Can Price Matching Defeat Showrooming?*

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Abstract

We study the impact of Best Buy’s recent price-matching policy on the price competition between Best Buy and Amazon, and examine whether the policy can defeat consumers’ showrooming behavior. We first empirically explore Best Buy’s and Amazon’s pricing patterns by using unique datasets collected from different sources. We find that both retailers reacted to the new policy; Best Buy and Amazon adjusted prices in the same directions. However, the directions vary across product categories. For products for which a consumer can obtain a large value from physical store experiences – i.e., the “showrooming” products – we find that both Best Buy’s and Amazon’s prices went down. In addition, Amazon cut prices more aggressively than Best Buy. For “non-showrooming” products, or the products for which consumers benefit less from store experiences, we find the opposite patterns – prices went up for both Best Buy and Amazon after the implementation of the policy.

We then develop an analytical model to explain the observed data patterns. Two retailers competing on a Hotelling line are assumed to focus on both profit maximization and relative competitive performances. Consumers who may or may not be aware of the price-matching policy optimally decide which store(s) to visit and where to make the purchase. We show that the effect of the price-matching policy depends on the additional value that consumers could obtain from visiting a physical store. Both retailers would raise prices when this value is small but would compete more aggressively on prices when this value is large, which is consistent with the data. We also show that for “showrooming” products, both retailers’ profits are lower as a result of the policy, but the online retailer’s payoff may actually increase.

Keywords: Price matching, Showrooming, E-commerce

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1 Introduction

“A year ago, people said that showrooming would kill Best Buy. I think that Best Buy has killed showrooming.”

— Hubert Joly, CEO, Best Buy

“Showrooming” behavior of consumers – i.e., viewing an item in a physical store and then buying it online – poses a significant threat to traditional brick-and-mortar retailers. Online retailers such as Amazon are well known for selling products at much lower prices than brick-and-mortar competitors such as Best Buy. Recently-developed mobile apps have made price comparison across stores almost effortless for consumers. As a result, consumers looking for savings may use physical stores as a showroom to test out and try on items, but then make the actual purchase from online retailers. This practice is detrimental to brick-and-mortar stores because they incur significant costs to maintain the showroom and provide customer service that would no longer generate revenue. Reports say that brick-and-mortar based retailers such as Best Buy have been losing out sales for years due to the increase in consumer “showrooming” behavior.\(^1\) For example, in the last quarter of 2011, Best Buy’s same-store sales decreased by more than 5%.\(^2\)

The challenge for brick-and-mortar retailers in competing with online retailers is to keep shoppers within the store and to prevent them from simply using the store as a showroom. In the battle for retail shoppers, Best Buy initiated a price-matching policy in 2012 that promised to match the prices not only of its local competitors, but also of a few major online retailers. Best Buy extended this policy permanently in early 2013 to include 19 major online retailers, including Amazon, Apple and Buy.com.\(^3\) According to Best Buy,


the introduction of this policy was expected to benefit the company because it could end consumer “showrooming” behavior. However, some people argued that it would remind consumers of the general price disadvantage of Best Buy versus its online competitors; others warned that having head-to-head, open-ended price competition with Amazon might not be a wise move (Tuttle, 2012).

A similar debate exists in the literature about whether price matching guarantees are anticompetitive or procompetitive. Analytical research in economics and marketing has found support for both views (see Salop (1986) and Corts (1997), for example). The introduction of Best Buy’s price-matching policy provides us with a unique opportunity to empirically examine the effect of price matching guarantees on market prices and competition between major retailers in this market. In this paper, we focus on the impact of Best Buy’s price-matching policy on the price competition between Best Buy and its major online competitor, Amazon. Best Buy was hit particularly hard by consumer showrooming because it was among the retailers that Amazon customers visited most as a showroom.4 We use both empirical and analytical methods to examine whether the policy is anticompetitive or procompetitive. We further shed light on whether Best Buy’s price-matching policy is a smart move to defeat showrooming – i.e., whether Best Buy would be better off as a result of the policy.

Showrooming generates value for consumers because, in general, they find it beneficial to physically test or experience the products. Visiting a Best Buy store can create additional value compared to buying directly from Amazon, and the value comes from two sources – one due to better product fit and the other due to the additional customer service provided by Best Buy. Consumers often need to compare different alternatives when shopping for a particular type of product. For instance, when shopping for a new TV, they are usually not sure whether a Sharp LED TV or a Samsung LCD TV will better fit their needs or what size TV will work better in their living room. Consumers run the risk of buying a mismatched product if they purchase directly online because they are not able to completely

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resolve these uncertainties. Best Buy also provides additional sales assistance and service that consumers appreciate and cannot get from the online retailer. The benefit of visiting a physical store, however, may not be the same for all product categories. For some categories, visiting a brick-and-mortar store does not create much value either because the variation across brands and models is less important or because the consumer’s uncertainty about the products could be easily resolved through online descriptions. We define such products as the “non-showrooming” products in our context. On the contrary, the “showrooming” product categories contain products for which consumers generally find a physical store experience much more valuable.

We compile a unique dataset from multiple sources that contains Amazon’s and Best Buy’s price information for a number of different product categories. We first empirically explore Best Buy’s and Amazon’s pricing patterns before and after the price-matching policy. We then examine the price change of each product through regression models that incorporate both item-specific effects and retailer time trends. Our results reveal that the direction and magnitude of price changes vary systematically across product categories for both Best Buy and Amazon. For the “showrooming” product categories, both Best Buy’s and Amazon’s prices decreased after the price-matching policy was implemented. Moreover, Amazon’s prices decreased more than Best Buy’s, making the price disparity between them even larger. For the “non-showrooming” product categories, we find exactly the opposite pattern – prices went up for both Best Buy and Amazon after the price-matching policy. Thus, we find that Best Buy’s price-matching policy can be both anticompetitive and pro-competitive, depending on the focal product category. Previous studies have not observed this divergent effect of price matching across product categories.

In order to better understand the empirical findings, we present a theoretical demonstration of why divergent effects of price match may be observed in the same industry. We propose an analytical model that captures the key characteristics of the market. First, the model captures the idea that the additional services provided by a physical store are valu-
able to consumers. This benefit is larger for the “showrooming” product categories than for the “non-showrooming” categories. Second, not all consumers will take advantage of the price-matching policy, which could be attributed to several reasons: some consumers might not be informed about the price-matching policy; others might find it too costly to claim the refund. Third, consumers have different costs associated with shopping online versus offline. Some consumers prefer shopping online to shopping in a physical store, while others like physical stores more than online stores.

In the model, we assume that the retailers are reference-dependent. The fact that consumers have reference-dependent preferences is a well-established phenomenon in marketing (Kahneman and Tversky, 1979; Winer, 1986; Kalwani and Yim, 1992; Hardie et al., 1993; Rajendran and Tellis, 1994; Kalyanaram and Winer, 1995; Lynch Jr and Ariely, 2000; Feinberg et al., 2002; Bolton et al., 2003). There is also an increasing body of literature showing that firms, like consumers, are also reference-dependent (Lev, 1969; Frecka and Lee, 1983; Fiegenbaum and Thomas, 1988; Fiegenbaum, 1990; Fiegenbaum et al., 1996; Ho and Zhang, 2008; Farber, 2008; Ho et al., 2010; Hsieh et al., 2015). That is, they not only care about their own performance, but also evaluate their performance with respect to a certain reference point. There could be several reasons why firms may have reference-dependent incentives. One reason is that setting reference points may help firms strategically align their internal resources with external conditions (Fiegenbaum et al., 1996). Another possible reason is that looking at external reference points, such as the competitors’ performance, will help justify the firm’s increasing level of commitment in a competitive market (Hsieh et al., 2015). A third explanation might have to do with the fact that modern firms usually pursue multiple goals at the same time (Whitehead, 2014), pertaining to different variables such as profit, market share and stock market performance. Since investors’ evaluation of the firm may be affected by its financial performance relative to that of others, referencing competitors’ performance may be in line with the firm’s stock market goals. After all, firms, no matter how large of small, are run by humans. It is not surprising that they could be subject to the
same behavior anomalies that consumers have been documented to have (Goldfarb et al., 2012). One variable that frequently serves as reference points is the performance of their competitors (Lev, 1969; Porter, 1980; Frecka and Lee, 1983; Hsieh et al., 2015). Lev (1969), for instance, found evidence that many firms use industry averages as their reference points. In fact, competitors are the most well-recognized external reference points in the strategic management literature (Fiegenbaum et al., 1996). In light of these findings, we propose a model in which retailers’ payoffs depend on both their own profits and their competitors’ profits.

We show that the observed empirical patterns could arise as the equilibrium outcome of a market with the aforementioned characteristics. The main prediction of the model is that prices of both retailers would change in the same direction due to price matching, but the direction of change depends on the size of the additional value that consumers obtain from visiting a physical store. When the additional value is relatively small – i.e., for the “non-showrooming” product categories, both retailers’ prices are higher as a result of the price match guarantee; the opposite is true when the additional value is relatively large – i.e., for the “showrooming” categories. Moreover, when prices decrease due to price match, the online retailer reduces price more than the physical retailer, which is consistent with the empirical finding.

Although we are unable to empirically test the profit and payoff implications because of the lack of sales information, the analytical model could provide insights into the profit and payoff implications of Best Buy’s price-matching policy. When the price-matching policy results in lower prices, both retailers’ profits are also lower. Even when the policy implies tacit pricing collusion between the two retailers, their profits may be hurt because more consumers are paying the lower of the two prices by utilizing price matching.\(^5\)

Overall, our paper empirically tests the impact of Best Buy’s price-matching policy on

\(^5\)Some investors estimated that Best Buy’s price-match promise could cost it more than $400 million of gross profit in a quarter after its online price-matching policy. See http://pando.com/2012/11/12/best-buys-amazon-price-match-is-a-400m-all-in-bet-it-cant-win/
Best Buy’s and Amazon’s prices. We develop a theoretical model that is able to predict the
data patterns and provides insights into the profit and payoff implications for both retailers.
Our research contributes to the literature in three ways. First, the literature studies price
match guarantees mainly theoretically (Moorthy and Winter, 2006; Jiang et al., 2012), and,
to our knowledge, there exist very few empirical studies on this topic, with the exception of
Hess and Gerstner (1991). We contribute to this stream of research by providing a unique
and systematic empirical examination of the effects of price matching. Second, we study the
competition between an online retailer and a brick-and-mortar store. This is different from
pure online or offline competition because the two competing firms in our data are asymmetric
and provide different values to consumers. Third, we provide a possible explanation for the
divergent price patterns observed in the data from a new perspective.

The rest of the paper is organized as follows. We provide a review of related research in
economics and marketing in Section 2. In Section 3, we present a detailed description of the
market background and the datasets we collected. Section 4 discusses the main empirical
findings from the data. We develop a theoretical model in Section 5 to provide further
insights on the main findings, and conclude the paper in Section 6.

2 Relevant Literature

Our research project explores, both theoretically and empirically, the impact of online price
matching on retail competition between online and offline channels. The paper builds
on several research streams. The first stream investigates how consumers choose between
shopping online and offline in the context of multichannel retail. The second stream examines
the impact of price match guarantees on competition.

For consumers, one of the primary benefits of shopping with an online retailer is con-
venience and the ability to avoid trips to local retailers. Therefore, factors that affect the
convenience of offline and online shopping should influence consumers’ choices between pa-
tronizing brick-and-mortar or online retailers (Chintagunta et al., 2012; Forman et al., 2009). Furthermore, with new e-commerce technologies, supply chain costs are reduced. Hence, online retailers may offer lower prices due to lower costs. However, the online channel keeps consumers from inspecting the goods before purchase. Consumers benefit from using the brick-and-mortar stores to evaluate products because many product attributes are non-digital in nature and are difficult to assess online (Lal and Sarvary, 1999; Mehra et al., 2013). There is also a delay between purchase and consumption if a consumer purchases online.

The current research is also related to a large literature in economics and marketing on price match guarantees. Many papers have studied the effect of price match guarantees on competition and coordination between firms, and the opinions so far have been mixed. Some studies have found price matching to be anticompetitive (Salop, 1986; Zhang, 1995; Moorthy and Winter, 2006; Hviid and Shaffer, 2010). In his pilot study, Salop (1986) discussed the possibility of using price match guarantees to facilitate coordination between competing firms and to raise competitive prices to the monopoly level. Matching competitors’ prices changes affects a firm’s incentive to reduce its own price and its competitor’s incentive to lower price, and, therefore, facilitates tacit collusion between oligopolistic firms. Using a Hotelling model with endogenous location choices, Zhang (1995) also found that price matching implies tacit collusion between firms by leading to increased market prices. Moorthy and Winter (2006) provided additional support for the anticompetitive effect of price matching by showing that in the existence of uninformed consumers, price matching can be used to credibly signal low prices. Some other studies have also established the anticompetitive role of price match guarantees.

The idea that price match guarantees work as a collusion mechanism was later challenged because the trade press usually viewed the announcement of price-matching policies as the initiation of a price war. Corts (1995) studied a situation in which price matching can lead to more competitive outcomes in a market – allowing firms to adopt a policy that not only
matches their competitor's price, but also offers additional compensation for finding a lower price elsewhere. He showed that when firms are allowed to choose a price-matching policy that effectively undercuts competitors, price matching is no long anti-competitive, in the sense that it does not lead to monopoly prices in the market. Belton (1987) examined a situation similar to that in Corts (1995) and established conditions under which price match guarantees are cooperative or procompetitive. He proved that a price match guarantee may lead to lower market prices, while pointing out that a necessary condition for this to occur is for the firm with the higher cost to offer price matching. In a separate study, Corts (1997) showed that price-matching policies could lead to lower prices if there exist both sophisticated and unsophisticated consumers in the market, and the price sensitivity of sophisticated consumers is stronger than that of unsophisticated consumers. His research also suggested that firms with higher prices are more likely to offer price match guarantees. Chen et al. (2001) also showed that price matching can be either anti- or pro-competitive depending on the structure of the consumer market. On the one hand, the presence of consumers who always shop at a particular retailer, but who may take advantage of saving opportunities by utilizing price match guarantees decreases the profit loss of the retailer from cutting price and leads to intensified price competition. On the other hand, consumers who search around for lower prices before making their purchase decisions are discouraged from searching by the presence of price match guarantees, leading to a lower incentive to offer price promotions. Price matching has different implications for competition in different market structures. Hviid and Shaffer (1999) and Jain and Srivastava (2000) also support the conclusion that price matching can either promote or diminish competition.

3 Data

In order to understand the competitive reactions to Best Buy’s price-matching policy, we collect historical price information from Best Buy and its major online competitor, Amazon,
before and after the policy change. We develop a computer program to crawl the historical price information of both retailers from a major price-tracking website. The website tracks daily price information over millions of items sold by major retailers such as Best Buy and Amazon. To get information from a large and representative sample, we start by collecting the list of products available on the Best Buy website and local stores under each product category.\(^6\) We then search for each product’s price history from both Best Buy and Amazon based on the product’s UPC code. We exclude those missing observations if the price record is not available from the tracking website.\(^7\)

This process results in 13,947 products that have at least a partial price history from either Best Buy or Amazon. Out of these products, 3,605 products have price information from both. In certain situations, it is possible that Amazon and Best Buy have different UPCs for the same product. We are not able to identify and match those items. In this paper, we restrict our attention mainly to the products for which we have a price history from both retailers. As a robustness check, we also include some Best Buy private label products in our analysis.

Best Buy carries products online, in the brick-and-mortar store, or both. According to Best Buy, the online and offline prices listed are exactly the same for the same product. To examine the potential differences in the price competition, we distinguish the products that are widely available in local stores from those sold only at a limited number of stores or exclusively in the online channel. We check product availability across all the Best Buy stores in the U.S. and define the products carried by fewer than 200 of the 1149 operating stores as “Best Buy major online products” and the rest as “Best Buy major store products.”\(^8\) In addition, Best Buy carries a few major private label brands such as “Dynex,” “Rocketfish”

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\(^6\)We do not start with Amazon to collect the list of products because Amazon offers a much larger selection of products. In addition, the focus of the paper is on the direct price competition between Amazon and Best Buy. So the products carried exclusively by Amazon are less likely to be affected by the new policy.

\(^7\)Some UPCs can not be matched exactly with any product on the tracking website. However, most of the top-selling products are matched in our case.

\(^8\)The store availability information is available on Best Buy website. We checked the availability of the products twice, in August 2013 and May 2014. We define an item as available at a particular store if it is available in at least one of the two observations.
and “Insignia.” We also include those items as “Best Buy private label products.” The number of products across different departments in our sample are summarized in Table 1. In total, we have 932 major store items, 2,673 major online items, and 436 private label items. The main purpose of the Best Buy policy change is to defeat showrooming. Thus, the impact on price competition between Best Buy and Amazon for the “Best Buy major store products” is the main focus of our study. We also carry out analyses on the other two product categories as supplementary comparisons.

We next classify the products in our sample into two categories: the “showrooming” products and the “non-showrooming” products. We want to point out that the classification is based on relative terms. In most cases, a consumer would find it valuable to have the opportunity to view and experience the real product in-store. This is because consumers often have heterogeneous preferences and need to compare different brands and models when shopping for a particular type of product. They may run the risk of buying a mismatched product when directly shopping at an online retailer. We base our classification of the products into the two categories on two factors: a) the degree of the in-store experience value to consumers in that particular product category and b) whether Best Buy provides direct and easy access for consumers to experience the product. We define showrooming products as products for which consumers generally prefer a store visit to obtain complete information on product quality and fit. In particular, products that Best Buy has on display in stores, such as TVs, Computer Tablets and Cameras, are typical examples of showrooming products. In contrast, we classify products for which the additional value of a store experience is relatively low as “non-showrooming” products. Note that the classification of items into the two categories is at the “product class” level, as defined on the Best Buy website. The classification process went through two stages. Three research assistants each evaluated a list of sample products in each product class and rated the product class as showrooming vs non-showrooming. Most of the product classes are rated consistently among them. In a follow-up stage, we surveyed a team of sales person at a Best Buy store and ask them...
to provide detailed comments on whether consumers can easily experience products in each category, and whether they frequently get questions from consumers. We modified our initial list based on their feedbacks and they agreed that our updated list made sense to them. Table 2 displays the classification. For example, digital cameras is classified as a showrooming product, because according to Best Buy employees, they have “open display; are operational and consumers can play through the settings and compare different models”; on the other hand, lenses is classified as a non-showrooming product class, because they are “shown in glass display cases, therefore consumers can see but cannot touch or use them; most consumers know which brand and type they want to buy.”

4 Empirical Patterns

In this section, we present empirical patterns of the price competition between Best Buy and Amazon. We are particularly interested in the comparisons of prices before and after Best Buy’s new price-matching policy. The original data record daily prices for each product. For our empirical analysis, we create and test several measures that closely reflect the nature and degree of price competition: Best Buy price index, Amazon price index and the price dispersion between the two. We first aggregate the price data for each product into average monthly price levels and use that as the basis for the construction of our measures. The Best Buy price index and Amazon price index are constructed based on the relative ratio of the average price in each month to the introductory price (regular price) when a product was launched. In our data, the regular price is always recorded, so that it is easy to directly construct these two measures. The advantage of using the price indexes instead of raw prices is that the measures are implicitly normalized across items and are directly comparable to each other. The third measure, price dispersion, is defined as the ratio of the difference between Amazon and Best Buy prices to the average of the two prices. We use the Amazon price minus the Best Buy price as the price difference. Thus, a negative price dispersion

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9 The complete survey response from Best Buy employees is available from the authors upon request.
means that, on average, Amazon has lower prices than Best Buy in the particular month for a particular product item.

As we are interested in the impact of the price-matching policy and how it interacts with the showroming effect, we define two dummy variables to capture these factors. The first variable, price matching, indicates whether it is before or after the new price-matching policy is introduced. In our context, January 2010 to October 2012 is defined as the pre period and November 2012 to April 2014 is the post-price-matching period. The showroming variable, as defined in Table 2, indicates whether a product is classified into the showroming category. The definitions of our constructed variables are listed in Table 3.

One common question regarding the price competition between Best Buy and Amazon is whether Amazon always offers a lower price. This question becomes even more relevant and important with the new price-matching policy. We provide a simple check of the price advantages between the two competitors in Table 4. This table summarizes the percentage of product-month observations where Amazon has a lower price, Best Buy has a lower price, or both have the same price across product categories. We also provide before and after comparisons in the table. As is evident from the table, Amazon clearly provides better average prices for consumers, but not always. In about 65%—70% of the instances, Amazon has consistently priced lower than Best Buy. Only about 5%—10% of the time, Best Buy and Amazon had the exact same average monthly price. This is true for both the Best Buy major store and Best Buy major online product categories and across both pre- and post-price-matching time periods. Intuitively, consumers might expect that after the new price-matching policy is implemented, Best Buy should price more the way that Amazon

\[1^{10}\text{Best Buy started to experiment with the price-matching policy in the holiday season of 2012. They officially made it permanent in March 2013. Given that there are only two months in between, we group all the months starting from November 2012 as the post-price-matching period.}

\[1^{11}\text{Our findings are consistent with some industry report claiming that 75 percent of the items offered by Best Buy are cheaper on Amazon, by 17 percent on average. See http://pando.com/2012/11/12/best-buys-amazon-price-match-is-a-400m-all-in-bet-it-cant-win/}.

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Insert Tables 1, 2, 3, 4 here.
does, so that it can deliver a consistent message to consumers with a low or “matched” price image. However, this is not the case in reality. It is very interesting to observe that after the new price-matching policy, Amazon was even more likely to have a lower price than Best Buy. This is especially the case for the Best Buy major store products, with an increase of 3% in the non-showrooming product categories and an even stronger 10% increase in the showrooming categories. In addition, in the post-price-matching policy period, non-showrooming products were more likely to have consistent prices between the two retailers than in the pre-price-matching period. However, the opposite is true for the showrooming products. Figures 1 and 2 further provide histograms regarding the price dispersion between the two retailers. Most of the time, the average monthly price from Amazon is 0%-20% lower than that from Best Buy. It seems that the dispersion distribution shrinks towards the middle for non-showrooming products and shifts towards the left for showrooming products in the Best Buy major store category.

The changes in price dispersion may be attributed to the reactions from either Amazon or Best Buy or both. To have a clearer picture of the competitive reactions to the price-matching policy, we use multiple regressions to examine the direction and magnitude of price adjustments. For all the regression analyses presented below, we include product item level fixed effects, monthly fixed effects as well as time trend variables to control for the heterogeneity across products and the seasonality and potential time trends in price adjustments. These factors are especially important for electronics products, for which dynamic pricing and seasonal pricing strategies are commonly observed in the marketplace. We run three regressions regarding the competitive reactions for the products in the Best Buy major store categories. This is the case in which the price-matching policy would potentially generate the largest impact because it creates direct structural changes in the nature of price competition between the two retailers. In addition, Best Buy adopted the price-matching policy solely to defeat showrooming for these products.
Table 5 presents results for the three regression equations. The two price matching with showrooming interactions are the focus of this analysis. First, regarding the Amazon price index, we find a significant effect of price increases (1.54%) for the non-showrooming products in the post period. However, we find a significantly different pattern for products in the showrooming category: prices, on average, were reduced by 5.34%. Best Buy adopted the exact same strategies as Amazon, at least directionally. On average, non-showrooming product prices increased by 5.76% and showrooming product prices decreased by 1.47%. The divergent results regarding the direction of price changes imply two different mechanisms at play. For products in the non-showrooming category, the price-matching policy seems to serve as a mechanism of tacit price collusion and resulted in an anti-competitive situation that reduced consumer welfare in the marketplace. On the other hand, for products that are in the showrooming category, the price-matching policy caused both retailers to reduce prices—a pro-competitive situation. Comparing the magnitudes of price adjustments between Amazon and Best Buy, we find that Amazon responded more aggressively for the showrooming products, while Best Buy made more significant changes for the non-showrooming products. Finally, the price adjustments from the two competitors lead to the changes in terms of price dispersion, which are captured in the third regression equation. Both interaction variables show a significantly negative impact, which indicates that the general price gap between Best Buy and Amazon has increased since Best Buy began matching Amazon’s online prices. The magnitudes are quite similar between the showrooming products and non-showrooming products. This is, to some degree, a surprising finding. Even though the price-matching policy is intended to deliver a low-price image to consumers, Best Buy (strategically) fails to close the price gap.

To further check the competitive effect of the price-matching policy, we conduct the same exercise on the common products that are carried mainly by Best Buy’s online channel. We use this as a robustness check. The results are presented in Table 6. Overall, the focal estimates are either insignificant or have smaller magnitudes. For the non-showrooming
product, Amazon would still increase prices. For showrooming products, although both of the competitors would reduce prices, the magnitudes are much smaller compared to the case of the major store products. The resulting price dispersions do not change significantly. In addition, the R-squared measures are much smaller than in the previous analyses, which indicates that price adjustments are more random.

Finally, we conduct another comparison in the case of Best Buy’s private label products. These products do not directly compete with Amazon. If the price-matching policy reduced the practices of consumer showrooming, Best Buy may face more opportunities to cross-sell products in this category to consumers that shop at their stores. In this case, Best Buy would have incentives to increase the prices. Table 7 confirms this prediction. Prices in both the non-showrooming and showrooming categories increase significantly, with the latter increasing as much as 11.81%!

The empirical analysis we conduct reveal interesting findings about the divergent effects price matching had on different product categories. Although existing research on price match guarantees provides explanations for both the anticompetitive and procompetitive aspects of the policy, explaining the observed patterns in our data remains a difficult task. One possible way to explain the observed divergence is to integrate existing models that predict either unconditionally anticompetitive results or procompetitive results. However, because these results were all derived in separate studies using distinct models, it is very difficult to coordinate the disparities between different models and apply the results to product categories within the same industry.

An alternative approach is to adopt the results of an existing study that examines the anticompetitive and procompetitive effects of price matching under different conditions. This, however, also proves to be quite challenging. For example, Chen et al. (2001) found that the implications of price matching for competition depend on the proportions of different consumer segments in the market. It is hard to explain the observed patterns in our research
through their model because our observations take place among product categories in the same industry, mainly electronics products. The underlying market structure and consumer behavior are unlikely to vary systematically among these product categories. Thus, their model is better suited to explaining the divergence in market outcomes across industries and markets. Corts (1997) proposed a different theory and asserted that the competitive effect of price match guarantees can be explained by the different price sensitivity levels of sophisticated and unsophisticated consumers. This model, again, does a better job of capturing the divergence across different industries. Jain and Srivastava (2000) examined consumers’ attitudes towards price match guarantees through experiments and incorporated the findings into a theoretical model to study the effect of price matching on competition. They demonstrated that the effect depends on the differentiation level among competing retailers. Price match leads to higher market prices when retailers are poorly differentiated and lower prices when they are highly differentiated. While this model might be able to explain the divergent price patterns we found between showrooming and non-showrooming product categories, it predicts a smaller price gap between retailers after a price match policy is implemented, which contradicts the findings of our study.

For these reasons, we would like to develop a simple framework that has the ability to predict the observed data patterns. In the next section, we propose such a model that uses the Hotelling framework and provides theoretical explanations about why the showrooming status of a product category may confound the effect of the price-matching policy offered by Best Buy. The model also allows us to examine the profit implications of the price-matching policy across different categories, which could not be studied using empirical methods.
5 Theoretical Demonstration

5.1 Model Setup

We assume that there are two retailers competing for a unit mass of consumers in a particular product category. One of the retailers is a brick-and-mortar store (Best Buy) and the other an online retailer (Amazon). Each consumer has demand for one unit product. Consumers need to incur a travel cost to shop at either retailer, and this cost is heterogeneous among consumers. For some consumers, it is more costly to shop at the physical store because they live far from the store. For others, it is more convenient to buy from the physical store either because they live close by or they are not familiar with online shopping. For simplicity, we model the distribution of consumer travel cost through a Hotelling model, in which consumers are uniformly distributed on a line between 0 and 1. For a consumer located at $x$ ($0 \leq x \leq 1$), the cost of visiting retailer 1 and 2 is $x$ and $1 - x$, respectively.\footnote{The specific distribution of travel cost among consumers is not essential to our results. The idea is to capture consumer heterogeneity in the costs associated with different options. Alternatively, one can assume the costs of visiting the two retailers to be independently distributed among consumers. All the main results of the paper will hold.}

Without loss of generality, we assume that retailer 1 is the physical store and retailer 2 is the online retailer. The two retailers are assumed to have identical cost structures, and we normalize both their fixed and variable costs to zero. We make this assumption in order to rule out any effect caused by cost discrepancy between the two retailers and focus purely on the interaction between showrooming and price match guarantee.

We consider two different scenarios – one in which the focal product category is a “showrooming” category and one in which it is a “non-showrooming” category – and compare the effect of price matching on competition in these two scenarios. To capture the idea that “showrooming” product categories offer higher value to consumers from visiting the physical store, we assume that consumers obtain a value of $V$ if they purchase from retailer 2 but obtain $V + \epsilon$ ($\epsilon > 0$) if they visit retailer 1 before making a purchase in a “non-showrooming” category. For a “showrooming” product category, consumers obtain a value of $V + \delta$ ($\delta > 0$).
and $\delta > \epsilon$) from visiting retailer 1. $\epsilon$ and $\delta$ capture the additional benefits from visiting the physical store, and $\delta - \epsilon$ captures the value disparity between “showrooming” and “non-showrooming” product categories. We further assume that $V$ is large enough to ensure full market coverage.

We assume that the two retailers in our model have reference-dependent payoff functions. Specifically, denoting retailer $i$'s profit by $\pi_i$, retailer $i$'s payoff function is $u_i = \pi_i + \theta(\pi_i - \pi_{3-i})$, $i = 1, 2$. The first component of the payoff function is the retailer’s own profit and the second component is its profit relative to the competitor’s. The parameter $\theta$ ($\theta \geq 0$) captures the reference dependence level of retailers, and is the same for both retailers. Note that when $\theta = 0$, the model reduces to a traditional model with profit maximization as the sole objective of the retailers.

The timeline of the model is as follows: retailers first set prices $p_i$ ($i = 1, 2$) simultaneously. Consumers then decide which retailer(s) to visit and to shop from. When examining consumers’ purchase decisions, we allow them to visit multiple stores before making their purchase decision. However, this is the not the same as a search model in which consumers incur search costs to find out prices at different retailers. In our model, the possibility of a consumer visiting multiple stores is not due to the incentive to search for a lower price. Consumers are fully aware of the prices charged by the two retailers once the prices are set. They may decide to visit multiple stores only to try out the actual products and enjoy the extra service offered by the physical store before finalizing their purchase decisions.

To model consumers’ reactions to price matching, we assume that there are two equal-sized consumer segments. Half of the consumers do not use the price-matching policy, either because they are not aware of the policy offered by retailer 1 or because their cost of redeeming the policy is too high. The other half of the consumers are aware of price matching and will use it if retailer 2’s price is lower when they decide to shop at retailer 1. A consumer’s response to the price-matching policy and his/her travel cost is assumed to be independent.
5.2 Results

In this section, we solve the model with and without the price match guarantee and examine whether showrooming status of the products affects the outcome of the price-matching policy. Note that the model without showrooming and that with showrooming can be solved in the same way because the sole distinction between the two scenarios is the magnitude of the additional value offered by retailer 1. For this reason, we present the solution for different values of $\delta$, and the same results apply to the model without showrooming as well. We then derive the implications based on the assumption that $\delta > \epsilon$.

5.2.1 No price match guarantee

We first look at the second stage of the model and examine consumers’ store visit and purchase decisions for given prices $p_1$ and $p_2$ observed by consumers. Consider a consumer located at $x$. Note that it is strictly suboptimal for the consumer to visit retailer 2 first and then buy from retailer 1, because visiting retailer 2 does not bring the consumer any incremental benefit. This means that if the consumer decides to visit retailer 2, she also expects to purchase from retailer 2, which will lead to a payoff of $y_2 = V - (1 - x) - p_2$. If she decides to visit retailer 1 instead, then she has the option of either buying from retailer 1 directly, in which case her payoff will be $y_1 = V + \delta - x - p_1$, or switching to retailer 2 to purchase, in which case her payoff will be $y_{12} = V + \delta - x - (1 - x) - p_2$. The optimal consumer behavior and the corresponding market share of the two retailers are summarized in Lemma 1.

**Lemma 1.** Define $x_1 = (1 + \delta - p_1 + p_2)/2$, $x_2 = \delta$ and $x_3 = 1 - p_1 + p_2$. When there is no price matching, consumers will make the following decisions in the second stage of the model.

1. **When $\delta \geq 1$**

   (a) If $p_1 - p_2 \leq 0$, all consumers will buy from retailer 1.
(b) If \(0 < p_1 - p_2 \leq 1\), consumers located at \([0, x_3]\) will purchase from retailer 1 and consumers located at \((x_3, 1]\) will visit retailer 1 first and buy from retailer 2.

(c) If \(p_1 - p_2 > 1\), all consumers will visit retailer 1 first and buy from retailer 2.

2. When \(\delta < 1\)

(a) If \(p_1 - p_2 \leq \delta - 1\), all consumers will buy from retailer 1.

(b) If \(\delta - 1 < p_1 - p_2 \leq 1 - \delta\), consumers located at \([0, x_1]\) will purchase from retailer 1 and consumers located at \((x_1, 1]\) will visit and buy from retailer 2.

(c) If \(1 - \delta < p_1 - p_2 \leq 1\), consumers located at \([0, x_3]\) will buy from retailer 1. Consumers located at \((x_3, x_2]\) will visit retailer 1 and buy from retailer 2. Consumers located at \((x_2, 1]\) will buy from retailer 2 directly.

(d) If \(p_1 - p_2 > 1\), Consumers located at \([0, x_2]\) will visit retailer 1 and buy from retailer 2. Consumers located at \((x_2, 1]\) will buy from retailer 2 directly.

The model we presented here is able to capture a diversity of consumer behavior in the presence of both online and offline environments. Lemma 1 summarizes their behavior for different values of \(\delta\). When the additional benefits offered by the physical store are large enough (\(\delta \geq 1\)), all consumers will visit the physical store first to check the products before they make a purchase. Some consumers may decide to purchase online if the online price is sufficiently low. When the additional benefits offered by the physical store are not very large (\(\delta < 1\)), only those consumers living relatively close to the physical store may check the products there before purchasing online. An interesting situation occurs when \(1 - \delta < p_1 - p_2 \leq 1\). Consumers located relatively close to retailer 1 will buy from retailer 1 directly because the cost difference between the two retailers is not enough to cover their travel costs. Consumers located in the middle of the line will find it optimal to check the products in store and buy online, while consumers located close to retailer 2 will buy online directly without visiting the physical store. Using the results in Lemma 1 to solve for the
optimal pricing decisions of retailers at the first stage of the model, we have the results in Lemma 2.

**Lemma 2.** When there is no price matching, the equilibrium prices are as follows.

1. When \( \delta \leq \frac{(\sqrt{2}-1)(2\theta+3)}{2\theta+\sqrt{2}+1} \), \( p_{1n} = \frac{(1+\theta)(2\theta+2\delta\theta+\delta+3)}{(2\theta+1)(2\theta+3)} \) and \( p_{2n} = \frac{(1+\theta)(2\theta-2\delta\theta-\delta+3)}{(2\theta+1)(2\theta+3)} \)

2. When \( \delta \geq \frac{(2-2\sqrt{2})(4\theta+6+\sqrt{2})}{4\theta+6} \), \( p_{1n} = \frac{2(1+\theta)^2}{(2\theta+1)(2\theta+3)} \) and \( p_{2n} = \frac{(1+\theta)}{(2\theta+1)(2\theta+3)} \)

3. When \( \frac{(\sqrt{2}-1)(2\theta+3)}{2\theta+\sqrt{2}+1} < \delta < \frac{(2-2\sqrt{2})(4\theta+6+\sqrt{2})}{4\theta+6} \), no pure strategy equilibrium exists. The equilibrium is in mixed strategy with \( p_{1n} = \frac{(1+\sqrt{2})(1-\delta)(1+\theta)}{1+2\theta} \), and the average price of retailer 2 is \( p_{2n} = \frac{(2+\sqrt{2})(16\theta^2-8\delta\theta^2-8\sqrt{2}\theta^2+28\theta-10\sqrt{2}\theta-16\delta\theta-2\sqrt{2}\theta-3\sqrt{25-8\delta+12-\sqrt{2}})}{4(2\theta+1)(2\theta+3+\sqrt{2})} \).

The equilibrium prices depend on the value of \( \delta \). When the additional benefit offered by the showroom is small, consumers will either purchase from retailer 1 directly or retailer 2 directly in the equilibrium. No one will visit retailer 1 and buy from retailer 2. When the additional benefit is large, some consumers checking the products in the store and purchasing online is the equilibrium outcome. In fact, when \( \delta \geq 1 \), the additional benefit of showrooming is so large that all consumers will visit the showroom before deciding where to make the purchase.

### 5.2.2 With price match guarantee

We next consider the situation in which retailer 1 offers price matching but retailer 2 does not. Consumers who do not use price matching are not affected by this offer and will behave the same as when there is no such policy. For consumers who utilize price matching, their decision is the same as before if retailer 1’s price is lower than that of retailer 2. When \( p_1 > p_2 \), consumers in this segment can redeem price matching at retailer 1, so they expect to pay \( p_2 \) no matter where they shop. As a result, they will optimally decide to visit retailer 1 if \( x \leq (\delta + 1)/2 \) and retailer 2 otherwise. Note that when \( \delta \geq 1 \), \( (\delta + 1)/2 \geq 1 \), which means that all consumers who use price matching will optimally decide to buy from retailer 1 and redeem the price match guarantee.
Lemma 3. When retailer 1 offers price matching, the equilibrium prices of the two retailers are as follows.

1. When \( 0 < \delta \leq \frac{1}{4\theta + 3} \), the equilibrium prices are \( p_{1m} = \frac{(1+\delta)(\theta+1)}{2\theta+1} \) and \( p_{2m} = \frac{(1+\delta)(\theta+1)}{2\theta+1} \).

2. When \( \frac{1}{4\theta + 3} < \delta \leq \frac{(2-\sqrt{2})(4\theta^2+12\theta+9-\sqrt{2})}{(8\theta^2+24\theta-6\sqrt{2}\theta+12-3\sqrt{2})} \), the equilibrium prices are \( p_{1m} = \frac{2(1+\delta\theta^2+5\theta+8\theta+4)}{(2\theta+1)(2\theta+3)} \) and \( p_{2m} = \frac{\theta+1)(2\theta-6\theta^2+5+3\delta)}{(2\theta+1)(2\theta+3)} \).

3. When \( \frac{(4-\sqrt{2})(8\theta^2+24\theta+2\sqrt{2}\theta+18+\sqrt{2})}{2(28\theta^2+64\theta-2\sqrt{2}\theta+31+\sqrt{2})} \leq \delta \leq 1 \), the equilibrium prices are \( p_{1m} = \frac{4\theta^2+8\theta-2\theta^2-5-\delta}{(2\theta+1)(2\theta+3)} \) and \( p_{2m} = \frac{\theta+1)(2-2\theta^2-\delta)}{(2\theta+1)(2\theta+3)} \).

4. When \( \delta > 1 \), the equilibrium prices are \( p_{1m} = \frac{2\theta^2+3\theta^2+2}{(2\theta+1)(2\theta+3)} \) and \( p_{2m} = \frac{(\theta+1)(1-2\theta)}{(2\theta+1)(2\theta+3)} \).

5. When \( \frac{(2-\sqrt{2})(4\theta^2+12\theta+9-\sqrt{2})}{(8\theta^2+24\theta-6\sqrt{2}\theta+12-3\sqrt{2})} < \delta < \frac{(1-\sqrt{2})(8\theta^2+24\theta+2\sqrt{2}\theta+18+\sqrt{2})}{2(28\theta^2+64\theta-2\sqrt{2}\theta+31+\sqrt{2})} \), no pure strategy equilibrium exists. The equilibrium is in mixed strategy with retailer 1 charging \( p_{1m} = \frac{(1+2\sqrt{2})(6\theta-14\theta^2+2\sqrt{2}\theta-\sqrt{2}\theta-10\delta+2\sqrt{2}+10)}{14(2\theta+1)} \). The average price charged by retailer 2 in the equilibrium is given in the appendix.

5.3 Effect of price match guarantee and showrooming

Comparing the equilibrium prices in Lemmas 3 and 2, we obtained the following result.

Proposition 1. When \( \theta > 0 \), price matching leads to higher equilibrium prices when \( \delta < 1/(2\theta + 1) \) and lower equilibrium prices when \( \delta > 1/(2\theta + 1) \). When \( \theta = 0 \), price matching leads to higher price when \( \delta < 1 \) and no change in equilibrium prices when \( \delta \geq 1 \).

Proof. Follows from direct comparison of the prices given in Lemmas 2 and 3. \( \square \)

Proposition 1 presents a very interesting finding. When the additional value offered by retailer 1 is relatively small, the presence of the price match guarantee facilitates coordination between the two retailers and leads to higher equilibrium prices. This is because in this region, not too many consumers will use price matching at retailer 1, so retailer 2’s attempt to reduce the profit gap between the two retailers by cutting price will not be very effective.
Instead, retailer 2 can enhance its payoff more by trying to increase its own profit. Because the purchase decision of consumers who utilize price matching will not be influenced by the prices of the two retailers, retailers do not have to worry about losing demand from this segment of consumers if they raise prices. Consequently, both retailers have stronger incentives to increase prices. When the additional value offered by retailer 1 is large enough, the presence of price matching from retailer 1 intensifies competition between the two retailers. The intuition is that when the benefits of visiting the showroom are very large, the majority of or all consumers who are aware of the policy will optimally choose to visit retailer 1 and purchase with the price-matching policy. Retailer 2 can significantly reduce the gap between its own profit and its competitor’s profit by cutting its own price, which will cause retailer 1 to also reduce price in order to compete for those consumers who do not use price matching guarantee. We illustrate the equilibrium prices of the two retailers with and without price matching for $\theta = 1/3$ in Figure 3.

However, the competition-enhancing effect of price matching is observed only when $\theta > 0$, or, in other words, when retailers compare its profits with competitors. When $\theta = 0$, price matching can only play a role in softening competition between the two retailers. The reason is that when retailers are not reference-dependent, the existence of a price match guarantee by one retailer lowers the incentives of retailers to cut prices, because cutting price is not as effective in expanding demand as when there is no price matching. This finding is also consistent with existing literature — price match guarantees are found to be purely procompetitive in models adopting the Hotelling framework (e.g., Zhang (1995)). The divergent effect of price match guarantees can be observed only when retailers have reference-dependent payoff structures.

The conclusion in Proposition 1 also applies to the situation in which the additional value offered by retailer 1 is $\epsilon$. Since $\epsilon < \delta$, the presence of price matching may have different implications for competition with and without product showrooiming. There are three possible
scenarios: 1. Price matching leads to higher prices both with and without showrooming; 2. Price matching leads to lower prices both with and without showrooming; 3. Price matching leads to higher prices without showrooming, but to lower prices with showrooming. The last scenario is the most interesting one because it shows how the showrooming status of a product category can interact with the effect of price matching. It also shows that when the effect is different with and without showrooming, the result will always be higher prices without showrooming and lower prices in the presence of showrooming. The opposite situation can never happen. Also note that when price matching leads to lower equilibrium prices for the two retailers, retailer 2’s price decreases more than retailer 1’s, which is consistent with the empirical observation from Best Buy and Amazon.

We also investigated the implications of price matching on retailers’ profits and payoffs. Note that in our model, retailers’ payoffs are not the same as their profits unless \( \theta = 0 \). We summarize the results in Proposition 2.

**Proposition 2.** When \( \theta > 0 \) and \( \delta < 1/(2\theta + 1) \), both retailers’ equilibrium profits and payoffs are first higher than without price matching and then lower as \( \delta \) increases. When \( \theta > 0 \) and \( \delta > 1/(2\theta + 1) \), retailer 1’s equilibrium profit and payoff are always lower than when there is no price matching. Retailer 2’s equilibrium profit is lower than without price matching, but its payoff could be higher when \( \theta \) is relatively large.

**Proof.** Follows from direct comparison of the equilibrium profits and payoffs given in the proof of Lemmas 2 and 3.

Figures 4 and 5 show the equilibrium profits and payoffs of the two retailers with and without price matching for \( \theta = 1/3 \). As can be seen from the figures, the directional change in equilibrium profits and payoffs is not necessarily the same as that in prices. When both prices are higher due to price matching, retailers’ profits could actually decrease due to the change in market share and the fact that consumers can pay less by utilizing the price match guarantee. Retailers’ payoffs could also decrease because they are less successful in defeating
their competitors. When both prices are lower due to price matching, both retailers’ profits decrease as a consequence.

Insert Figures 4 and 5 here.

Figure 6 further shows retailers’ payoff changes with $\theta$ when $\delta \geq 1$. When $\delta \geq 1$, the equilibrium does not change with $\delta$. So, the figure shows how retailer 2’s payoff is affected by the presence of price matching when $\delta$ is large enough. The interesting thing is that price matching could have asymmetric effects on the two retailers’ payoffs. Retailer 1’s equilibrium payoff is always lower when $\delta$ is large enough, but retailer 2’s equilibrium payoff may be higher than when there is no price matching.

Insert Figure 6 here.

6 Conclusion

The showrooming phenomenon has brought fundamental challenges to the traditional brick-and-mortar stores in today’s changing landscape of retailing. Understanding the effectiveness of retailer attempts to defeat showrooming is of great importance to both industry practitioners and the academic audience. In this paper, we empirically test the effect of one such attempt – Best Buy’s price-matching policy – on the competition between Best Buy and Amazon. We collect price data in a number of different product categories from the two retailers before and after the introduction of the policy. We identify an interactive effect between price match and the showrooming status of the products. Retail prices went up for non-showrooming products, suggesting tacit collusion between the two retailers. However, an opposite effect was observed in the showrooming product categories: both Best Buy and Amazon lowered their prices after the price-matching policy, with Amazon cutting prices more aggressively than Best Buy.

We further propose a theoretical model to explain the empirical patterns. Two retailers, each with the dual objectives of maximizing their own profit and defeating competitors,
compete for a unit mass of consumers on a Hotelling line. The difference between show-
rooming and non-showrooming product categories is captured by the additional value that
consumers obtain from visiting the physical store. The model yields several key predictions
that resonate with the empirical observations. We show that the effect of the price-matching
policy depends on the additional value consumers gain from physical store experiences. Price
match is anti-competitive when the additional value is small but pro-competitive when the
value is large. In addition, when price matching leads to lower prices, both retailers’ profits
are also lower, but retailer 2’s overall payoff could actually rise in equilibrium. Our findings
are consistent with Mehra et al. (2013)’s conclusions that the price-matching policy is not
able to improve the profits of the brick-and-mortar stores.

To simplify the analysis, the paper abstracts away from a few interesting aspects. First,
we assume that consumers shop for a single product when, in reality, they may purchase
multiple products when they visit a retailer. If the price-matching policy helps increase the
physical store’s traffic, it may benefit from cross-selling other product categories. Although
we find some empirical evidence on the price increases of Best Buy’s own private label
products, we do not focus on this issue in the current paper. Second, most existing studies
on price matching focus on the impact of such policies on common products available at
multiple sellers; the current research does, we well. The impact of price matching on other
marketing strategies, such as product assortment decisions are also of great importance.
Coughlan and Shaffer (2009) has done a pioneer work on this topic. Future research can
build on their insights to empirically test such an impact. In addition, because of the lack
of sales data from either retailer, we were unable to directly investigate the profitability
implications. Incorporating sales information directly into the investigation would further
deepen our understanding of this issue.
References


Table 1: Number of Products Across Best Buy Departments in the Sample

<table>
<thead>
<tr>
<th>Department</th>
<th>Major Online Products</th>
<th>Major Store Products</th>
<th>Private Label Products</th>
</tr>
</thead>
<tbody>
<tr>
<td>Accessories</td>
<td>77</td>
<td>22</td>
<td>127</td>
</tr>
<tr>
<td>Appliance</td>
<td>97</td>
<td>57</td>
<td>7</td>
</tr>
<tr>
<td>Audio</td>
<td>119</td>
<td>107</td>
<td>27</td>
</tr>
<tr>
<td>Computers</td>
<td>1111</td>
<td>234</td>
<td>46</td>
</tr>
<tr>
<td>Digital Communication</td>
<td>93</td>
<td>147</td>
<td>81</td>
</tr>
<tr>
<td>Interactive Software</td>
<td>90</td>
<td>62</td>
<td>19</td>
</tr>
<tr>
<td>Mobile Audio</td>
<td>88</td>
<td>33</td>
<td>2</td>
</tr>
<tr>
<td>Photo/Commodities</td>
<td>868</td>
<td>188</td>
<td>83</td>
</tr>
<tr>
<td>Video</td>
<td>130</td>
<td>82</td>
<td>44</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>2673</strong></td>
<td><strong>932</strong></td>
<td><strong>436</strong></td>
</tr>
</tbody>
</table>

Table 2: Showrooming and Non-Showrooming Product Classifications

<table>
<thead>
<tr>
<th>Classification</th>
<th>Product Classes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Showrooming Products</td>
<td>KITCHEN, LAUNDRY, HEADPHONES-MP3 SPKRS SPEAKERS, DIGITAL CAMERAS, DSLR DIGITAL SLR, DIGITAL CAMCORDERS, COMPUTER SPEAKERS, HT MOUNTS, GPS NAVIGATION, GAME PERIPHERALS, LARGE FPTV 46&quot;+, MID FPTV 32-45&quot;, SMALL FPTV 0-31&quot;, TABLET, DESK TOP COMPUTERS, LIVE SOUND, VIDEO GAME HARDWARE, MONITORS</td>
</tr>
<tr>
<td>Non-showrooming Products</td>
<td>INK &amp; PAPER, SCANNERS, COMPUTER PRINTERS, LASER PRINTERS, LENSES, C-PAB, HOME THEATER IN A BOX, DIGITAL CAMERA ACCY, GPS ACCESSORIES, PORTABLE DVD PLAYERS, BLU RAY PLAYERS, HARD DRIVES, BLANK DIGITAL MEDIA, SEASONAL, HOME COMPONENTS, HT ACCESSORIES, PERSONAL PORTABLES, CAR STEREO, TABLET ACCESSORIES, DVD, MOBILE COMP. ACCESS., COMPUTER ACCESSORIES, SEC MKT HT APP, MICROWAVE, BATTERIES, SEC MKT DI MOB GM, DIG PHOTO SOLUTIONS, HOME CONTROL, OFFICE ELECTRONICS, DJ EQUIPMENT, BOOM BOXES, AUDIO &amp; VIDEO CABLES, TRAFFIC APPLIANCES, HEV HARDWARE, INPUT DEVICES, MOBILE PHONE ACCY, MP3 ACCESSORIES, NETWORKING, USB FLASH DRIVES, MEMORY, TECH TOYS, CARDS/COMPONENTS, GADGETS, BATTERIES &amp; POWER</td>
</tr>
</tbody>
</table>
Table 3: List of Model Variables

<table>
<thead>
<tr>
<th>Variable</th>
<th>Explanation</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Dependent variables</strong></td>
<td></td>
</tr>
<tr>
<td>Best Buy price index</td>
<td>A product’s monthly average price from Best Buy divided by its regular price</td>
</tr>
<tr>
<td>Amazon price index</td>
<td>A product’s monthly average price from Amazon divided by its regular price</td>
</tr>
<tr>
<td>Price dispersion</td>
<td>$2 \times (\text{Amazon Price Index} - \text{Best Buy Price Index})/(\text{Amazon Price Index} + \text{Best Buy Price Index})$</td>
</tr>
<tr>
<td><strong>Independent variables</strong></td>
<td></td>
</tr>
<tr>
<td>Month dummies</td>
<td>Month dummies of January to December.</td>
</tr>
<tr>
<td>Month</td>
<td>The month indicator, from 1 to 52, with January 2010 being 1.</td>
</tr>
<tr>
<td>Month squared</td>
<td>Month squared.</td>
</tr>
<tr>
<td>Price-matching</td>
<td>Indicator for the Best Buy price-matching policy. 1 being periods after October 2012.</td>
</tr>
<tr>
<td>Showrooming</td>
<td>Indicator for whether it is a showrooming product.</td>
</tr>
</tbody>
</table>

Table 4: Best Buy and Amazon Price Advantage Comparisons

<table>
<thead>
<tr>
<th></th>
<th>Pre Price Matching</th>
<th>Post Price Matching</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Amazon</td>
<td>Best Buy</td>
</tr>
<tr>
<td>Best Buy major store products</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Non-showrooming</td>
<td>0.69</td>
<td>0.26</td>
</tr>
<tr>
<td>Showrooming</td>
<td>0.63</td>
<td>0.27</td>
</tr>
<tr>
<td>Best Buy major online products</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Non-showrooming</td>
<td>0.71</td>
<td>0.24</td>
</tr>
<tr>
<td>Showrooming</td>
<td>0.64</td>
<td>0.29</td>
</tr>
</tbody>
</table>

Note: numbers indicate the percentage of the time that Amazon has a lower price, Best Buy has a lower price, and both have an equal price, respectively.

Table 5: Price Changes Overtime: Best Buy Major Store Products

<table>
<thead>
<tr>
<th></th>
<th>Amazon Price Index</th>
<th>BestBuy Price Index</th>
<th>Price Dispersion</th>
</tr>
</thead>
<tbody>
<tr>
<td>Product fixed effects</td>
<td></td>
<td>Included</td>
<td>Price dispersion</td>
</tr>
<tr>
<td>Month dummies</td>
<td></td>
<td>Included</td>
<td></td>
</tr>
<tr>
<td>Month</td>
<td>$-0.0014^{**}$</td>
<td>0.0011*</td>
<td>$-0.0033^{**}$</td>
</tr>
<tr>
<td>(0.0005)</td>
<td>(0.0005)</td>
<td>(0.0007)</td>
<td></td>
</tr>
<tr>
<td>Month squared</td>
<td>$-0.0001^{**}$</td>
<td>$-0.0001^{**}$</td>
<td>0.0000*</td>
</tr>
<tr>
<td>(0.0000)</td>
<td>(0.0000)</td>
<td>(0.0000)</td>
<td></td>
</tr>
<tr>
<td>Price matching: Non-showrooming</td>
<td>0.0154**</td>
<td>0.0576**</td>
<td>$-0.0411^{**}$</td>
</tr>
<tr>
<td>(0.0036)</td>
<td>(0.0041)</td>
<td>(0.0058)</td>
<td></td>
</tr>
<tr>
<td>Price matching: Showrooming</td>
<td>$-0.0534^{**}$</td>
<td>$-0.0147^{*}$</td>
<td>$-0.0443^{**}$</td>
</tr>
<tr>
<td>(0.0053)</td>
<td>(0.0060)</td>
<td>(0.0084)</td>
<td></td>
</tr>
<tr>
<td>$R^2$</td>
<td>0.1557</td>
<td>0.1056</td>
<td>0.0294</td>
</tr>
<tr>
<td>Adj. $R^2$</td>
<td>0.1481</td>
<td>0.1005</td>
<td>0.0280</td>
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<tr>
<td>Num. obs.</td>
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<td>19365</td>
<td>19365</td>
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$^{**}p < 0.01, ^{*}p < 0.05$; $R^2$ and Adj. $R^2$ are incremental values with respect to a simple model with only fixed effects.
Table 6: Price Changes Over Time: Best Buy Major Online Products

<table>
<thead>
<tr>
<th></th>
<th>Amazon Price Index</th>
<th>BestBuy Price Index</th>
<th>Price Dispersion</th>
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<tr>
<td>Product fixed effects</td>
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<td></td>
</tr>
<tr>
<td>Month dummies</td>
<td></td>
<td>Included</td>
<td></td>
</tr>
<tr>
<td>Month</td>
<td>−0.0116** (0.0005)</td>
<td>−0.0033** (0.0003)</td>
<td>−0.0050** (0.0003)</td>
</tr>
<tr>
<td>Month squared</td>
<td>0.0001** (0.0000)</td>
<td>0.0000** (0.0000)</td>
<td>0.0000** (0.0000)</td>
</tr>
<tr>
<td>Price matching: Non-showrooming</td>
<td>0.0254** (0.0044)</td>
<td>0.0060* (0.0026)</td>
<td>−0.0003 (0.0031)</td>
</tr>
<tr>
<td>Price matching: Showrooming</td>
<td>−0.0153** (0.0043)</td>
<td>−0.0111** (0.0025)</td>
<td>−0.0028 (0.0030)</td>
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<tr>
<td>R²</td>
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<tr>
<td>Adj. R²</td>
<td>0.0304</td>
<td>0.0254</td>
<td>0.0151</td>
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<tr>
<td>Num. obs.</td>
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</table>

*p < 0.01, **p < 0.05; R² and Adj. R² are incremental values over a simple model with only fixed effects.

Table 7: Price Changes Over Time: Best Buy Private Label Products

<table>
<thead>
<tr>
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</thead>
<tbody>
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</tr>
<tr>
<td>Month dummies</td>
<td>Included</td>
</tr>
<tr>
<td>Month</td>
<td>0.0060** (0.0014)</td>
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<tr>
<td>Month squared</td>
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<td>Price matching: Non-showrooming</td>
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<td>Price matching: Showrooming</td>
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<td>R²</td>
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</table>

*p < 0.01, **p < 0.05; R² and Adj. R² are incremental values over a simple model with only fixed effects.
Price Dispersions Between Best Buy and Amazon: Best Buy Major Store Products

Figure 1: Price Dispersions Between Best Buy and Amazon: Best Buy Major Store Products
Figure 2: Price Dispersions Between Best Buy and Amazon: Best Buy Major Online Products

Figure 3: Equilibrium prices as a function of $\delta$ ($\theta = 1/3$)
Figure 4: Equilibrium profits as a function of $\delta$ ($\theta = 1/3$)

Figure 5: Equilibrium payoffs as a function of $\delta$ ($\theta = 1/3$)
Equilibrium payoff changes when $\delta \geq 1$

Figure 6: Equilibrium payoff changes due to price matching when $\delta \geq 1$
Appendix A: Derivation of Analytical Results

Proof of Lemma 1

As discussed in the main text, for given prices $p_1$ and $p_2$, a consumer who has visited retailer 1 will travel to retailer 2 to make the purchase if and only if $x > 1 - p_1 + p_2$, which is $x_3$ in the lemma. If a consumer expects to switch stores after visiting retailer 1, he/she will prefer to visit retailer 1 if and only if $x < \delta$, which is $x_2$ in the lemma. On the other hand, if a consumer expects to stay at retailer 1, he/she will prefer to visit retailer 1 if and only if $x < (1 + \delta - p_1 + p_2)/2$, which is $x_1$ in the lemma.

When $\delta \geq 1$ and $p_1 - p_2 \leq 0$, $x_i \geq 1$ for $i = 1, 2, 3$, which means that all consumers will visit retailer 1 and buy from retailer 1 as well. This proves Item 1(1) in the lemma.

When $\delta \geq 1$ and $0 < p_1 - p_2 \leq 1$, $0 \leq x_3 < 1$, $x_2 \geq 1$ and $x_3 < x_1$, which means that consumers located at $(x_3, 1]$ will visit retailer 1 and purchase from retailer 2. Consumers located at $[0, x_3]$ will purchase directly from retailer 1. This proves Item 1(2) in the lemma.

When $\delta \geq 1$ and $p_1 - p_2 > 1, x_3 < 0$ and $x_2 \geq 1$, which means that all consumers expect to switch to retailer 2 after visiting retailer 1 and will decide to visit retailer 1 first. This proves Item 1(3) in the lemma.

When $\delta < 1$ and $p_1 - p_2 \leq \delta - 1, x_3 > 1$ and $x_1 > 1$, which means that all consumers expect to purchase from retailer 1 after visiting retailer 1, and they will optimally decide to visit retailer 1. This proves Item 2(1).

When $\delta < 1$ and $\delta - 1 < p_1 - p_2 \leq 1 - \delta$, $x_3 \geq x_2$, $x_3 \geq x_1$ and $0 < x_1 < 1$, which means consumers who expect to switch stores after visiting retailer 1 will optimally decide to visit retailer 2. Consumers who expect themselves to stay at retailer 1 will visit retailer 1 if and only $x \leq x_1$. So, consumers with $x \leq x_1$ will visit and buy from retailer 1, and consumers with $x > x_1$ will visit and buy from retailer 2. This proves Item 2(2) in the lemma.

When $\delta < 1$ and $1 - \delta < p_1 - p_2 \leq 1$, $x_3 < x_2 < 1$ and $x_3 < x_1$, which means that
consumers with \( x < x_3 \) will all visit and buy from retailer 1. Consumers between \( x_3 \) and \( x_2 \) will visit retailer 1 and buy from retailer 2. Consumers with \( x > x_2 \) will buy from retailer 2 directly. This proves Item 2(3).

When \( \delta < 1 \) and \( p_1 - p_2 > 1 \), \( x_3 < 0 \) and \( 0 < x_2 < 1 \), which means that consumers with \( x \leq x_2 \) will visit retailer 1 and purchase from retailer 2. Consumers with \( x > x_2 \) will buy from retailer 2 directly. This proves Item 2(4) and concludes the proof.

**Proof of Lemma 2**

We first consider the case in which \( \delta \geq 1 \). Define region 1 as \( p_1 - p_2 \leq 0 \), region 2 as \( 0 < p_1 - p_2 \leq 1 \) and region 3 as \( p_1 - p_2 > 1 \). The profit functions of retailers are different in the three regions according to Lemma 1. Note that the equilibrium prices could not be in the interior of region 1 because retailer 1 has the whole market share in this region and can strictly increase its profit and payoff by raising price to \( p_1 - p_2 = 0 \). Similarly, the equilibrium prices could not be in the interior of region 3 either because retailer 2 can strictly increase its payoff by raising price to \( p_1 - p_2 = 1 \). This means that the equilibrium prices should be in region 2. The payoff functions of retailers in regions 1 are as below.

\[
\begin{align*}
  u_1 &= p_1 (1 - p_1 + p_2) + \theta [p_1 (1 - p_1 + p_2) - p_2 (p_1 - p_2)] \\
  u_2 &= p_2 (p_1 - p_2) + \theta [p_2 (p_1 - p_2) - p_1 (1 - p_1 + p_2)]
\end{align*}
\]

(1) \(\uparrow\) (2)

Solving the first-order conditions of the two payoff functions together, we have \( p_{1sn1} = \frac{2(1+\theta)^2}{(2\theta+1)(2\theta+3)} \) and \( p_{2sn1} = \frac{(1+\theta)^2}{(2\theta+1)(2\theta+3)} \). We then need to check the boundary conditions to make sure that \( 0 < p_1 - p_2 \leq 1 \) is indeed, satisfied. At the calculated prices, \( p_1 - p_2 = \frac{\theta+1}{2\theta+3} \). Because \( 0 < \frac{\theta+1}{2\theta+3} < 1 \) when \( \theta \geq 0 \), the boundary condition is satisfied. Equilibrium profits and payoffs of the two retailers are given below.

\[
\pi_{1sn1} = \frac{2(\theta + 1)^2(\theta + 2)}{(2\theta + 3)^2(2\theta + 1)}
\]

(3)
\[ \pi_{2sn1} = \frac{(\theta + 1)^2}{(2\theta + 3)^2(2\theta + 1)} \] \hspace{1cm} (4)

\[ u_{1sn1} = \frac{(\theta + 1)^2(2\theta^2 + 5\theta + 4)}{(2\theta + 3)^2(2\theta + 1)} \] \hspace{1cm} (5)

\[ u_{2sn1} = \frac{(\theta + 1)^2(-2\theta^2 - 3\theta + 1)}{(2\theta + 3)^2(2\theta + 1)} \] \hspace{1cm} (6)

Next, we consider the case in which \( \delta < 1 \). Define region 1 as \( p_1 - p_2 \leq \delta - 1 \), region 2 as \( \delta - 1 < p_1 - p_2 \leq 1 - \delta \), region 3 as \( 1 - \delta < p_1 - p_2 \leq 1 \) and region 4 as \( p_1 - p_2 > 1 \). For similar reasons to the ones discussed in the proof of \( \delta \geq 1 \), the equilibrium will not be in region 1 or 4. Suppose the equilibrium is in region 3. According to Lemma 1, in region 3, consumers located in \([0, x_3]\) will buy from retailer 1 and consumers located in \((x_3, 1]\) will buy from retailer 2. Therefore, the payoff functions of retailers are the same as in Equations 1 and 2. Using the first-order conditions to solve for the prices will also lead to the same results. We need only to check for the boundary condition that \( 1 - \delta < p_1 - p_2 \leq 1 \), which is satisfied when \( \delta \geq \frac{\theta + 2}{2\theta + 3} \). Define \( d_1 = \frac{\theta + 2}{2\theta + 3} \).

Now, suppose that the equilibrium is in region 2. According to Lemma 1, consumers with \( x \leq x_1 \) will buy from retailer 1 and those with \( x > x_1 \) will buy from retailer 2. So, the payoff functions of the retailers are as follows.

\[ u_1 = \frac{1}{2}p_1(1 + \delta - p_1 + p_2) + \frac{1}{2}\theta[p_1(1 + \delta - p_1 + p_2) - p_2(1 - \delta + p_1 - p_2)] \] \hspace{1cm} (7)

\[ u_2 = \frac{1}{2}p_2(1 - \delta + p_1 - p_2) + \frac{1}{2}\theta[p_2(1 - \delta + p_1 - p_2) - p_1(1 + \delta - p_1 + p_2)] \] \hspace{1cm} (8)

Using first-order conditions to solve the two equations, we have \( p_{1sn2} = \frac{(1+\theta)(2\theta + 2\delta + \delta + 3)}{(2\theta + 1)(2\theta + 3)} \) and \( p_{2sn2} = \frac{(1+\theta)(2\theta - 2\delta - \delta + 3)}{(2\theta + 1)(2\theta + 3)} \), which are the prices given in item 1 of the lemma. We still need to check the boundary condition that \( \delta - 1 < p_1 - p_2 \leq 1 - \delta \), which is satisfied when \( \delta \leq \frac{2\theta + 3}{4\theta + 5} \). The equilibrium profits and payoffs of the two retailers are given below.

\[ \pi_{1sn2} = \frac{(\theta + 1)(2\theta + \delta + 3)(2\theta + 2\theta\delta + \delta + 3)}{2(2\theta + 3)^2(2\theta + 1)} \] \hspace{1cm} (9)
\[ \pi_{2sn} = \frac{(\theta + 1)(2\theta - \delta + 3)(2\theta - 2\theta\delta - \delta + 3)}{2(2\theta + 3)^2(2\theta + 1)} \]  
\[ u_{1sn} = \frac{(\theta + 1)(24\delta\theta^2 + 2\delta^2\theta + 8\delta^3 + 4\theta^2 + 12\theta + 22\delta\theta + \delta^2 + 6\delta + 9)}{2(2\theta + 3)^2(2\theta + 1)} \]  
\[ u_{2sn} = -\frac{(\theta + 1)(8\delta\theta^3 - 4\theta^2 + 24\delta^2\theta - 2\delta^2\theta - 12\theta + 22\delta\theta - \delta^2 + 6\delta - 9)}{2(2\theta + 3)^2(2\theta + 1)} \]

We still have to check that the retailers will not deviate from these prices to a price in other regions. We will illustrate how to check for deviations from \( p_{1sn1} \) and \( p_{2sn1} \). The procedure for checking \( p_{1sn2} \) and \( p_{2sn2} \) follows analogously. We first consider possible deviation by retailer 2 from \( p_{2sn1} \) to regions outside region 3. Note that deviation to region 1 or region 4 is strictly suboptimal. So, we need only to consider the possibility that retailer 2 may deviate to region 2. The payoff function of retailer 2 in region 2 is given by Equation 2. Since the function is quadratic, using the first-order condition leads to the maximum point of \( p_{2d1} = \frac{4(1-\delta)\theta}{2(2\theta + 3)(2\theta + 1)} \) when \( p_1 = p_{1sn1} \). The boundary condition of \( \delta - 1 < p_1 - p_2 \leq 1 - \delta \) is satisfied when \( \delta < \frac{4\theta + 7}{3(2\theta + 3)} \) and \( \delta < \frac{4\theta + 5}{2\theta + 3} \). Since the latter condition is always satisfied when \( \delta < 1 \), only the former condition is an effective constraint. So, when \( \delta < \frac{4\theta + 7}{3(2\theta + 3)} \), retailer 2 may potentially deviate to the internal point in region 2 \( p_{2d1} \). When \( \delta \geq \frac{4\theta + 7}{3(2\theta + 3)} \), retailer 2 will not deviate from \( p_{2sn1} \). Note that \( \frac{4\theta + 7}{3(2\theta + 3)} - d_1 > 0 \) is always true, so there is also a region in which retailer 2 may potentially deviate to \( p_{2d1} \). Comparing retailer 2’s profit at \( p_{2sn1} \) and \( p_{2d1} \) given \( p_1 = p_{1sn1} \), we find that retailer 2 will deviate to \( p_{2sn1} \) when \( \delta < \frac{(2-2\sqrt{2})(4\theta+6+\sqrt{2})}{4\theta+6} \). Following the same procedure to check the deviation of retailer 1, we arrive at the result that retailer 1 will never deviate from \( p_{1sn1} \). This means that the equilibrium prices \( p_{1sn1} \) and \( p_{2sn1} \) hold when \( \delta \geq \frac{(2-2\sqrt{2})(4\theta+6+\sqrt{2})}{4\theta+6} \). This proves the second item of the lemma.

Following a similar procedure, one could prove that \( p_{1sn2} \) and \( p_{2sn2} \) hold in the equilibrium when \( \delta \leq \frac{(2-2\sqrt{2})(4\theta+6+\sqrt{2})}{4\theta+6} \), which is item 1 of the lemma. Define \( d_2 = \frac{(2-2\sqrt{2})(4\theta+6+\sqrt{2})}{4\theta+6} \).

It remains to prove the result in item 3. To show that no pure equilibrium exists in this region, we need only to show that the equilibrium does not exist on the boundary between regions 1 and 2, 2 and 3 or 3 and 4. We will show the proof that the equilibrium is not on
the boundary between regions 2 and 3. The proof of the other two possibilities are similar. Because the payoff functions are quadratic in both regions 2 and 3, it is sufficient to check the derivative of \( u_i \) with respect to \( p_i \) at \( p_1 - p_2 = 1 - \delta \). If there exist prices \((p_1, p_2)\) such that \( \partial u_i / \partial p_1 > 0 \) in region 2, \( \partial u_i / \partial p_1 < 0 \) in region 3, \( \partial u_2 / \partial p_2 < 0 \) in region 2 and \( \partial u_2 / \partial p_2 > 0 \) in region 3. If such an equilibrium exists, then it could be shown that the following conditions need to be satisfied.

\[
\frac{3(1+\theta)}{1+2\theta} (1-\delta) \leq p_1 \leq \frac{2(1+\theta)}{1+2\theta} (1-\delta) \\
\frac{1+\theta}{1+2\theta} (2\delta - 1) \leq p_2 \leq \frac{1+\theta}{1+2\theta} (3\delta - 1)
\]

Because \( \frac{3(1+\theta)}{1+2\theta} (1-\delta) > \frac{2(1+\theta)}{1+2\theta} (1-\delta) \), the conditions can never be satisfied for any price \((p_1, p_2)\). This proves that the equilibrium does not exist on the boundary between regions 2 and 3. This also means that the equilibrium prices are in mixed strategy.

We will then prove that the result given in item 3 is indeed supported in the equilibrium. Consider the following strategy profile. Retailer 1 charges a price \( p_{1sn3} = \frac{(1+\sqrt{2})(1-\delta)(1+\theta)}{1+2\theta} \) for sure. Retailer 2 charges price \( p_{2snh} = \frac{(1-\delta)(2\theta+2+\sqrt{2})}{2(2\theta+1)} \) with probability \( n = \frac{(2+\sqrt{2}(4\theta-2\delta\theta-2\sqrt{2}\theta-3\delta+5-2\sqrt{2})}{(1-\delta)(\sqrt{2}+3+2\theta)} \) and \( p_{2snl} = \frac{(1-\delta)(1+\sqrt{2})}{2(2\theta+1)} \) with probability \( 1-n \). We will first prove that retailer 2’s strategy is the best response to retailer 1’s strategy. When \( p_1 = p_{1sn3} \), retailer 2’s best response could only be in region 2 or 3. Solving the first-order condition of retailer 2’s payoff functions in regions 2 and 3, respectively, one could verify that the solutions are \( p_{2snh} \) in region 2 and \( p_{2sml} \) in region 3. It can also be verified that \( \delta - 1 < p_{1sn3} - p_{2snh} \leq 1 - \delta \) and \( 1 - \delta < p_{1sn3} - p_{2sml} \leq 1 \), so \( p_{2snh} \) and \( p_{2sml} \) are the local maximal in regions 2 and 3, respectively. Retailer 2’s payoffs at \( p_{2snh} \) and \( p_{2sml} \) are both equal to \( \frac{(3+2\sqrt{2})(1-\delta)(\theta+1)(-4\sqrt{2}+6\theta-\delta-2\delta\theta+1)}{4(2\theta+1)} \). This means that retailer 2 is indifferent between \( p_{2snh} \) and \( p_{2sml} \), and both prices are the best response to \( p_{1sn3} \).

Next, we move on to the proof that retailer 1’s strategy is also the best response to retailer 2’s pricing strategy. Given retailer 2’s strategy, we can write out the expected profit of retailer 1 if it charges a price in \([p_{2sml} + 1-\delta, p_{2snh} + 1-\delta]\). The function is too complicated to be included here, but it can be shown that it is a quadratic function in \( p_1 \)
with the parameter associated with $p_1^2$ being negative. This means that the function has a maximum point. When retailer 2 follows the strategy specified previously, the maximum point is exactly equal to $p_{1sn3}$, which means that $p_{1sn3}$ is the local maximum. Similarly, it can also be shown that the local maximum is $p_{2snh+1-\delta}$ when $p_1 \geq p_{2snh+1-\delta}$ and $p_{2snl+1-\delta}$ when $p_1 < p_{2snl+1-\delta}$. This proves that $p_{1sn3}$ is the best response of retailer 1 to retailer 2’s strategy. Moreover, $\frac{\partial n}{\partial \delta} < 0$ and $n = 1$ when $\delta = d_2$ and $n = 0$ when $\delta = d_1$. So, $0 < n < 1$ when $d_2 < \delta < d_1$. The aforementioned strategy profile is indeed the equilibrium in this region. The average price of retailer 2 $n*p_{2snh} + (1-n)*p_{2snl}$ is the same as the price given in item 3. This completes the proof of item 3. The equilibrium profits and payoffs of the two retailers in item 3 are given below.

$$\pi_1 = \frac{(1 + \sqrt{2})(1 - \delta)(1 + \theta)(2\delta + \sqrt{2}\delta + 2 + \sqrt{2} + 2\theta)}{2(2\theta + 1)(2\theta + 3 + \sqrt{2})}$$ (13)

$$\pi_2 = -\frac{((3 + 2\sqrt{2})(1 - \delta)[(8 - 4\delta - 4\sqrt{2})\theta^2 + (12 - 8\delta - 4\sqrt{2})\theta + (3 + \sqrt{2})(1 - \delta)]}{4(2\theta + 1)(2\theta + 3 + \sqrt{2})}$$ (14)

$$u_1 = \frac{(2\sqrt{2} + 3)(1 - \delta)[(4\delta - 12 + 8\sqrt{2})\theta^2 + (2\sqrt{2}\delta + 8\delta - 20 + 14\sqrt{2})\theta^2]}{4(2\theta + 1)(2\theta + 3 + \sqrt{2})}$$

$$+ \frac{(2\sqrt{2} + 3)(1 - \delta)[(5\sqrt{2}\delta + 3\delta + 7\sqrt{2} - 7)\theta + 2\sqrt{2}(1 + \delta)]}{4(2\theta + 1)(2\theta + 3 + \sqrt{2})}$$ (15)

$$u_2 = \frac{(3 + 2\sqrt{2})(1 - \delta)(\theta + 1)(-4\sqrt{2}\theta + 6\theta - \delta - 2\delta\theta + 1)}{4(2\theta + 1)}$$ (16)

This concludes the proof of the lemma.

**Proof of Lemma 3**

The proof for this lemma is very similar to that of Lemma 2. The only difference is item 1, a scenario that was not present in Lemma 2. We will show the proof of item 1 and sketch the proof of the rest items without going through all the details.

Define consumers who do not utilize price match as segment 1 and those who utilize...
price match as segment 2. As discussed in the main text, when $\delta > 1$, segment 1 consumers behave the same as in Lemma 1. Segment 2 consumers will visit and buy from retailer 1 if and only if $x < \delta$ when $p_1 > p_2$. This means that the entire segment 2 will buy from retailer 1 when $\delta > 1$. Define region 1 as $p_1 - p_2 \leq 0$, region 2 as $0 < p_1 - p_2 \leq 1$ and region 3 as $p_1 - p_2 > 1$. In region 1, all consumers (segment 1 and segment 2) will purchase from retailer 1. So, the equilibrium could not be in this region because retailer 1 will raise price to $p_1 = p_2$. In region 3, segment 2 consumers purchase from retailer 1, and segment 1 consumers purchase from retailer 2. Retailers’ payoffs in this region are $u_1 = u_2 = \frac{1}{2}p_2$.

Because retailer 1’s payoff does not depend on $p_1$, retailer 1 is indifferent everywhere in this region. For retailer 2, $\frac{\partial u_2}{\partial p_2} > 0$, so retailer 2 will have an incentive to raise price to $p_1 - p_2 = 1$. This means that the equilibrium could not be in region 3, either. So, similar to the situation in which there is no price matching, the equilibrium must be in region 2. The payoff functions of retailers in region 2 are given below.

$$u_1 = \frac{1}{2} [p_2 + p_1 (1 - p_1 + p_2)] + \frac{1}{2} \theta [p_2 + p_1 (1 - p_1 + p_2) - p_2 (p_1 - p_2)] \quad (17)$$

$$u_2 = \frac{1}{2} p_2 (p_1 - p_2) + \frac{1}{2} \theta [p_2 (p_1 - p_2) - p_2 - p_1 (1 - p_1 + p_2)] \quad (18)$$

Solving the first-order conditions of the two functions leads to $p_{1sm} = \frac{2\theta^2 + 3\theta + 2}{(2\theta + 1)(2\theta + 3)}$ and $p_{2sm} = \frac{(\theta + 1)(1 - 2\theta)}{(2\theta + 1)(2\theta + 3)}$, which are the prices given in item 4. It can be verified that $0 < p_{1sm} - p_{2sm} \leq 1$, so the boundary condition is satisfied. This proves item 4 of the lemma. The equilibrium profits and payoffs of retailers in item 4 are as follows.

$$\pi_{1sm} = -\frac{4\theta^3 + 4\theta^2 - 5\theta - 7}{2(2\theta + 1)(2\theta + 3)^2} \quad (19)$$

$$\pi_{2sm} = \frac{(1 + \theta)(1 - 2\theta)}{2(2\theta + 3)^2} \quad (20)$$

$$u_{1sm} = -\frac{(1 + \theta)(4\theta^2 - 4\theta - 7)}{2(2\theta + 1)(2\theta + 3)^2} \quad (21)$$
When $\delta < 1$, we need to define five regions with distinct market outcomes. Define region 1 as $p_1 - p_2 \leq \delta - 1$, region 2 as $\delta - 1 < p_1 - p_2 \leq 0$, region 3 as $0 < p_1 - p_2 \leq 1 - \delta$, region 4 as $1 - \delta < p_1 - p_2 \leq 1$ and region 5 as $p_1 - p_2 > 1$. The reason that there is one more region than when there is no price match is that segment 2 consumers’ behavior is different when $p_1 \leq p_2$ and $p_1 > p_2$. For similar reasons as discussed previously, the equilibrium will not be in region 1 or 5.

The proof of item 3 is analogous to that of item 2 in Lemma 2. The equilibrium is in region 4 and the solution to the first-order conditions in this region is the prices given in item 3. After checking the boundary conditions and retailers’ incentive to deviate to other regions, the equilibrium holds for $\left(\frac{4 - \sqrt{2}}{2(2\theta^2 + 6\theta - 2\sqrt{2}\theta + 31 + \sqrt{2})}\right)^2 \leq \delta \leq 1$, which is the condition given in item 3. The equilibrium profits and payoffs in this region are given below.

\[
\pi_{1sm2} = \frac{(8 - 8\delta - 16\delta^2)^3\theta^3 + (38 - 16\delta - 38\delta^2)^2\theta^2 + (59 - 6\delta - 33\delta^2)\theta - 9\delta^2 + 6\delta + 31}{4(2\theta + 1)(2\theta + 3)^2} \tag{23}
\]

\[
\pi_{2sm2} = \frac{(1 + \theta)(4\theta + 5 - 3\delta)(2\theta - 6\delta\theta - 3\delta + 5)}{4(2\theta + 1)(2\theta + 3)^2} \tag{24}
\]

\[
u_{1sm2} = \frac{(1 + \theta)[16\delta(1 - \delta)\theta^3 + (8 + 32\delta - 56\delta^2)\theta^2 + (34 - 42\delta^2 + 24\delta)\theta - 9\delta^2 + 9\delta + 31]}{4(2\theta + 1)(2\theta + 3)^2} \tag{25}
\]

\[
u_{2sm2} = \frac{16(\delta^2 - \delta)^4 + (8 - 80\delta + 56\delta^2)\theta^2 + (34 + 78\delta^2 - 144\delta)^2}{4(2\theta + 1)(2\theta + 3)^2} + \frac{(45\delta^2 - 114\delta + 49)\theta + 9\delta^2 - 30\delta + 25}{4(2\theta + 1)(2\theta + 3)^2} \tag{26}
\]

Similarly, the proof of item 2 is analogous to that of item 1 in Lemma 2. The equilibrium profits and payoffs of retailers are given below.

\[
\pi_{1sm3} = \frac{8(1 - 2\delta - \delta^2)^3\theta^3 + (-20\delta^2 - 40\delta + 44)\theta^2 + (-18\delta^2 - 32\delta + 70)\theta - 5\delta^2 - 4\delta + 37}{8(2\theta + 1)(2\theta + 3)^2} \tag{27}
\]
\[
\pi_{2sm3} = \frac{(1 + \theta)(2\theta + 2 - \delta)(2 - 2\delta\theta - \delta)}{2(2\theta + 1)(2\theta + 3)^2}
\] (28)

\[
u_{1sm3} = \frac{(1 + \theta)[8(1 - \delta^2)\theta^3 + (28 - 28\delta^2 - 16\delta)\theta^2 + (54 - 22\delta^2 - 16\delta)\theta - 5\delta^2 - 4\delta + 37]}{8(2\theta + 1)(2\theta + 3)^2}
\] (29)

\[
u_{2sm3} = \frac{8(\delta^2 - 1)\theta^4 - 4(7 - 7\delta^2 + 4\delta)\theta^3 - (22 - 38\delta^2 + 48\delta)\theta^2 + (21\delta^2 - 52\delta + 11)\theta + 4(\delta - 1)^2}{8(2\theta + 1)(2\theta + 3)^2}
\] (30)

The proof of item 5 is analogous to that of item 3 in Lemma 2. Retailer 1 charges the price given in the lemma for sure, and retailer 2 plays mixed strategy in the equilibrium. The average price of retailer 2 in the equilibrium is equal to

\[
p_{2sm4} = m \cdot p_{2smh} + (1 - m) \cdot p_{2sml},
\]

where

\[
p_{2smh} = \frac{(4 - 12\delta)\theta^2 + (12 + 2\sqrt{2} - 16\delta - 4\sqrt{2}\delta)\theta + (6 + 3\sqrt{2})(1 - \delta)}{4(1 + \theta)(1 + 2\theta)},
\]

\[
p_{2sml} = -\frac{4\delta\theta^2 + (4\sqrt{2}\delta + 6\delta - 2\sqrt{2} - 4)\theta + (3 + 3\sqrt{2})(\delta - 1)}{4(1 + \theta)(1 + 2\theta)},
\]

\[
m = \frac{4 + \sqrt{2} \left((4\sqrt{2} + 28\delta - 16)\theta^2 + (-2\sqrt{2}\delta + 64\delta + 8\sqrt{2} - 46)\theta - 35 + 31\delta + 7\sqrt{2} + \sqrt{2}\delta\right)}{7 \left((8\delta - 4)\theta^2 + (2\sqrt{2}\delta + 18\delta + 2\sqrt{2} - 12)\theta + (9 + 2\sqrt{2})(\delta - 1)\right)}
\]

The equilibrium profits and payoffs in item 5 can be calculated by substituting the equilibrium pricing strategies into the corresponding profit and payoff functions. We will not present the profits and payoffs here due to the complexity of the functions and the limited space.

It remains to show item 1 of the lemma. The equilibrium prices in this region are

\[
p_{1sm5} = p_{2sm5} = \frac{(1 + \delta)(\theta + 1)}{2\theta + 1}.
\]

We will prove that \(p_{2sm5}\) is the best response of retailer 2 to \(p_{1sm5}\). The proof for retailer 1 is similar. As we have discussed earlier, retailer 2 could not possibly deviate to regions 1 and 5. Because the equilibrium prices are on the boundary between regions 2 and 3, we need only to check retailer 2’s deviation to the interior of region 2, interior of region 3 and region 4. The payoff function of retailer 2 in region 2 is

\[
u_2 = \frac{1}{2}p_2(1 - \theta + p_1 - p_2) + \frac{1}{2}\theta[p_2(1 - \theta + p_1 - p_2) - p_1(1 + \delta - p_1 + p_2)]
\]

and \(\frac{\partial \nu_2}{\partial p_2} < 0\) at \((p_{1sm5}, p_{2sm5})\). This means that retailer 2 will not deviate to the interior of region 2 by
increasing price. Following similar reasoning, it can be shown that retailer 2 will not deviate
to the interior of region 3 or region 4, either. So, \( p_{2sm5} \) is indeed the best response to retailer
1’s price. The equilibrium profits and payoffs are

\[
\pi_{1sm5} = \frac{1 + \theta}{1 + 2\theta}(\delta + 1)^2/2 \quad (31)
\]

\[
\pi_{2sm5} = \frac{1 + \theta}{1 + 2\theta}(1 - \delta^2)/2 \quad (32)
\]

\[
u_{1sm5} = \frac{(1 + \delta)(1 + \theta)(1 + \delta + 2\delta\theta)}{2(2\theta + 1)} \quad (33)
\]

\[
u_{2sm5} = \frac{(1 + \delta)(1 + \theta)(1 - \delta - 2\delta\theta)}{2(2\theta + 1)} \quad (34)
\]

This concludes the proof of the lemma.