11 percent lower than in markets with many competitors.

My analysis suggests that, while useful in some respects, the Baye-Morgan model is incomplete as it fails to explain observed asymmetries. While Baye-Morgan analyze a symmetric equilibrium the data suggest a wide range of behaviors even after controlling for observed heterogeneities and systematic difference that may occur over time and across products. In an asymmetric Baye-Morgan model, it is not at all clear that one would obtain an inverse relation between α and n. Additional theoretical work attempting to explain the asymmetries observed in these data would be a useful avenue for future research to see if relaxing this assumption leads to predictions more consistent with the empirical evidence presented in this paper.

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Figure 1: Snapshot of the Shopper.com Site

Samsung SyncMaster 151S

List price: $449.00

Lowest price: $289.50

Manufacturer: **Samsung Electronics Co. Ltd.**

Part number: 151S

> Add to my shopping list

> View my shopping list

> Read review

Description: The SyncMaster 151S is the ideal display for all business and professional applications. Its new slim design refined with Samsung's digital technology allows the product to fit all working environments. Three different color... **More**

Sort by:	Merchant	CNET Certified	Price	State	Est. shipping	In Stock	Order by phone	Shop
PCNation.com Company info | Buy now		★★★	$289.50 as of 1/15/2003	IL	FREE	Yes	1-800...	▸ Buy info
PC Connection *Best Service & Selection* Company info | Buy now		★★★	$299.95 as of 1/13/2003	NH	14.08	No	1-888...	▸ Buy info
Newegg.com Company info | Buy now		★★★	$305.00 as of 1/13/2003	CA	0.01	Yes	1-800...	▸ Buy info
TheNerds.net Company info | Buy now		★★★	$311.23 as of 1/15/2003	FL	9.95	40	1-888...	▸ Buy info
buy.com *The Internet Superstore* Company info | Buy now		★★★	$316.99 as of 1/15/2003	CA	Free	Yes	1-800...	▸ Buy info
Gateway *Trusted since 1985* Company info | Buy now		★★★	$324.95 as of 1/14/2003	CA	Free Shipping	Yes	1-888...	▸ Buy info
Next Generation Company info | Buy now		★★★	$325.08 as of 1/15/2003	NY	Free Ground	in stock	1-800...	▸ Buy info
eSpecialz.com Company info | Buy now		★★★	$325.08 as of 1/14/2003	OH	4.20 - 10.00	in stock	N/A	▸ Buy info
Mwave.com Company info | Buy now		★★★	$326.04 as of 1/14/2003	CA	15 -- 50	Yes	1-800...	▸ Buy info
COMPUTERS 4sure.com *An Office Depot Company* Company info | Buy now		★★★	$329.99 as of 1/15/2003	CT	14.80	Yes	1-888...	▸ Buy info
Tech Depot Company info | Buy now		★★★	$329.99 as of 1/15/2003	CT	14.80	Yes	1-800...	▸ Buy info
Dell Home & Home Office Company info | Buy now		★★★	$336.95 as of 1/14/2003	TX	see site	see site	N/A	▸ Buy info
Dell Small Business Company info | Buy now		★★★	$336.95 as of 1/13/2003	TX	see site	see site	N/A	▸ Buy info
Etronics.com Company info | Buy now		★★★	$338.85 as of 1/15/2003	NY	19.00	Yes	1-800...	▸ Buy info
PC Mall Company info | Buy now		★★★	$339.00 as of 1/15/2003	CA	FREE!	Yes	N/A	▸ Buy info
MacMall Company info | Buy now		★★★	$339.00 as of 1/15/2003	CA	$20.08-$23.17	Yes	1-800...	▸ Buy info
ClubMac Company info | Buy now		★★★	$339.00 as of 1/15/2003	CA	$20.08-$23.17	Yes	1-800...	▸ Buy info
Digitally Unique Company info | Buy now		★★★	$347.99 as of 1/14/2003	CO	see site	Yes	1-800...	▸ Buy info
eCOST.com Company info | Buy now		★★★	$348.99 as of 1/15/2003	CA	FREE(Hdl $0-12)	Yes	N/A	▸ Buy info
CDW www.cdw.com *Right Technology. Right Away.* Company info | Buy now		★★★	$359.37 as of 1/15/2003	IL	Starting at $5.95	Yes	1-888...	▸ Buy info
Super Warehouse Company info | Buy now		★★★	$385.99 as of 1/12/2003	CA	21.68	Yes	1-800...	▸ Buy info
Beach Camera Company info | Buy now		★★★	$499.00 as of 1/15/2003	NJ	19.95	Yes	1-800...	▸ Buy info
BuyDig.com Company info | Buy now		★★★	$499.00 Brand New/Fast Service as of 1/15/2003	NJ	29.95	No	1-800...	▸ Buy info

> **Resort by** ▸ **Price** ▸ **Sponsor**

> **Shopping feedback: share your shopping experiences**

Figure 2: Theoretical Relationship in Baye-Morgan between the Propensity to Advertise Price Information (α) and the Number of Competitors (n)
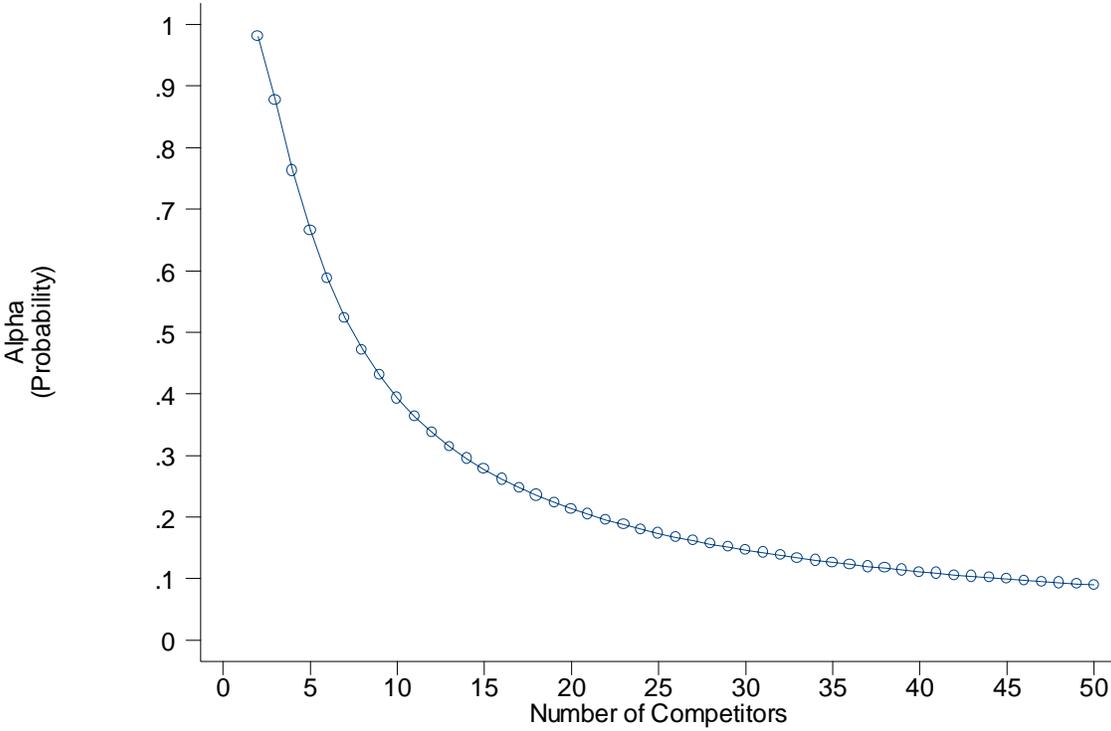
Figure 3: Scatter Plot of Advertising Propensities and the Portion of Banner Logo Merchants
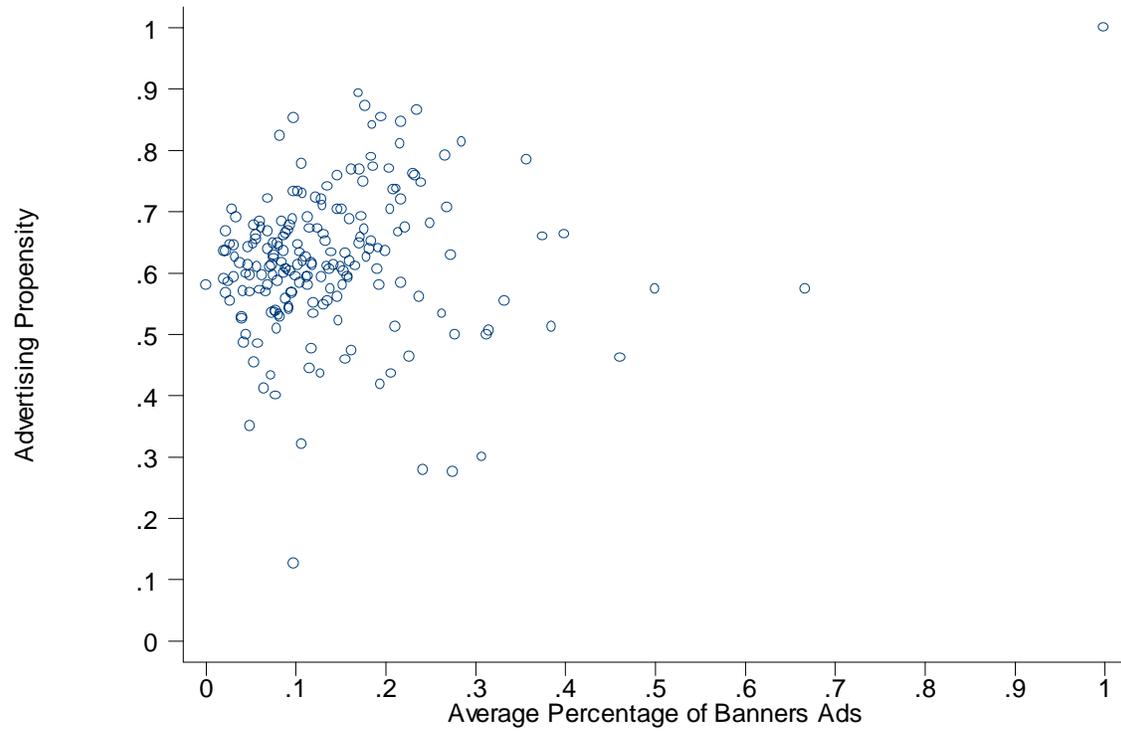
Figure 4: Scatter Plot of Advertising Propensities and the Portion of Cnet Certified Merchants
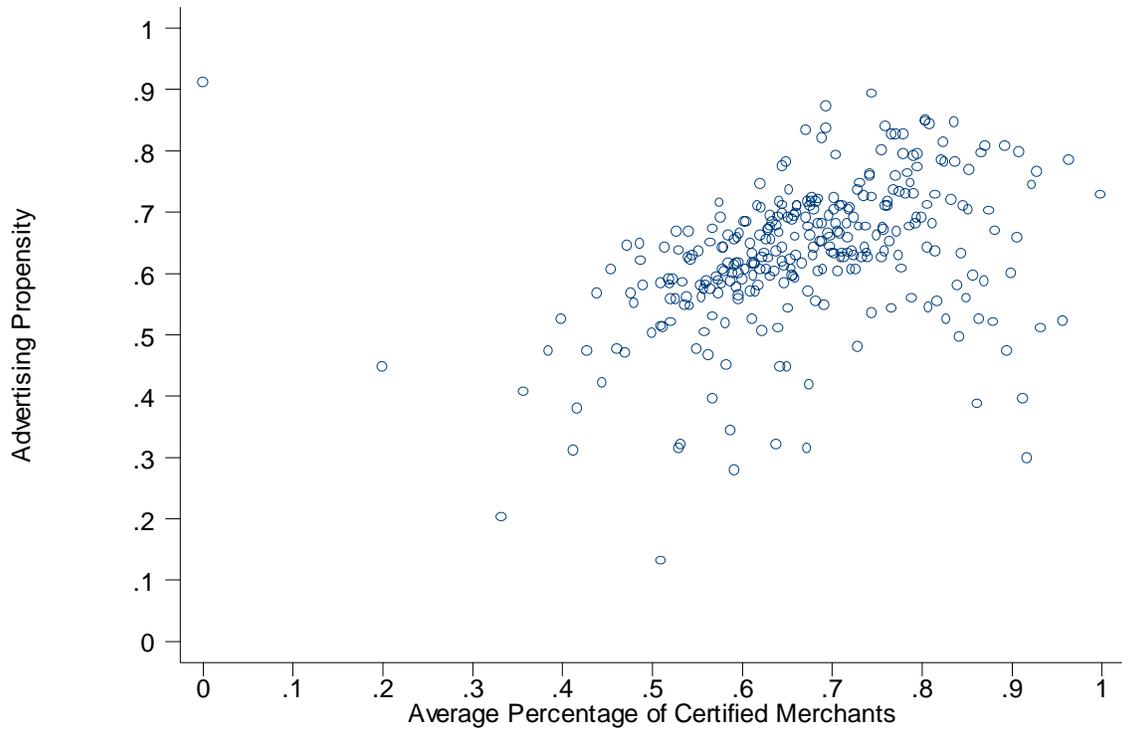
Figure 5: Average Propensity to Advertise Over Time
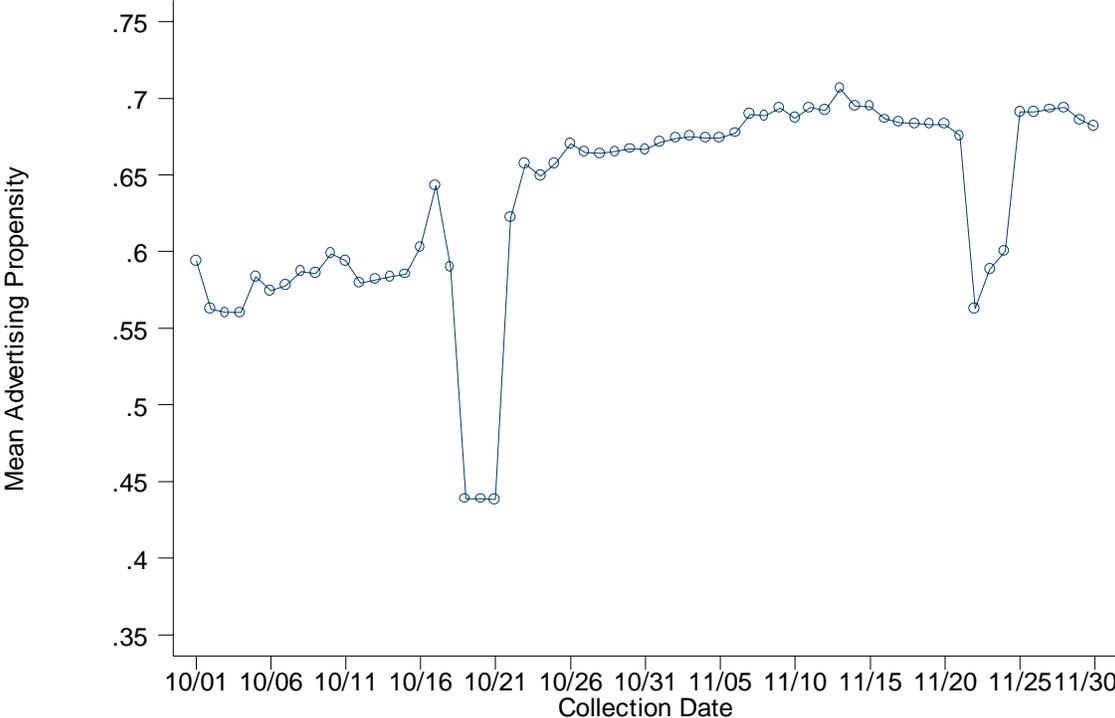
Figure 6: Mean Advertising Propensity by Number of Competitors

Table 1: Summary Statistics

Product	(2) Total Number of Obs.	(3) Total Number of Firms	(4) Total Number of Ads	(5) Average Price	(6) Average Range	(7) Average Number of Ads	(8) Ad	(9) Banner	(10) CM	(11) Product Rank
100.0GB EIDE ULTRA/ATA 100	2,135	35	1,253	$257.95	$75.08	20.54	0.59	0.11	0.68	167.30
11MBPS WIRELESS BROADBAND ROUTER 4PORT	1,647	27	1,105	203.10	79.10	18.11	0.67	0.18	0.74	470.38
128MB 16X64 SDRAM PC133 8NS	793	13	657	15.50	11.18	10.77	0.83	0.08	0.74	227.66
128MB 3.3V SMARTMEDIA CARD .	1,789	29	740	79.85	67.25	12.33	0.41	0.22	0.83	553.65
128MB MEMORY STICK .	1,220	20	617	109.21	30.89	10.11	0.51	0.19	0.74	366.26
128MB MEMORY STICK FOR SONY DIGITAL CAM	2,623	42	1,421	135.10	113.80	23.30	0.54	0.09	0.70	54.97
1394 FIREWIRE PCI DIGITAL VIDEO DV EDIT	732	12	490	33.52	11.32	8.03	0.67	0.24	0.75	494.25
256MB 32X64 SDRAM PC133 8NS	671	11	448	26.48	14.77	7.34	0.67	0.04	0.69	100.61
256MB 800MHZ PC800 RAMBUS 184-PIN RIMM	366	6	185	191.31	276.61	3.03	0.51	0.16	0.67	488.11
256MB PC 100 SDRAM	671	11	489	26.14	11.87	8.02	0.73	0.18	0.73	41.00
3Com Home Wireless Router	1,525	25	1,076	239.29	146.84	17.64	0.71	0.16	0.75	440.31
512MB PC 133 ECC REG SDRAM	549	9	322	69.49	17.31	5.28	0.59	0.11	0.74	217.75
60GB EIDE ULTRA-ATA/100 DESKSTAR 7200RP	2,074	34	1,350	161.03	64.07	22.13	0.65	0.08	0.60	229.30
64MB MMC CARD .	854	14	440	68.40	29.46	7.21	0.52	0.21	0.70	779.05
64MB SMART MEDIA 3.3V CARD	1,403	22	896	43.92	68.21	14.69	0.64	0.21	0.69	592.28
64MB SMARTMEDIA- BLISTER PACK .	1,586	25	930	57.18	57.97	15.25	0.59	0.19	0.71	263.49
820 SLOT1 UPTO 512MB RDRAM ATX 5PCI AGP	122	2	70	72.09	10.27	1.15	0.57	0.50	1.00	337.39
AMD ATHLON-1.4GHZ 384K CACHE SOCKA PGA4	1,281	21	559	148.62	45.19	9.16	0.44	0.19	0.86	29.75
ASUSTek AGP-V 7700 GeForce2	671	11	228	124.41	11.95	3.74	0.34	0.18	0.73	445.90
ATI Radeon VE (32MB DDR, dual display,	1,891	31	1,154	85.59	42.39	18.92	0.61	0.16	0.72	458.93
ATX 250W POWER SUPPLY VERSION 2.01 COMP	976	16	691	27.85	14.60	11.33	0.71	0.24	0.81	864.34
ATX MBD AMD VIA 133A SA 5PCI 266/200FSB	1,037	17	689	133.14	65.71	11.30	0.66	0.18	0.72	442.56
ATi All-in-Wonder Radeon 32MB	2,074	34	1,315	179.56	80.23	21.56	0.63	0.11	0.68	59.59
ATi TV Wonder USB TV Tuner	1,586	26	1,064	86.29	24.66	17.44	0.67	0.19	0.75	647.49
Abit KT7A (Socket A)	1,159	19	779	106.37	46.49	12.77	0.67	0.05	0.56	79.84
Abit KT7A-RAID (Socket A)	1,159	19	719	125.90	40.94	11.79	0.62	0.05	0.56	232.36
Acrobat 5.0: Win9X/ME/NT4/2K	1,952	32	1,383	222.72	52.79	22.67	0.71	0.21	0.74	49.70
Adobe Photoshop 6.0 UPG Win9X/ME/2K/NT4	1,952	32	1,397	189.52	40.06	22.90	0.72	0.18	0.73	568.49
Adobe Photoshop Elements 1.0: Win, MacO	1,464	24	1,169	88.38	20.66	19.16	0.80	0.25	0.81	671.33
Apple AirPort 1.2	793	13	500	293.85	23.96	8.20	0.63	0.15	0.88	711.98
Apple Cinema Display (22-inch flat pane	1,037	17	689	2444.78	157.78	11.30	0.66	0.06	0.74	415.44
Apple Power Mac G4 (867 MHz, Silver)	1,098	18	815	2390.17	310.10	13.36	0.74	0.11	0.80	81.77
Apple PowerBook G4 (PowerPC G4 500MHz,	1,342	22	762	2520.39	893.62	12.49	0.57	0.14	0.70	100.31

Table 1: Summary Statistics (cont.)

	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
	Total	Total	Total			Average				
	Number of	Number	Number	Average	Average	Number of				Product
Product	Obs.	of Firms	of Ads	Price*	Range*	Ads*	Ad**	Banner**	CM**	Rank**
Apple Powerbook G4/400 Titanium	1,220	20	810	1916.07	450.22	13.28	0.66	0.15	0.72	134.08
Apple Studio Display	305	5	175	485.26	20.16	2.87	0.57	0.00	0.80	416.02
Apple iBook Special Edition (Graphite)	510	8	266	1367.23	711.00	4.43	0.52	0.00	0.64	677.26
Archos Jukebox 6000	1,647	27	1,014	249.01	107.42	16.62	0.62	0.22	0.71	571.41
Archos Jukebox Recorder	1,586	26	810	323.00	64.59	13.28	0.51	0.19	0.80	158.92
Asus A7M266 (Socket A)	915	15	639	163.49	31.62	10.48	0.70	0.00	0.57	52.95
Asus A7V (Socket A)	366	6	226	117.36	23.22	3.70	0.62	0.00	0.60	184.00
Asus P4T (Pentium 4 Motherboard)	1,098	18	488	176.66	27.60	8.00	0.44	0.06	0.62	21.11
Athlon Thunderbird - 1000 MHz (200MHz/2	671	11	415	89.18	14.63	6.80	0.62	0.00	0.73	569.77
Athlon Thunderbird - 1200 MHz (200MHz/2	671	11	469	101.87	16.98	7.69	0.70	0.00	0.73	468.03
Athlon Thunderbird - 1333 MHz (266MHz/2	488	8	351	109.41	13.49	5.75	0.72	0.00	0.63	253.98
AverMedia AVerTV USB (TV Tuner, Video C	915	15	655	65.99	16.37	10.74	0.72	0.26	0.78	581.46
BACK UPS OFFICE 500 6OUTLET 120V STANDB	1,098	18	372	95.89	27.09	6.10	0.34	0.17	0.78	548.23
Brother HL-1440	1,647	27	1,150	289.30	76.94	18.85	0.70	0.18	0.70	291.59
Canon BJC-85	2,074	33	1,387	278.33	110.24	22.74	0.67	0.19	0.70	725.16
Canon BJC-S450	2,013	32	1,248	93.10	39.04	20.46	0.62	0.15	0.76	700.62
Canon CanoScan D660U	1,525	24	1,016	123.97	42.45	16.66	0.67	0.24	0.73	534.51
Canon CanoScan N650U	793	13	238	88.18	49.21	3.90	0.30	0.31	0.67	320.08
Canon CanoScan N656U	1,037	16	271	95.71	45.81	4.44	0.26	0.18	0.69	411.03
Canon EOS D30	2,013	33	1,397	2545.13	1065.56	22.90	0.69	0.06	0.58	82.28
Canon GL1	2,257	37	1,426	1989.23	846.30	23.38	0.63	0.04	0.52	551.21
Canon PowerShot A10	2,684	43	1,821	273.71	121.85	29.85	0.68	0.09	0.69	251.59
Canon PowerShot A20	3,599	58	2,495	358.80	112.63	40.90	0.69	0.10	0.65	18.26
Canon PowerShot G1	3,172	51	2,064	675.47	255.12	33.84	0.65	0.11	0.54	73.77
Canon PowerShot G2	2,745	44	1,830	793.55	207.01	30.00	0.67	0.07	0.62	2.75
Canon PowerShot Pro90 IS	2,562	41	1,762	896.70	476.31	28.89	0.69	0.05	0.57	347.69
Canon PowerShot S10	1,342	22	741	428.79	230.55	12.15	0.55	0.14	0.71	232.79
Canon PowerShot S100	1,281	21	811	417.33	154.16	13.30	0.63	0.14	0.70	201.51
Canon PowerShot S20	1,525	24	837	507.74	299.43	13.72	0.55	0.08	0.53	196.80
Canon PowerShot S300	3,111	50	2,166	467.10	208.79	35.51	0.70	0.08	0.57	29.28
Canon S600	2,379	38	1,475	145.60	56.95	24.18	0.62	0.13	0.76	63.82
Canon S800	1,647	26	905	283.35	49.75	14.84	0.55	0.18	0.73	228.26
Casio Cassiopeia EM-500 (Blue)	915	14	467	383.08	99.59	7.66	0.51	0.00	0.93	330.38
ColdFusion Server 5.0 Pro: Win9X/ME/NT/	1,220	20	641	1179.58	209.20	10.51	0.53	0.20	0.73	481.77

Table 1: Summary Statistics (cont.)

Product	(2) Total Number of Obs.	(3) Total Number of Firms	(4) Total Number of Ads	(5) Average Price*	(6) Average Range*	(7) Average Number of Ads*	(8) Ad**	(9) Banner**	(10) CM**	(11) Product Rank**
Compaq Presario 1700US (Pentium III, 85	2,013	32	1,020	1667.89	364.83	16.72	0.51	0.12	0.74	478.51
Compaq iPaq PA-1	1,342	22	667	224.46	89.74	10.93	0.50	0.18	0.85	354.18
Corel Draw Graphics Suite 10: Win98/ME/	1,403	23	1,005	462.84	140.75	16.48	0.72	0.13	0.75	767.20
Creative Labs Nomad II (64 MB, Silver)	1,525	25	1,161	174.09	120.73	19.03	0.76	0.20	0.70	74.16
Creative Labs Nomad Jukebox	1,891	31	1,434	249.94	119.69	23.51	0.76	0.16	0.81	192.23
Creative Labs Sound Blaster Audigy Plat	1,647	27	745	181.20	21.26	12.21	0.45	0.15	0.75	399.81
D-Link DI-704 Cable/DSL Internet Gatewa	1,647	27	1,149	97.41	26.78	18.84	0.70	0.20	0.74	221.10
D-Link DMP-CD100	1,220	20	834	93.04	43.12	13.67	0.68	0.19	0.78	110.39
D-Link DWL-1000AP Wireless Access Point	1,647	27	1,159	185.49	64.58	19.00	0.70	0.18	0.79	384.41
D-Link iShare Cable/DSL Router and Fire	1,098	18	508	88.77	14.99	8.33	0.46	0.26	0.74	725.11
DAZZLE HOLLYWOOD: 1394 DV ANALOG VIDEO	1,769	29	1,244	261.21	76.49	20.39	0.70	0.10	0.78	418.21
DESKTOP THEATER DTT3500 DIGITAL 5 SATEL	1,647	27	1,075	258.00	95.29	17.62	0.65	0.18	0.72	347.61
DI-713P WIRELESS 802.11B ROUTER BROADBA	1,464	24	1,103	201.50	94.56	18.08	0.75	0.20	0.77	336.87
Dazzle Digital Video Creator II	671	11	216	270.35	31.35	3.54	0.32	0.00	0.82	636.69
Dreamweaver 4.0: Win9X/ME/NT4 SP5/2K	1,647	27	1,166	270.26	59.83	19.11	0.71	0.22	0.73	262.31
EROUTER SERVER 4PORT 10/100 SWITCH DSL/	976	16	786	95.34	24.82	12.89	0.81	0.18	0.69	424.52
Easy CD Creator Deluxe 4.0: Win9X/NT4	183	3	105	80.28	4.85	1.72	0.57	0.67	0.67	458.97
Epson Perfection 1250	2,623	42	1,599	143.63	33.73	26.21	0.61	0.14	0.67	491.41
Epson Perfection 1640SU	976	16	284	238.34	256.68	4.66	0.29	0.25	0.59	653.66
Epson Perfection 640U	305	5	185	143.76	12.49	3.03	0.61	0.40	0.55	436.62
Epson PhotoPC 3100Z	2,989	48	1,807	571.61	306.86	29.62	0.60	0.10	0.59	159.10
Epson Stylus C80	2,379	38	1,449	173.73	39.43	23.75	0.61	0.15	0.72	408.54
Epson Stylus Color 880	1,342	22	644	94.39	98.65	10.56	0.48	0.18	0.73	189.16
Epson Stylus Color 980	1,830	30	827	195.41	221.11	13.56	0.45	0.20	0.73	229.34
Epson Stylus Photo 1280	2,806	45	1,592	473.25	108.29	26.10	0.57	0.15	0.71	74.54
Epson Stylus Photo 2000P	3,172	51	2,115	810.71	225.31	34.67	0.67	0.11	0.67	203.62
Epson Stylus Photo 780	1,525	25	645	102.40	99.13	10.57	0.42	0.16	0.81	152.59
Epson Stylus Photo 785EPX	2,684	43	1,748	204.30	74.77	28.66	0.65	0.17	0.72	191.18
Epson Stylus Photo 870	793	13	271	155.72	73.36	4.44	0.34	0.08	0.58	366.64
Epson Stylus Photo 890	2,928	47	2,001	285.48	67.68	32.80	0.68	0.14	0.74	500.61
FIC AD11 Socket-A AMD 760 DDR ATX	1,098	18	655	111.82	43.68	10.74	0.60	0.16	0.72	505.98
Flash 5.0: Win9X/2K/NT4	1,647	27	1,243	359.15	78.49	20.38	0.75	0.22	0.73	641.00
Fujifilm FinePix 1400 Zoom	1,284	21	450	229.65	76.43	7.39	0.35	0.05	0.40	522.56
Fujifilm FinePix 2300	1,769	29	1,062	229.20	85.32	17.41	0.60	0.17	0.62	572.10

Table 1: Summary Statistics (cont.)

Product	(2) Total Number of Obs.	(3) Total Number of Firms	(4) Total Number of Ads	(5) Average Price*	(6) Average Range*	(7) Average Number of Ads*	(8) Ad**	(9) Banner**	(10) CM**	(11) Product Rank**
Fujifilm FinePix 2400 Zoom	2,196	36	1,389	296.48	130.31	22.77	0.63	0.11	0.49	347.18
Fujifilm FinePix 40i	2,227	36	892	439.31	204.13	14.74	0.40	0.14	0.60	528.97
Fujifilm FinePix 4900 Zoom	1,830	30	1,276	661.75	251.07	20.92	0.70	0.10	0.61	389.97
Fujifilm FinePix 6800 Zoom	3,586	54	2,450	601.30	295.65	40.81	0.68	0.08	0.67	250.00
Fujifilm FinePix 6900 Zoom	2,501	41	1,579	672.50	272.30	25.89	0.63	0.07	0.47	82.62
GEFORCE2 MX-400 PCI 64MB VIDEO CARD	1,281	21	706	97.08	34.65	11.57	0.55	0.14	0.69	634.18
GEFORCE3 4X/2X DDR AGP 64MB VGA TV/S-VI	1,952	32	1,070	317.06	108.98	17.54	0.55	0.15	0.67	217.89
GIGASET 2420 BASIC SYSTEM DSKPHNE HNDSE	1,281	21	856	273.07	129.98	14.03	0.67	0.19	0.71	643.79
GLADIAC 920 64MB AGP GEFORCE3 GRAPHICS	1,769	29	1,002	364.30	63.07	16.43	0.57	0.13	0.70	402.31
Gigabyte GA-7DX AMD 761	1,464	24	940	140.69	53.03	15.41	0.64	0.08	0.69	280.90
HP CD-Writer 8230e CD-RW External USB	488	8	409	168.45	71.16	6.70	0.84	0.25	0.95	385.80
HP Color LaserJet 4550	2,257	37	1,658	1914.85	529.50	27.18	0.73	0.13	0.62	324.98
HP Color LaserJet 4550DN	1,891	31	1,533	3522.53	941.63	25.13	0.81	0.13	0.72	642.61
HP DeskJet 1220C	1,952	32	1,383	477.17	230.23	22.67	0.71	0.13	0.72	366.85
HP DeskJet 842C	671	11	501	92.70	41.99	8.21	0.75	0.18	0.85	566.36
HP DeskJet 932C InkJet Printer	732	12	251	121.92	17.90	4.11	0.34	0.08	0.89	81.56
HP DeskJet 952C	244	4	194	151.42	36.89	3.18	0.80	0.01	1.00	461.95
HP DeskJet 970Cse	366	6	104	283.58	34.21	1.70	0.28	0.00	0.67	624.98
HP DeskJet 990Cse	854	14	679	295.26	105.29	11.13	0.80	0.22	0.74	530.33
HP Jornada 525	1,342	22	855	253.24	136.72	14.02	0.64	0.20	0.82	198.84
HP Jornada 540	732	12	482	392.93	144.37	7.90	0.66	0.08	0.81	649.38
HP Jornada 548	1,708	28	1,307	401.38	107.06	21.43	0.77	0.14	0.90	203.95
HP Jornada 720	1,952	32	1,141	783.63	319.11	18.70	0.58	0.06	0.68	210.93
HP LaserJet 1200	2,257	37	1,718	377.51	114.20	28.16	0.76	0.11	0.66	46.10
HP LaserJet 2200D	2,074	34	1,608	762.40	204.08	26.36	0.78	0.12	0.64	505.44
HP LaserJet 3200	2,257	37	1,662	543.29	210.19	27.25	0.74	0.13	0.73	389.74
HP LaserJet 4100	2,196	36	1,741	1062.26	213.42	28.54	0.79	0.14	0.67	356.51
HP OfficeJet G85	549	9	375	471.91	80.58	6.15	0.68	0.18	0.70	407.90
HP OfficeJet G85XI	2,074	34	1,649	478.83	174.38	27.03	0.80	0.17	0.71	533.33
HP OfficeJet V40xi	1,952	32	1,332	248.14	65.19	21.84	0.68	0.16	0.70	409.20
HP PSC 500 Printer/Scanner/Copier	366	6	279	229.04	75.97	4.57	0.76	0.33	0.77	297.59
HP PhotoSmart 1215	1,098	18	797	293.10	78.70	13.07	0.73	0.24	0.64	405.08
HP PhotoSmart 215	793	13	590	150.60	73.30	9.67	0.74	0.15	0.82	588.32
HP PhotoSmart 315	976	16	741	230.87	110.25	12.15	0.76	0.19	0.77	307.36

Table 1: Summary Statistics (cont.)

	(2) Total Number of Obs.	(3) Total Number of Firms	(4) Total Number of Ads	(5) Average Price*	(6) Average Range*	(7) Average Number of Ads*	(8) Ad**	(9) Banner**	(10) CM**	(11) Product Rank**
Product										
HP PhotoSmart 618	915	15	787	372.79	79.99	12.90	0.86	0.27	0.79	567.16
HP PhotoSmart P1000	915	15	674	177.58	47.50	11.05	0.74	0.18	0.66	204.59
Handspring Visor (Graphite)	1,098	18	760	126.57	37.40	12.46	0.69	0.11	0.65	434.25
Handspring Visor Deluxe (Blue)	1,403	23	1,064	168.31	50.84	17.44	0.76	0.17	0.69	525.03
Handspring Visor Deluxe (Graphite)	1,769	29	1,183	170.51	92.68	19.39	0.67	0.18	0.72	226.93
Handspring Visor Deluxe (Ice)	1,403	23	991	166.21	56.95	16.25	0.71	0.17	0.60	680.67
Handspring Visor Platinum (Silver)	1,830	30	1,295	205.37	118.72	21.23	0.71	0.13	0.72	317.38
Handspring Visor Prism (Cobalt Blue)	1,891	31	1,324	315.47	132.77	21.70	0.70	0.13	0.70	115.64
Handspring Visor Pro (Silver)	1,342	22	823	290.97	40.88	13.49	0.61	0.18	0.67	403.38
Harman Kardon SoundSticks	793	13	617	165.42	50.57	10.11	0.78	0.22	0.88	545.20
Hitachi CM771 (Ergo Flat)	915	15	390	400.58	120.55	6.39	0.43	0.33	0.78	453.92
IBM Deskstar 75GXP 75GB	1,525	25	539	246.39	40.33	8.84	0.35	0.12	0.61	281.16
IBM Microdrive 1 GB CF Plug-in module	1,769	28	1,102	383.05	160.76	18.07	0.62	0.14	0.75	332.33
IBM Microdrive 340 MB CF Plug-in modul	488	8	327	200.84	62.67	5.36	0.67	0.13	0.75	602.59
IBM NetVista A40 (Pentium III, 933 MHz)	488	8	326	1003.25	65.41	5.34	0.67	0.32	0.88	67.13
IBM ThinkPad T23 (Pentium III-M, 1.13 G	1,586	26	896	2976.74	599.22	14.69	0.56	0.12	0.62	543.61
IBOOK G3-500 10GB 128MB CDRW EOL 5/21/0	610	10	371	1491.33	259.89	6.08	0.61	0.10	0.86	360.90
IBOOK G3-500 10GB 128MB DVD 12.1-XGA EN	1,037	17	756	1388.55	207.25	12.39	0.73	0.18	0.85	393.34
INTEL P3-1GHZ 256KB L2 CACHE SLOT1 SECC	854	14	278	255.75	121.93	4.56	0.33	0.14	0.72	323.02
INTEL P3-800MHZ 256KB L2 CACHE SLOT1 SE	854	14	420	148.02	87.57	6.89	0.49	0.21	0.76	485.23
INTEL P4-1.4GHZ 256KB L2 CACHE PGA423 4	1,220	20	651	263.07	425.99	10.67	0.53	0.15	0.83	418.31
INTEL P4-1.5GHZ 256KB OD CACHE PGA423 4	854	14	348	212.81	99.25	5.70	0.41	0.14	0.83	203.69
INTEL P4-1.6GHZ 256KB L2 CACHE PGA423 4	1,647	27	911	198.56	114.54	14.93	0.55	0.11	0.71	185.34
INTERNAL FAX MODEM V90 PCI WITH VOICE A	1,098	18	672	20.69	10.96	11.02	0.61	0.16	0.63	157.64
INTL PENTIUM III 850MHZ SECC2 100MHZ FS	1,037	17	267	209.28	128.95	4.38	0.26	0.12	0.67	521.69
IPAQ PCCARD EXPANSION JACKET H3650 H315	1,769	29	1,282	138.40	108.39	21.02	0.72	0.17	0.75	347.90
Intel Pocket PC Camera	1,586	26	1,114	123.66	52.62	18.26	0.70	0.27	0.77	220.49
Iomega ZIP 250 MB drive External USB po	2,135	35	1,668	145.11	58.61	27.34	0.78	0.19	0.74	180.59
JVC GR-DVL805U	793	13	337	605.06	210.80	5.52	0.42	0.15	0.47	422.52
JVC GR-DVP3U	3,050	49	1,706	1017.61	684.73	27.97	0.56	0.06	0.58	457.54
KDS Rad-5	1,830	30	1,143	372.35	81.18	18.74	0.62	0.13	0.67	85.57
Kingston 128MB DRAM DIMM 168-PIN	2,137	25	1,773	19.64	23.34	31.15	0.83	0.17	0.77	555.88
Kingston 256MB DRAM DIMM 168-PIN	2,799	28	2,339	35.32	35.18	38.67	0.84	0.18	0.78	233.88
Kodak DC290 Zoom	610	10	227	460.78	105.65	3.72	0.37	0.10	0.47	339.52

Table 1: Summary Statistics (cont.)

Product	(2) Total Number of Obs.	(3) Total Number of Firms	(4) Total Number of Ads	(5) Average Price*	(6) Average Range*	(7) Average Number of Ads*	(8) Ad**	(9) Banner**	(10) CM**	(11) Product Rank**
Kodak DX3500	4,026	65	2,651	238.01	172.92	43.46	0.66	0.09	0.62	36.77
LG Electronics Flatron 795FT Plus	1,220	20	808	254.44	73.94	13.25	0.66	0.19	0.72	213.21
LT150 XGA PORTABLE PROJECTOR 1024X768 8	1,891	31	1,443	2825.08	2412.30	23.66	0.76	0.13	0.70	338.38
Lexmark Optra E312L	1,769	29	1,242	239.85	71.74	20.36	0.70	0.17	0.69	643.34
Lexmark X83	1,647	27	1,070	190.14	37.39	17.54	0.65	0.18	0.70	388.23
Linksys EtherFast Cable/DSL Ethernet Ro	1,769	29	1,267	156.00	38.79	20.77	0.72	0.17	0.81	419.80
Linksys EtherFast Cable/DSL Ethernet, F	1,586	26	1,198	71.62	24.23	19.64	0.76	0.19	0.75	119.52
Linksys EtherFast four-port cable/DSL r	2,074	34	1,456	89.01	38.30	23.87	0.70	0.16	0.76	48.75
Lucent Orinoco RG-1000 Residential Wire	427	7	395	305.61	121.52	6.48	0.93	0.00	0.86	463.59
MP2800 MICRO PROJECTOR 1024X768 XGA 110	1,464	24	998	4392.43	950.42	16.36	0.68	0.13	0.79	567.77
MS Works 6.0: Win9X/ME/2K/NT4	1,708	28	1,283	45.47	18.63	21.03	0.75	0.21	0.74	296.52
MediaStudio Pro 6.0	1,159	19	600	304.67	244.57	9.84	0.52	0.31	0.81	506.16
Micro Solutions Backpack CD Rewriter	1,586	26	1,069	192.21	81.03	17.52	0.67	0.15	0.72	826.98
Microsoft FrontPage 2002: Win98/ME/NT4/	1,830	30	1,371	152.74	34.80	22.48	0.75	0.23	0.72	320.84
Microsoft Office XP Pro: Win98/ME/NT4/2	2,501	41	1,889	479.93	220.69	30.97	0.76	0.17	0.75	409.33
Microsoft Outlook 2002: Win98/ME/NT4/2K	1,525	25	1,094	98.83	28.98	17.93	0.72	0.24	0.78	155.61
Microsoft Publisher 2002: Win98/ME/NT4/	2,013	33	1,428	118.50	24.75	23.41	0.71	0.21	0.75	804.11
Microsoft Windows 2000 Server 5-Clients	1,952	32	1,589	838.24	247.76	26.05	0.81	0.18	0.74	467.67
Microsoft Windows Millennium Edition	2,074	34	1,507	177.62	61.94	24.70	0.73	0.20	0.81	564.77
Microsoft Windows XP - Home Edition	2,196	36	1,339	199.56	22.54	21.95	0.61	0.16	0.80	141.23
Microsoft Windows XP - Home Edition Upg	1,891	31	1,049	100.65	13.97	17.20	0.55	0.19	0.80	11.46
Microsoft Windows XP - Professional	2,440	40	1,480	295.62	49.10	24.26	0.61	0.15	0.77	121.36
Microsoft Windows XP - Professional Upg	2,074	34	1,308	198.91	22.35	21.44	0.63	0.17	0.78	88.52
Minolta Dimage 5	2,440	39	1,436	776.77	289.72	23.54	0.59	0.08	0.68	408.77
Minolta Dimage 7	3,172	51	1,778	1141.70	656.48	29.15	0.56	0.10	0.59	55.08
Motorola SURFboard Cable Modem	183	3	143	133.31	35.75	2.34	0.78	0.33	1.00	241.79
NEC MultiSync LCD1530V	2,196	36	1,567	388.75	102.35	25.69	0.71	0.15	0.73	131.13
NEC MultiSync LCD1800	366	6	117	1031.24	59.08	1.92	0.32	0.17	0.84	506.34
NO.78 STD TRI-COL INK CART DJ 930C 950C	2,013	33	1,470	32.49	17.64	24.10	0.73	0.20	0.69	585.21
NVIDIA TNT2 PRO 32MB SDRAM AGP VIDEO CA	305	5	219	66.82	2.79	3.59	0.72	0.40	0.80	53.82
Nero Burning ROM 5.5	610	10	273	67.10	10.27	4.48	0.45	0.20	0.67	494.36
Nexian HandyGPS	122	2	102	150.00	0.01	1.67	0.84	0.00	0.32	717.30
Nikon Coolpix 800	854	14	318	430.08	208.63	5.21	0.37	0.14	0.69	356.84
Nikon Coolpix 880	915	15	461	568.61	276.26	7.56	0.50	0.07	0.60	169.54

Table 1: Summary Statistics (cont.)

Product	(2) Total Number of Obs.	(3) Total Number of Firms	(4) Total Number of Ads	(5) Average Price*	(6) Average Range*	(7) Average Number of Ads*	(8) Ad**	(9) Banner**	(10) CM**	(11) Product Rank**
Nikon Coolpix 990	854	14	362	702.35	352.73	5.93	0.42	0.07	0.64	117.54
Nikon Coolpix 995	4,392	71	3,064	758.51	272.48	50.23	0.66	0.07	0.62	4.74
Nikon Coolscan IV ED	2,745	44	1,526	846.85	144.39	25.02	0.76	0.09	0.66	162.13
Nikon Super Coolscan 4000 ED	2,562	41	1,518	1602.22	432.20	24.89	1.00	0.12	0.71	158.05
Norton AntiVirus 2001 7.0: Win9X/ME/NT	976	16	647	34.29	20.86	10.61	0.70	0.25	0.81	86.16
Norton AntiVirus 2002	1,525	25	1,001	46.98	14.41	16.41	0.65	0.20	0.72	240.34
Norton Internet Security 2002	1,403	23	938	66.56	11.85	15.38	0.72	0.21	0.78	618.26
Norton Utilities 2001 5.0: Win9X/ME/NT	854	14	706	37.51	24.89	11.57	0.76	0.28	0.98	482.15
Olympus C-2500L	793	13	416	789.50	393.34	6.82	0.70	0.15	0.49	589.85
Olympus D-360L	976	16	355	245.22	98.16	5.82	0.93	0.06	0.54	109.38
Olympus D-460 Zoom	1,037	17	403	299.29	103.82	6.61	0.68	0.06	0.50	426.85
Olympus D-490 Zoom	1,464	24	698	366.07	148.38	11.44	0.75	0.08	0.56	144.03
Olympus D-510 Zoom	3,477	56	2,144	365.30	121.79	35.15	0.52	0.09	0.61	13.39
Olympus E-10	3,538	57	2,259	1415.17	773.94	37.03	0.67	0.09	0.61	67.25
Olympus P-400 Photo Printer	2,562	41	1,591	819.88	342.27	26.08	0.75	0.12	0.65	320.95
PERFECTION 1650 SCANNER 1600X3200 48BIT	2,318	37	1,491	192.38	41.31	24.44	0.76	0.10	0.66	83.95
Paint Shop Pro 7.0: Win9X/2K/NT4	1,342	22	844	87.45	23.31	13.84	0.72	0.27	0.79	99.77
Palm IIIc	2,745	44	1,711	259.28	97.00	28.05	0.71	0.14	0.72	125.82
Palm VII	305	5	167	330.00	183.94	2.74	0.81	0.20	0.34	427.70
Palm VIIx	3,233	52	2,160	212.93	290.10	35.41	0.73	0.11	0.67	125.70
Palm Vx	3,294	53	2,049	246.03	110.27	33.59	0.61	0.11	0.66	4.49
Palm m100	2,928	47	2,014	106.33	63.58	33.02	0.55	0.12	0.68	94.39
Palm m105	2,806	45	1,976	155.95	71.34	32.39	0.61	0.13	0.69	89.85
Palm m500	3,172	51	2,294	311.66	118.50	37.61	0.63	0.12	0.65	54.34
Palm m505	3,782	61	2,493	394.20	108.70	40.87	0.59	0.10	0.62	9.49
PartitionMagic 7.0	1,220	20	827	60.52	16.89	13.56	0.56	0.24	0.79	341.41
Philips HDR312 with TiVo service	793	13	377	286.97	62.12	6.18	0.78	0.09	0.66	488.89
Philips Professional Brilliance 180P	1,525	25	988	1074.64	191.85	16.20	0.71	0.16	0.71	340.61
Pinnacle Systems Studio DV	1,464	23	968	84.39	111.47	15.87	0.32	0.19	0.75	464.93
Plextor PlexWriter 16/10/40A	2,257	37	1,601	172.66	64.13	26.25	0.73	0.11	0.70	120.87
Polaroid PhotoMax 2300Z	915	15	392	254.14	110.30	6.43	0.72	0.20	0.78	414.02
Premiere 6.0	1,525	25	1,235	540.83	118.48	20.25	0.45	0.23	0.78	325.51
Quantum 20GB Fireball Plus AS Hard Driv	610	10	273	95.13	34.74	4.48	0.84	0.20	0.50	383.74
Quicken 2002 Deluxe	1,525	25	1,140	56.33	13.15	18.69	0.37	0.20	0.80	358.28

Table 1: Summary Statistics (cont.)

Product	(2) Total Number of Obs.	(3) Total Number of Firms	(4) Total Number of Ads	(5) Average Price*	(6) Average Range*	(7) Average Number of Ads*	(8) Ad**	(9) Banner**	(10) CM**	(11) Product Rank**
RAVE MP2200 MP3 PLAYER DIGITAL MEDIA PL	244	4	149	233.47	56.26	2.44	0.50	0.25	1.00	668.49
Samsung Electronics Co. Ltd. SyncMaster	1,647	27	1,064	224.75	62.90	17.44	0.42	0.19	0.76	360.59
Samsung Electronics Co. Ltd. SyncMaster	1,647	27	1,004	362.51	111.15	16.46	0.61	0.18	0.76	406.87
Samsung ML-1210	1,281	21	715	196.16	47.10	11.72	0.56	0.24	0.66	362.85
Samsung SyncMaster 150 Mp	1,891	31	1,462	645.81	109.58	23.97	0.77	0.13	0.79	628.13
Samsung SyncMaster 150 T	1,891	31	1,409	535.68	149.21	23.10	0.75	0.16	0.82	504.49
Samsung SyncMaster 170 MP	1,708	28	1,322	1120.40	297.44	21.67	0.77	0.14	0.84	527.46
Samsung SyncMaster 170 T	1,830	30	1,131	873.51	197.50	18.54	0.62	0.13	0.78	271.23
Samsung SyncMaster 570v	2,013	33	1,403	403.95	117.11	23.00	0.70	0.18	0.77	299.51
Samsung SyncMaster 700NF	1,525	25	1,091	252.09	75.07	17.89	0.72	0.20	0.82	741.25
Samsung SyncMaster 753 DF	1,952	32	1,267	181.39	55.05	20.77	0.65	0.16	0.76	542.82
Samsung SyncMaster 770 TFT	1,952	32	1,277	817.51	196.88	20.93	0.65	0.15	0.86	45.79
Samsung SyncMaster 900NF	1,708	28	990	407.21	109.58	16.23	0.58	0.18	0.73	398.21
Samsung SyncMaster 955DF	1,769	29	960	284.84	76.73	15.74	0.54	0.17	0.77	305.41
Samsung Syncmaster 950P	1,403	23	721	239.88	73.85	11.82	0.51	0.17	0.89	82.57
SanDisk Corp. 128MB Flash CompactFlash	793	13	406	96.44	65.44	6.66	0.51	0.38	0.56	354.25
Sonicblue Diamond Mako	732	12	297	225.36	201.77	4.87	0.41	0.08	0.58	250.39
Sonicblue Rio Volt SP100	2,196	36	1,235	142.62	43.98	20.25	0.56	0.15	0.61	48.15
Sonicblue Rio Volt SP250	1,403	23	596	181.21	145.24	9.77	0.42	0.22	0.64	115.39
Sonicblue Rio Volt SP90	1,281	21	846	95.42	66.14	13.87	0.66	0.19	0.71	780.61
Sony 64MB Flash Memory Stick	2,867	46	1,906	77.60	77.05	31.25	0.66	0.09	0.66	121.72
Sony CLIE PEG-N610CV (Metallic Purple)	1,830	29	1,182	370.74	71.30	19.38	0.65	0.07	0.74	348.84
Sony CLIE PEG-N710C	2,135	34	1,472	438.17	223.90	24.13	0.69	0.09	0.66	68.59
Sony CLIE PEG-S300	1,159	19	732	252.39	220.24	12.00	0.63	0.01	0.75	190.87
Sony CLIE PEG-S320	2,257	36	1,417	182.11	86.58	23.23	0.63	0.08	0.72	92.15
Sony Cyber Shot DSC-F505V	3,233	52	1,998	759.06	309.73	32.75	0.62	0.08	0.65	249.30
Sony Cyber Shot DSC-F707	3,172	52	1,128	953.04	125.60	18.49	0.36	0.08	0.54	63.39
Sony Cyber Shot DSC-P1	3,294	53	1,722	621.32	178.63	28.23	0.52	0.07	0.60	288.80
Sony Cyber Shot DSC-P30	3,965	64	2,616	280.38	80.04	42.89	0.66	0.06	0.62	175.18
Sony Cyber Shot DSC-P50	4,148	67	2,730	373.18	109.74	44.75	0.66	0.09	0.63	63.54
Sony Cyber Shot DSC-S30	549	9	235	396.72	107.31	3.85	0.43	0.00	0.45	793.02
Sony Cyber Shot DSC-S70	732	12	540	652.73	187.40	8.85	0.74	0.00	0.73	333.00

Table 1: Summary Statistics (cont.)

Product	(2) Total Number of Obs.	(3) Total Number of Firms	(4) Total Number of Ads	(5) Average Price*	(6) Average Range*	(7) Average Number of Ads*	(8) Ad**	(9) Banner**	(10) CM**	(11) Product Rank**
Sony Cyber Shot DSC-S75	4,026	65	2,580	631.77	165.14	42.30	0.64	0.08	0.61	239.57
Sony Cyber Shot DSC-S85	4,087	66	2,404	721.08	196.20	39.41	0.59	0.08	0.60	25.05
Sony DCR-PC5	854	14	347	1161.62	364.35	5.69	0.41	0.00	0.36	132.25
Sony DCR-PC9	2,867	46	1,583	1085.99	404.62	25.95	0.55	0.03	0.55	320.80
Sony DCR-TRV17	2,806	45	1,634	930.41	486.11	26.79	0.58	0.03	0.55	463.21
Sony DCR-TRV230	2,501	40	1,399	586.03	234.10	22.93	0.56	0.06	0.53	579.02
Sony DCR-TRV30	2,989	48	1,866	1400.25	532.43	30.59	0.62	0.02	0.52	153.57
Sony DCR-TRV330	2,928	47	1,693	676.33	326.41	27.75	0.58	0.06	0.55	298.52
Sony DCR-TRV530	2,745	44	1,637	743.33	352.44	26.84	0.60	0.04	0.56	446.93
Sony DCR-TRV730	2,989	48	1,807	790.80	377.48	29.62	0.60	0.03	0.54	228.07
Sony MVC-CD200 Digital Mavica	4,026	65	2,625	706.82	208.69	43.03	0.65	0.06	0.61	316.62
Sony MVC-CD300 Digital Mavica	4,270	69	2,627	893.15	227.71	43.07	0.62	0.08	0.59	51.87
Sony MVC-FD75 Digital Mavica	3,904	63	2,569	357.86	87.57	42.11	0.66	0.07	0.61	369.90
Sony MVC-FD85 Digital Mavica	549	9	196	477.42	157.60	3.21	0.36	0.00	0.48	582.85
Sony MVC-FD90 Digital Mavica	732	12	389	534.32	153.94	6.38	0.53	0.00	0.50	678.72
Sony MVC-FD95 Digital Mavica	2,013	33	1,414	617.21	402.48	23.18	0.70	0.03	0.61	155.28
Sony MVC-FD97 Digital Mavica	3,782	61	2,206	790.84	270.50	36.16	0.58	0.05	0.60	380.59
Sony Multiscan CPD-G400 (19-Inch Trinit	1,891	31	1,412	454.03	253.81	23.15	0.75	0.16	0.72	315.31
Sony Multiscan LCD Display SDM-M81 (Whi	2,257	37	1,612	1155.58	293.89	26.43	0.71	0.11	0.69	280.85
Sony Spressa CRX 1600L-A2 12x/8x/32x	1,830	30	1,200	221.96	103.45	19.67	0.66	0.18	0.71	365.18
Sony VAIO C1VP PictureBook	1,830	30	1,124	1747.55	316.81	18.43	0.61	0.04	0.61	369.25
Sony VAIO PCG-FX170 (Pentium III 800 MH	1,037	17	465	1813.55	450.31	7.62	0.45	0.06	0.45	6.80
Sony VPL-CX1 Superlite LCD Projector	1,281	21	925	1743.25	800.11	15.16	0.72	0.06	0.70	195.26
Sony Vaio SR17 notebook	732	12	303	1374.16	221.67	4.97	0.41	0.00	0.47	172.21
TDK Mojo	1,159	19	585	143.64	49.17	9.59	0.50	0.21	0.78	327.70
TOSHIBA DOCSIS CABLE MODEM WITH USB & E	1,037	17	751	155.21	74.00	12.31	0.72	0.17	0.77	121.20
Toshiba PDR-M70	1,891	31	1,024	613.10	281.57	16.79	0.54	0.13	0.60	454.00
Toshiba Satellite 1755 Laptop 700MHZ/DV	305	5	139	1044.65	82.16	2.28	0.46	0.00	0.20	27.20
Toshiba Satellite 1800-S203 (Celeron, 8	2,196	35	1,296	1124.30	511.80	21.25	0.59	0.17	0.65	324.46
Toshiba Satellite 2805-S202 Laptop PIII	671	11	414	1381.62	470.30	6.79	0.62	0.00	0.55	111.46
Toshiba Satellite 2805-S503 (Pentium II	1,952	32	1,235	1729.29	1805.51	20.25	0.63	0.12	0.66	561.74
Toshiba Satellite 2805-S603 (Pentium II	1,281	21	694	2298.40	1501.84	11.38	0.54	0.14	0.50	712.59
ULTRALIGHT X350 XGA PROJECTOR 1024X768	2,135	35	1,589	3935.62	1573.30	26.05	0.74	0.15	0.73	491.31

Table 1: Summary Statistics (cont.)

Product	(2) Total Number of Obs.	(3) Total Number of Firms	(4) Total Number of Ads	(5) Average Price*	(6) Average Range*	(7) Average Number of Ads*	(8) Ad**	(9) Banner**	(10) CM**	(11) Product Rank**
UPG OFFICE XP PROFESSIONAL 98/WME/NT/W2	2,440	40	1,794	284.65	82.87	29.41	0.74	0.17	0.74	466.10
UPG-V ADOBE ACROBAT 5.0 95/98/NT4/WME/W	1,708	28	1,296	89.71	20.31	21.25	0.76	0.25	0.80	134.82
VIA KT133 SOCKA MAX 1.5GB ATX 5PCI AGP4	366	6	149	66.59	6.19	2.44	0.41	0.17	1.00	629.82
ViewSonic E70f	2,013	33	1,605	189.73	60.09	26.31	0.80	0.15	0.76	722.26
ViewSonic GS 790	976	16	715	327.31	90.99	11.72	0.73	0.12	0.65	638.54
ViewSonic Optiquest Q95	1,098	18	662	238.47	52.85	10.85	0.60	0.16	0.78	239.57
ViewSonic PF790	1,525	25	838	353.93	156.54	13.74	0.55	0.15	0.66	303.69
ViewSonic VE 150	2,318	38	1,634	410.50	121.47	26.79	0.70	0.13	0.74	275.36
ViewSonic VG 175	2,501	41	1,898	927.87	624.88	31.11	0.76	0.14	0.73	179.11
Visioneer OneTouch 8650	2,074	34	1,311	283.68	77.35	21.49	0.63	0.17	0.71	744.61
WINGMAN FORMULA FORCE GP FORCE FEEDBACK	1,525	25	1,074	83.18	40.33	17.61	0.70	0.16	0.66	327.52
WINGMAN STRIKE FORCE 3D USB FORCE FEEDB	1,525	25	1,115	76.12	38.20	18.28	0.73	0.12	0.71	723.18
WORDPERFECT OFFICE 2002 STD CD W9X/NT U	1,647	27	1,104	131.95	38.14	18.10	0.67	0.21	0.77	530.00
WinFax Pro 10.0: Win9X/NT4/2K	1,647	27	835	89.14	63.89	13.69	0.51	0.22	0.78	424.54
Xirlink IBM PC Camera Pro Max	427	7	262	67.67	94.85	4.30	0.61	0.00	0.43	209.57
Average	1659.07	26.87	1052.85	473.48	169.37	17.25	0.60	0.11	0.66	338.37
Total	527,568		334,773							

Table 2: Three-day Snapshot of Advertising and Pricing Decisions for Two Products

Palm m500

Firms	10/1/01	11/1/01	11/30/01
2Buystore.com		$ 288.92	$ 283.98
42nd Street Photo		329.99	329.99
800.com	329.92	329.92	329.92
Abe's of Maine	338.99	279.99	274.99
Ahead Technologies		321.41	320.74
Amazon.com	329.99	329.99	329.99
AMDV.com	281.00	272.00	269.00
Beach Camera	279.00	329.00	329.00
Broadway Computer and Video	287.48		
buy.com	324.95	324.95	324.95
BuyDig.com	274.00	264.00	257.95
California Computer Center	334.00	284.00	284.00
CameraClub.com	319.99	319.99	319.99
CDW		329.00	329.00
Circuit City	329.99	329.99	329.99
Comark	329.00	329.00	329.00
Compu America	369.00	278.00	279.00
Computers4SURE.com	329.00	324.95	324.95
Crazy Eddie	339.95	299.95	299.95
Dbuys.com	292.00	279.00	276.00
DiscoveryCameras.com	279.00		
eBay's Half.com			313.00
eCOST.com	399.00	399.00	329.00
Etronics.com		299.00	295.00
Euclid Computers	385.00	385.00	320.00
Family Photo and Video	334.00	283.99	258.99
FocusCamera.com		279.99	279.99
Gateway.com	329.00	329.00	329.00
Half.com		299.99	
Harmony Computers	285.00	279.00	265.00
ibuydigital.com		273.00	
LA Computer Center	329.00	279.00	263.00
MacUniverse, Inc.	275.00		
Micro Warehouse	329.00	329.00	329.00
MobilePlanet	329.95	329.95	329.95
MPSuperstore.com	294.99	269.98	258.88
Outpost.com	329.00	329.00	329.00
Palm, Inc.		329.00	329.00
PC Connection		329.00	329.00
PC Mall	329.00		
PCnomad.com		295.00	285.95
Photo King	285.00		
Port.com	369.99		
State Street Direct	299.95		
TC Computers			329.99
TheNerds.net		289.66	
Urbancomp.com	327.99		
U-Save Gelt	319.00		

Memory Stick for Sony Digital Cameras (128 MB)

Firms	10/1/01	11/1/01	11/30/01
#1 TechStore		$ 119.22	$ 128.41
1st eWeb, Inc.	103.88		
42nd Street Photo	159.99	179.99	199.99
800.com	149.95	149.95	
Abe's of Maine		139.99	139.99
Abt Electronics	139.00	139.00	
Ahead Technologies			136.46
Broadway Computer and Video	132.07		
buy.com			139.95
CameraClub.com	139.99	139.99	139.99
Comark	121.00	120.00	120.00
Computers4SURE.com	137.99	127.99	125.95
Dbuys.com	149.00	149.00	149.00
Digitaltronics	149.99	149.99	149.99
eBay's Half.com			115.00
eByWeb.com	149.99		
eCOST.com	108.99	129.99	104.85
Etronics.com	104.86	104.86	104.86
Family Photo and Video			139.99
FocusCamera.com		112.89	119.95
Gateway.com	146.95	147.95	147.95
Half.com		115.00	
ibuydigital.com		149.00	
J&R Music and Computer World		139.99	139.99
Libi Industries			129.95
Memory4Less	113.30	118.80	119.84
Micro Warehouse	149.95	149.95	149.95
MobilePlanet	139.95	139.95	139.95
Outpost.com	149.95	129.95	129.95
Page Computer			118.90
PC Connection			149.95
PC Mall	108.00	119.00	104.85
PCNation.com	118.44		
TC Computers			149.95
TheNerds.net	108.92	108.92	108.92
Urbancomp.com		147.99	147.99

Table 3: Probit Regressions of Firms' Advertising Propensities with Market Structure and Market Thickness Effects*

Dummy variables for:	Model 1 Marginal Effects	Model 2 Marginal Effects	Model 3 Marginal Effects	Model 4 Marginal Effects
Few-firm markets	0.02	0.20	-0.13	-0.11
	(0.015)	(0.026)**	(0.051)*	(.037)**
Less popular products	0.00	-0.10	-0.11	-0.13
	(0.007)	(0.010)**	(0.011)**	(0.012)**
Banner Logo			0.13	-0.78
			(0.002)**	(0.013)**
Cnet Certified Merchant			0.31	0.25
			(0.002)**	(0.006)**
Suppressed coefficients	0	382	382	674
Predicted Probability (at the mean)	0.64	0.65	0.66	0.69
Product Fixed Effects	No	Yes	Yes	Yes
Date Fixed Effects	No	Yes	Yes	Yes
Firm Fixed Effects	No	No	No	Yes
Hypothesis: Fixed effects jointly zero				
Significant Product Fixed Effects	No	Yes	Yes	Yes
Significant Date Fixed Effects		Yes	Yes	Yes
Significant Firm Fixed Effects				Yes

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Note: The binary dependent variable = 1 if a firm i advertises price information for product k at date t, = 0 otherwise. Coefficient estimates report the marginal effect of a discrete change in the dummy variable from 0 to 1, holding other variables at their mean values. Robust standard errors in reported in parentheses. * indicates significance at the 5% level; ** significance at the 1% level.