Price Dispersion and Cost Change at an Internet Price Comparison Site

Kyle J. Anderson
Visiting Assistant Professor
Kelley School of Business
Indiana University

October, 2009

Abstract. This paper analyzes price dispersion occurring after a wholesale cost change at an internet price comparison site. Price dispersion increases following a cost change, and remains increased for a significant period of time, even though competition is intense and menu costs are quite low. While price dispersion has been analyzed extensively in off line and online markets, few papers have looked at cost changes, and asymmetric reactions to cost changes as a contributing factor to price dispersion. The results shed light on important differences across different product markets.

1 I appreciate the feedback of Michael Baye, Neil Morgan, John Maxwell, and Shibo Li on an earlier draft of this paper. I also owe a debt of thanks to seminar participants in the business economics department at the Kelley School of Business, and to Lan Zhang. I welcome feedback to kyjander@iupui.edu.
1. Introduction

Price dispersion has been demonstrated to be both significant and persistent in both online and offline markets, even for homogeneous goods. Even at websites in which many retailers compete right alongside one another, prices remain spread over a fairly large range. While there is some evidence that the level of price dispersion may decrease as the Internet continues to mature (Ratchford et al, 2003, Bock et al, 2007), it is clear that prices remain widely dispersed for homogeneous products. Violations of the law of one price are far from new (Stigler 1961), but they still generate a high level of interest in the economics, information science, and marketing literature. This is in large part because the magnitude of dispersion remains very high, and the availability of information through internet marketplaces is so great. Price dispersion has empirically been shown to be a function of a number of factors, including, the number of competitors (Clay et al, 2001, Baye et al, 2004a), the characteristics of the competitors (Baylis and Perloff, 2002, Ancarani and Shankar, 2004), the price level of the product (Pratt et al, 1979), and differences in service quality (Pan et al, 2002, Bock et al, 2007). However, there has been a scarcity of research examining the effect of wholesale cost and cost changes as potential determinants of the level of price dispersion in retail marketplaces. Presumably this is in part due to the difficulty researchers have had in obtaining data about wholesale prices.

This paper examines the effect of marginal cost changes on price dispersion in retail markets. Price listings for cameras and memory cards from the Pricegrabber price comparison

---

Specifically, we examine what impact marginal cost changes have on price dispersion in online markets. If menu costs are positive and heterogeneous across sellers, then a wholesale cost change that affects all sellers may lead to increased price dispersion, as some sellers respond more quickly than other firms. In the extreme, much of the observed price dispersion in online markets may be a reflection of reactions to cost changes. Alternatively, a cost change may be an opportunity for firms to monitor their rival’s prices and price more aggressively. If all firms update prices at the same time, this may lead the market closer to an equilibrium that resembles Bertrand in which price dispersion is low and economic profits are zero. The purpose of this paper is to identify whether price dispersion increases or decreases after a cost change, and whether cost heterogeneity is accounts for a large portion of the price dispersion observed in online markets for electronics.

Through a close relationship with one of the online retailers, we are able to track wholesale cost changes, and identify the impact of cost changes on price dispersion. Given the rapidly improving technology in digital cameras and digital memory, new and improved products are frequently introduced by the original equipment manufacturers (OEMs). The result is that products tend to have a relatively short product lifecycle of 2-3 years, and during that lifecycle, the wholesale price from the manufacturer to the retailer tends to experience relatively frequent and significant cost declines. Marginal cost differences are important in the theoretical literature on price dispersion of homogeneous products, but have received little empirical attention.
Price comparison sites are online gatekeepers that offer consumers a one-stop shop to compare prices and other information prior to making a retail purchase. There are several types of sites that aggregate shopping information for consumer use. This research focuses on price comparison sites on which retailers actively list prices and agree to pay a fee for each potential customer referred from the comparison site to the retailers’ website. This is in contrast to so-called shopbots, which retrieve pricing information from retailers without any input from the online retailer. On Pricegrabber, each retailer must first sign up to list products at the price comparison site, and make an upfront deposit to cover the cost of consumer clicks. They then choose which products to list and provide the comparison site with a product listing and price feed. In addition, they choose shipping methods and fees, provide stock information, and can provide additional information such as whether there are rebates available.

Referral fees vary by comparison site and product category. On the Pricegrabber comparison site, during the time period of the study (the first half of 2006), referral fees for digital cameras and memory cards were $.75 per click and $.70 per click, respectively. Firms that use a logo pay an additional $.15 per click. In addition, Pricegrabber offers the option of becoming a “featured merchant.” Featured merchants get a small designation by the side of their name that indicates that they are featured, and occupy the top four listings on the product page. Only four firms can be designated as featured on a product day. This designation is determined by a bidding system in which firms bid a higher referral fee in exchange for being featured. The highest bid gets the first listing slot on the page, and up to three more featured merchants are listed in bid order. After the featured merchants, the default listing is that firms are listed in descending order based on price. If the consumer enters her zip code, then the listing order is based on the total combined price, which is the product price plus shipping and
tax. Firms that select not to enter shipping information are then listed at the bottom of the page. At any time the consumer can click on a column to sort based on that category.

Unlike some other popular price comparison sites (e.g. Shopzilla), Pricegrabber lists all merchants on a single page. Consumers can simply scroll down to see every listing. By contrast, Shopzilla lists 10 sellers per page, meaning that a market with 75 sellers would have 8 pages of listings. Intuitively, this would make listing order less important on Pricegrabber than other similar comparison sites. Another feature of Pricegrabber is that only new products are listed on the main listing page for each product. Each product has a unique Manufacturer Product Number (MPN) and all sellers are required to list only new products on the main page. There is a secondary page for used and refurbished models.

Electronic goods in aggregate and specifically, digital cameras and digital memory, are products in which there is a high incentive for consumers to engage in search before purchasing the products. Reasons include the relatively high cost of digital cameras as compared to other consumer goods (books, CDs, etc.), the high availability of information about retailers and relatively complex products, and the fact that prices change often enough to reward search. The result is that price comparison sites are an extremely low cost and attractive tool for consumers to use to gain pricing information for electronics goods. Once a product is selected, a large number of price listings are presented in a simple format that allows easy comparison with virtually zero marginal search costs. In this way, we can analyze a competitive market in which consumers have high incentives to search, products are virtually undifferentiated, and search costs are virtually zero.

The purpose of the paper is to explore how retailers react to cost changes in a competitive environment, and whether and how much these marginal cost changes contribute to the well-
documented price dispersion at online price comparison sites. The rest of the paper is laid out as follows: Section 2 reviews the existing literature on search and price comparison markets. Section 3 describes the data collected, while Section 4 presents the model. The results are presented in Section 5 and discussion and conclusion appear in Section 6.

2. Theoretical and Empirical Considerations

In the theoretical analysis of online price dispersion, there are several approaches to explaining equilibrium price dispersion. One of the main schools of thoughts examines marginal search costs for consumers and heterogeneous marginal costs among firms to explain price dispersion. Representative models of these types include Reinganum (1979), Carlson and McAfee (1983), and Burdett and Judd (1983). Sellers in these models have heterogeneous marginal costs, and price rankings align with marginal cost rankings.

The problematic assumption with this particular literature on price dispersion is that marginal search costs are positive. Zhang et al (2006) find that consumers are engaging in significantly more search as Internet markets mature and broadband access increases. Online price comparison sites are known for their having extremely low search costs. They are costless for consumers and take only a few keystrokes. Furthermore, the marginal search cost is even lower due to the fact that a whole list of prices is generated at one time.

Another stream of literature follows an information clearinghouse model in which a certain subset of the consumers are either informed or uninformed (Salop and Stiglitz 1977; Varian 1980) or brand loyal or shoppers (Rosenthal 1980; Narasimhan 1988). In these models, consumers are dichotomous in whether or not they select the lowest-priced seller, and firms try to balance extracting high margins from uninformed/loyal consumers with trying to compete for the informed/shopper consumers. Firms engage in mixed strategy pricing and prices are
dispersed in equilibrium. These models show that price dispersion exists in equilibrium, but rely on exogenous differences in consumers’ willingness or ability to find the lowest price. Baye and Morgan (2001) show that price dispersion is an equilibrium phenomenon even with homogeneous firms and consumers when a profit-maximizing gatekeeper charges an optimal fee that prevents some firms from using the gatekeeper site. In the Baye-Morgan model, the fee is fixed, which is somewhat in contrast to price comparison sites that charge click-through fees rather than a fixed listing fee. However, this can be reconciled by viewing the staff time and effort to manage price listings as a fixed fee. Alternatively, retailers listing on price comparison sites generally incur fees in terms of customers that click-through to their website without ever completing a sale.

The above models assume there are no transaction costs, and in fact, one of the suggested benefits of online markets is the reduced transaction costs that firms and consumers face. One of these is the cost to retailers of changing prices in response to changes in marginal cost or changes in the competitive environment. These so-called menu costs result in firms changing their prices less frequently than they otherwise might (Levy et al, 1997). This leads to “sticky” prices, prices that do not change as frequently as they would in the absence of menu costs. In online markets, however, menu costs are much lower than in traditional markets. Brynjolfsson and Smith (2000) find that Internet retailers’ price adjustments are up to 100 times smaller and much more frequent than conventional retailers, reflecting reduced menu costs. A firm selling products on a price comparison site needs only to click a few keystrokes to upload a new price sheet which updates the firm’s online prices. However, this reduced transaction cost has not completely eradicated price stickiness. For example, Arbatskaya and Baye (2004) show that a majority of online lenders do not respond quickly to cost changes at a mortgage comparison site, even in the presence of competition.
While there continues to be significant interest in the causes and degree of price dispersion for homogeneous products in online markets, few empirical studies have considered the effects of cost changes and retailer reactions to them when analyzing price dispersion. One notable exception is Marvel (1976) who analyzes price dispersion at gas stations across cities and finds that firms face consumers with differing levels of information. Firms that serve consumers with low levels of information charge higher prices and change prices less frequently than firms that serve well-informed consumers. This paper complements Marvel’s work by bringing the findings up to date and examining a single market with a presumably high level of information available to consumers. Therefore the heterogeneity of information should be diminished.

Peltzman (2000) examines firm reactions to cost shocks and finds that in most markets, firms are more likely to pass on cost increases more quickly and completely than cost decreases. He points out that there is no accepted economic theory for this asymmetric response to wholesale cost changes.

The consumer electronics market is an interesting and appropriate market to analyze for several reasons. First, the effect of cost changes on price dispersion is likely to be greatest when marginal cost changes frequently or dramatically. Electronics goods tend to have relatively short lifecycles and have declining marginal costs as the product progresses through their life cycle. Second, since consumer electronics have been used in other studies (Baye et al, 2004a, Bock et al, 2007, Haynes and Thompson, 2008) comparisons can be drawn with the existing literature to help determine the magnitude of the effects. Finally, the fact that the products are relatively expensive (the average price of our sample ranges from 73.13 to 1044.35) means that consumers have a strong incentive to engage in search.
While there is a large literature on price dispersion, there has not always been consistency on what price dispersion actually entails, or the best way to measure it. This analysis uses three different measures of price dispersion. The coefficient of variation (COV) is measured as the sample standard deviation divided by the mean price, and has been used in many studies of online price dispersion (Clay et al. 2001; Ratchford et al. 2003; Scholten & Smith 2002; Baye, et al. 2004). The benefit of COV is that it is a standardized measure of price dispersion, making it valuable for comparisons across products or over time (Baye, Morgan et al. 2007). Since the products listed vary widely in average price from $80 to over $1000, it is beneficial to use a standardized measure. Since the calculation involves the sample mean and sample standard deviation, each price listing on a particular day effects that COV. Previous empirical studies have found the COV for electronics goods to be anywhere from 8-13% (Ratchford et al. 2003, Baye et al. 2003, Baye et al. 2004). Detailed reviews of findings concerning online price dispersion can be found in Pan et al. (2004) and Baye et al. (2007).

A second way of measuring price dispersion is to compare the average price with the minimum price. This is termed the value of information (VOI) (Baye, Morgan et al. 2003), because it compares the discount an informed consumer will get relative to an uninformed consumer who randomly selects a seller and gets (on average) the average price. This is generally calculated as a percentage difference, making it useful for comparing products that are fairly different from one another. Some research has used the median price rather than the mean price in this calculation (Haynes & Thompson 2008). An advantage of the median price dispersion as opposed to COV or VOI using the mean price is that there tend to be some occasional outliers at the high end of the price range on online price comparison sites. Firms that are new to listing will sometimes list high prices prior to making a serious effort to sell products. By using the median price, the impact of high prices by a few sellers are minimized,
and the researcher is absolved from having to decide which prices are outliers and which are not. Haynes and Thompson (2008) find that price dispersion as measured by median price dispersion is dependent upon the number of sellers in the marketplace.

A third measure of price dispersion is referred to as the gap, which is the percentage difference between the two lowest sellers in the marketplace (Baye et al. 2004). While this only incorporates the two lowest prices, it is important in the sense that the existence of a price differential between the two lowest sellers is inconsistent with theoretical models of Bertrand equilibrium as well as perfectly competitive markets. Baye et al (2004) find that the gap decreases as the number of sellers increases in the marketplace.

3. Data

The data for this study comes from daily price listings on the Pricegrabber comparison site from January, 2006 to June, 2006, and proprietary wholesale pricing information provided by Roberts Imaging, an online retailer listing products on the Pricegrabber price comparison site. The products analyzed include digital cameras and memory cards that are used in digital cameras and other electronic devices. The digital cameras are of two general types: point and shoot, and SLR (single lens reflex) cameras. The SLR cameras tend to be larger, more complex, and more expensive.

In order to examine the effects of a cost change, we include only products in which the manufacturer’s wholesale price declined during our sample period. This reduced the number of products from 27 to 15, and the product-date observations to 1534. In addition, product-date observations were only included if they followed a cost change, so that it was known precisely when the most recent cost change occurred. The result is an unbalanced panel of daily price observations for 15 products, ranging from 3 to 5 months for each product. The dataset
includes 15 products made up of 6 models of point and shoot cameras, 5 models of SLR cameras, and 4 models of digital memory. Summary statistics of the products included in the analysis are presented in Table 1.

The point and shoot cameras include models manufactured by Canon and Nikon. The lowest observed price for one of the models is $144.49 and the average listing price across all point and shoot models is $295.83. Point and shoot cameras are popular products on price comparison sites, drawing an average of 48.1 sellers per day.

The 6 different SLR cameras are manufactured by Canon and Nikon and have a minimum price range of $478.99 to $1044.89. The average number of sellers listing SLR cameras is 35.4, and the average price across models is $726.79.

Memory products include both secure digital and compact flash formats manufactured by Kingston and Sandisk. The amount of memory ranges from 1 gigabyte to 4 gigabytes and ranges in price from $60 to over $400. The average number of sellers for the memory products is 34.2.

The price used is the consumer’s price including shipping. It is important to include shipping costs in since some retailers offer free shipping while others charge as much as $10-$20. Sales tax is not included since it varies depending upon where the consumer lives, making it difficult to compare across retailers.

Each product experienced at least one cost change during the sample period. In every case, the cost change was downward, and the average cost decline was 20.4%. The panel is unbalanced, since for each product, the first observation is the day immediately following a cost change. From that point forward, the dispersion is measured for the remaining sample period. For example, for the Sandisk 1GB Extreme III compact flash card, Sandisk informed its retailers of a price change on Feb. 2, 2006, and the sample observations begin on Feb. 3 and run through
June 30 of that year. Using only observations following a cost change is appropriate because the sample is left-truncated, and it is unknown when any cost changes occurred prior to January 1, 2006. The panel data allows us to control for both product fixed effects and time effects.

The cost change event is identified when the OEM notified Roberts Imaging that it was changing the wholesale price on a product. In all of the cases in this dataset, the wholesale price changes went into effect immediately, so that there is not a lag between the notification of the cost change and the time it actually goes into effect. While there is some evidence that there are temporal differences as to when cost changes are applied across retailers, it is evident from the reaction of retailers that the cost change is likely affecting a majority of the retailers. Table 2 gives an aggregate summary of the effects of a cost change on each of price dispersion measures.

The menu costs of changing a price on the Pricegrabber system are minimal. Firms upload prices using a spreadsheet based data feed. In order to change a price, they only need to update the price on their data feed and submit the prices through the Pricegrabber website. The time involved in updating a price is less than five minutes and a new price feed will result in an updated listing appearing on Pricegrabber within a couple hours.

In addition to the above information, the date of the original release of the product was collected by examining the OEM websites for the initial product launch. In each case, the product launch was announced by press release that indicated the date the product was first available. This allows the examination of (and the ability to control for) any lifecycle effects that may affect price dispersion in the market for these goods.

4. Model
The model in this paper closely follows previous empirical work on price dispersion in online markets, including (Baye et al, 2003, Haynes and Thompson, 2008). The baseline model is as follows:

\[ PD_{it} = \varphi_i + \beta_0 + \beta_1 S_{it} + \beta_2 T_{it} + \beta_3 D_{it} + \epsilon_{it} \]

Here, \( PD_{it} \) is the price dispersion for product \( i \) on day \( t \), where dispersion is measured (depending on the specification) as the value of information (the percentage difference between median and minimum price)\(^3\), the coefficient of variation (standard deviation divided by the mean), and the gap (the difference between the two lowest prices)\(^4\).

\( S_{it} \) is the number of sellers for product \( i \) on a day \( t \) and has previously been shown to impact not only the price level, but the level of price dispersion in the market. The impact that it has depends upon the measure of price dispersion. Baye et al (2004) and Haynes & Thompson (2008) show that the VOI increases as the number of sellers increases. Baye et al (2003) show that the gap between the lowest prices decreases as the number of sellers increases.

Since the product life cycle is important in electronics (Haynes & Thompson, 2008), we include a variable (T) that controls for the number of days since the product launch. Since the first observation begins when a cost change has occurred, it follows that none of the products is brand new. OEMs generally wait a significant period prior to instituting a price change on electronics products.

---

\(^3\) Baye et al (2003) use mean price rather than median. Haynes and Thompson (2008) use median price due to concerns that the maximum price listed is often significantly higher than other sellers and appears stable for long periods. This paper follows Haynes and Thompson in this regard.

\(^4\) All three measures of price dispersion have been used widely in the literature for both online and offline markets. Representative papers for online markets for VOI include Baye et al (2003), Smith & Brynjolfsson (2001), and Haynes & Thompson (2008). Coefficient of variation has been used in numerous papers, including, Clay et al (2001), Baye et al (2004a), Pan et al (2003). Gap has been used in Baye et al (2004a) and Gatti & Kattuman (2003). For a review, see Baye et al (2007).
The main variable that we are interested in is the number of days (D) following the most recent cost change. In certain specifications, we take the log of the number of days, as the impact of days on price dispersion decreases the longer away from the event. In other specifications, we use dummy variables to group the period of time since the last cost change.

In the model, $\varphi_i$ represents the model fixed effects, $\beta_0$ represents a generic constant, and $\varepsilon_{it}$ represents an error term.

5. Results

The regression results are presented in Table 3. Cost changes have a significant impact upon price dispersion that is robust to a number of specifications and measures. Price dispersion is greatest shortly after a cost change and then gradually declines. The nature of the change depends upon in part on the measure of price dispersion. Model 1 indicates that the value of information is greatest in the days following a cost change, and then declines over a relatively short period. Using dummy variables in Model 2, it is straightforward to calibrate the effect of a cost change on the value of information. In the first 5 days following a cost change, the difference between the median price and the lowest price is 24.2%, whereas it is only 13.9% more than 20 days after a cost change. By this measure, price dispersion is 73.5% greater immediately following a cost change than several weeks after one. Furthermore, it appears to take about 10 days for the VOI to settle to a stable level.

The effects of cost change on the coefficient of variation are more subtle, both in magnitude and temporal response. Model 3 shows that the COV also declines following a price change. However, as Model 4 indicates, the effect is not immediate. The greatest change in dispersion occurs 5-15 days after a cost change. Whereas in the case of VOI, one firm reacting
swiftly will widen the spread, there is a greater time lag for COV, since all prices are incorporated into this measure.

The gap between the lowest priced seller and the second lowest seller is also greatest immediately following a cost change. The expected gap between the two lowest sellers is 5.6% in the first few days following a cost change, but declines to 2.1% after three weeks. By this measure, price dispersion is 162% greater following a cost change than otherwise. Unlike other measures of dispersion, the gap narrows very quickly. The coefficients for the gap for 5-10 days and 10-20 days following a price drop are the expected sign (positive), but not significantly different from zero.

Figure 1 shows the average price dispersion based on all three measures as a function of the number of days since a cost change. Dispersion is higher and more volatile following a cost decrease, but still significant up to 60 days following the change. The effect of the number of sellers on price dispersion again depends upon the measure used. The value of information increases as the number the number of sellers increases, which is consistent with previous empirical work (Baye et al, 2003, Haynes & Thompson, 2008). However, the gap between the two lowest priced sellers declines as the number of sellers increases, which is consistent with the findings of (Baye et al, 2004). The number of sellers does not appear to have a significant effect on the COV.

Price dispersion increases in the number of days since the product launch, consistent with prior empirical work (Haynes & Thompson, 2008). The coefficient is positive in all the models, and significant for value of information, and one of the gap models.

In addition to the results presented in Table 3, several other model specifications were included. Most notably, a model in which dummy variables were included for each day
following the cost change event. Results were similar and less informative, so these were excluded from the final models.

6. Conclusion

This paper attempts to distinguish between several theoretical frameworks that attempt to explain price dispersion in competitive markets for homogeneous products. Some frameworks rely on marginal cost differences to explain different prices, while others recognize that equilibrium price dispersion can occur even when firms are identical. The results in this paper lend support to both frameworks. While we cannot observe the marginal cost of each firm, we analyze market price levels following pricing changes that we know to impact some of the firms in the market place. By several different measures, price dispersion is greatest immediately following a price change, and then declines. This suggests that heterogeneity in firms’ marginal costs and firms’ reactions to marginal cost changes may explain a significant portion of the price dispersion in online markets. This is indicated by the fact that the gap between the lowest price and the second lowest price is more than twice as large in the five days following a marginal cost change. While these observations give support to marginal cost differences as an important driver of price dispersion, it is important to note that even during long periods of steady costs, price dispersion is significant and consistent with previous empirical work. This suggests that marginal cost differences are only a partial explanation, and that, consistent with clearinghouse models (Baye & Morgan, 2001), price dispersion would continue to exist in the absence of these differences.

There are limitations to the approach taken in this line of research, most notably that we only have marginal cost information from a single firm, and must rely on their experiences as an indication of the entire market. However, even if there is some heterogeneity in the cost
changes, this research still allows us to understand the importance of marginal cost differences and different responses to changes as an important attribute in determining relative price levels. Having cost information from multiple retailers would be valuable, however data limitations may make that very difficult. In addition, it is difficult to know whether the heterogeneous response to a cost change is a function of different retailers having cost changes at different times, or the result of differences in menu costs that lead to a different response to identical cost changes. The first case is conceivable if the OEM is pursuing some sort of price discrimination strategy in which it treats its retailers differently. We take some comfort in the fact that the Robinson-Patman Act of 1936 makes this sort of price discrimination illegal unless it is the result of differential costs. In the latter case, different firms have different abilities or strategies in responding to a change in the competitive environment.

There are several competitive implications for this research. First, as Baye & Morgan (2001) point out, the price comparison sites (gatekeepers) are profit-maximizing entities. To the extent that they thrive in providing information to consumers, price dispersion is a key element in providing value to consumers and earning returns. Without price dispersion, consumers have no incentive to search, and gatekeepers are unable to charge fees for listing prices. It is not surprising then that electronics goods are the most commonly searched for item on price comparison sites. Products with relatively short lifecycles and frequent cost changes throughout the lifecycle are more likely to have greater price dispersion, thereby increasing the value of search (VOI) and the value of gatekeepers. By contrast, this research would suggest that products with longer lifecycles and fewer marginal cost changes would exhibit lower levels of price dispersion, and more closely resemble perfectly competitive markets.
Table 1 - Summary statistics of Cost Changes

<table>
<thead>
<tr>
<th>Product</th>
<th>Obs.</th>
<th>Ave price across all sellers during period</th>
<th>Average daily number of sellers</th>
<th>Average number of days since product launch</th>
<th>Cost changes during sample period</th>
<th>Ave cost change</th>
</tr>
</thead>
<tbody>
<tr>
<td>Canon A610</td>
<td>92</td>
<td>207.53</td>
<td>46.7</td>
<td>250.2</td>
<td>1</td>
<td>-16.9%</td>
</tr>
<tr>
<td>Canon A620</td>
<td>114</td>
<td>257.44</td>
<td>60.8</td>
<td>232.6</td>
<td>2</td>
<td>-11.6%</td>
</tr>
<tr>
<td>Nikon Coolpix S6</td>
<td>54</td>
<td>311.23</td>
<td>43.1</td>
<td>89.8</td>
<td>1</td>
<td>-11.1%</td>
</tr>
<tr>
<td>Nikon D50</td>
<td>24</td>
<td>517.04</td>
<td>7.7</td>
<td>352.6</td>
<td>1</td>
<td>-11.8%</td>
</tr>
<tr>
<td>Nikon D50 w/ lens</td>
<td>134</td>
<td>602.64</td>
<td>39.8</td>
<td>317.4</td>
<td>2</td>
<td>-7.2%</td>
</tr>
<tr>
<td>Canon EOS 20D</td>
<td>103</td>
<td>1,044.35</td>
<td>42.4</td>
<td>610.4</td>
<td>1</td>
<td>-13.8%</td>
</tr>
<tr>
<td>Canon Rebel Black</td>
<td>102</td>
<td>740.01</td>
<td>42.7</td>
<td>429.5</td>
<td>1</td>
<td>-10.2%</td>
</tr>
<tr>
<td>Canon Rebel Silver</td>
<td>97</td>
<td>729.90</td>
<td>59.9</td>
<td>430.0</td>
<td>1</td>
<td>-10.2%</td>
</tr>
<tr>
<td>Canon S80</td>
<td>90</td>
<td>422.35</td>
<td>48.7</td>
<td>212.9</td>
<td>1</td>
<td>-10.1%</td>
</tr>
<tr>
<td>Sandisk 1GB EXT III CF</td>
<td>133</td>
<td>73.13</td>
<td>15.4</td>
<td>562.2</td>
<td>2</td>
<td>-30.7%</td>
</tr>
<tr>
<td>Sandisk 2GB EXT III CF</td>
<td>105</td>
<td>112.60</td>
<td>15.2</td>
<td>560.4</td>
<td>1</td>
<td>-47.8%</td>
</tr>
<tr>
<td>Sandisk 2GB ULT II CF</td>
<td>120</td>
<td>82.24</td>
<td>53.8</td>
<td>837.1</td>
<td>1</td>
<td>-54.3%</td>
</tr>
<tr>
<td>Sandisk 4GB EXT III CF</td>
<td>127</td>
<td>229.07</td>
<td>12.2</td>
<td>565.6</td>
<td>1</td>
<td>-42.5%</td>
</tr>
<tr>
<td>Canon SD450</td>
<td>118</td>
<td>254.18</td>
<td>58.0</td>
<td>234.3</td>
<td>1</td>
<td>-15.3%</td>
</tr>
<tr>
<td>Canon SD550</td>
<td>121</td>
<td>322.27</td>
<td>61.7</td>
<td>235.1</td>
<td>1</td>
<td>-12.0%</td>
</tr>
<tr>
<td></td>
<td>Cost change within prior 5 days</td>
<td>Cost change prior 5-10 days</td>
<td>Cost change prior 10-20 days</td>
<td>Cost change prior 20+ days</td>
<td></td>
<td></td>
</tr>
<tr>
<td>--------------------------------</td>
<td>---------------------------------</td>
<td>-----------------------------</td>
<td>-----------------------------</td>
<td>---------------------------</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Median price dispersion (VOI)</td>
<td>0.2238</td>
<td>0.1414</td>
<td>0.1332</td>
<td>0.1428</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Coefficient of variation</td>
<td>0.1193</td>
<td>0.1375</td>
<td>0.1302</td>
<td>0.1220</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gap</td>
<td>0.0547</td>
<td>0.0244</td>
<td>0.0222</td>
<td>0.0221</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Observations</td>
<td>81</td>
<td>76</td>
<td>158</td>
<td>1215</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Mod. 1</td>
<td>Mod. 2</td>
<td>Mod. 3</td>
<td>Mod. 4</td>
<td>Mod. 5</td>
<td>Mod. 6</td>
</tr>
<tr>
<td>------------------</td>
<td>---------</td>
<td>---------</td>
<td>---------</td>
<td>---------</td>
<td>---------</td>
<td>---------</td>
</tr>
<tr>
<td>Number of sellers (N)</td>
<td>0.00173 ***</td>
<td>0.00158 ***</td>
<td>0.00016</td>
<td>0.00014</td>
<td>-0.00055 ***</td>
<td>-0.0006 ***</td>
</tr>
<tr>
<td></td>
<td>(7.12)</td>
<td>(6.67)</td>
<td>(1.19)</td>
<td>(1.07)</td>
<td>(3.80)</td>
<td>(4.65)</td>
</tr>
<tr>
<td>Days on market</td>
<td>0.00058 ***</td>
<td>0.00035 ***</td>
<td>0.00003</td>
<td>0.00000</td>
<td>0.00016 ***</td>
<td>0.00001</td>
</tr>
<tr>
<td></td>
<td>(7.69)</td>
<td>(5.88)</td>
<td>(0.68)</td>
<td>(0.13)</td>
<td>(3.64)</td>
<td>(0.38)</td>
</tr>
<tr>
<td>Days since cost change (Log)</td>
<td>-0.02420 ***</td>
<td>-0.00577 ***</td>
<td>-0.01222 ***</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(8.58)</td>
<td>(3.70)</td>
<td>(7.34)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cost change 5 days</td>
<td>0.10237 ***</td>
<td></td>
<td>0.00008</td>
<td></td>
<td>0.03441 ***</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(11.60)</td>
<td></td>
<td>(0.02)</td>
<td></td>
<td>(6.44)</td>
<td></td>
</tr>
<tr>
<td>Cost change 5-10 days</td>
<td>0.01913 **</td>
<td></td>
<td>0.02395 ***</td>
<td></td>
<td>0.00546 (1.00)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(2.11)</td>
<td></td>
<td>(4.73)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cost change 10-20 days</td>
<td>0.00466 (0.70)</td>
<td>0.01945 ***</td>
<td></td>
<td>0.00520 (1.29)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>(5.24)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Constant</td>
<td>-0.07609 **</td>
<td>-0.0725 **</td>
<td>0.12638 ***</td>
<td>0.11626 ***</td>
<td>0.02485 (1.41)</td>
<td>0.04325 **</td>
</tr>
<tr>
<td></td>
<td>(2.55)</td>
<td>(2.41)</td>
<td>(7.64)</td>
<td>(6.89)</td>
<td>(2.37)</td>
<td></td>
</tr>
<tr>
<td>Observations</td>
<td>1534</td>
<td>1534</td>
<td>1534</td>
<td>1534</td>
<td>1534</td>
<td>1533</td>
</tr>
<tr>
<td>Products</td>
<td>15</td>
<td>15</td>
<td>15</td>
<td>15</td>
<td>15</td>
<td>15</td>
</tr>
<tr>
<td>F-Test</td>
<td>34.92</td>
<td>34.29</td>
<td>8.1</td>
<td>11.07</td>
<td>27.63</td>
<td>14.09</td>
</tr>
</tbody>
</table>

All models are fixed effects regressions on an unbalanced panel of 15 products.

In models 1 & 2, the dependent variable is price dispersion measured as (Median-Minimum)/Min Price
In models 3 & 4, the dependent variable is price dispersion measured as COV = SD/mean price
In models 5 & 6, the dependent variable is percentage difference between the two lowest prices

***p=.01, **p=.05, *p=.10
Figure 1: Price Dispersion Following a Cost Change
References


