Price Match Guarantees in the Age of Showrooming: An Empirical Analysis *

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Abstract

Consumer showrooming – the behavior of examining a product in a brick-and-mortar store and later buying it from an online retailer – is seen as a major threat to brick-and-mortar retailers. To combat showrooming, Best Buy announced a price-matching policy in 2012 to compete with major online retailers. In this paper, we examine the impact of Best Buy's price-matching policy on the price competition between Best Buy and Amazon across a wide variety of product categories. We empirically explore Best Buy's and Amazon's pricing patterns using unique datasets collected from different sources, and find robust results that the competitive effect of the price-matching policy depends on the showrooming value of a product. For those products that offer consumers large value from physical-store experiences – i.e., the "showrooming products" – the policy led to more intense price competition. Moreover, Amazon cut prices more aggressively than Best Buy. For those products that offer relatively small showrooming value – i.e., the "non-showrooming products" – it alleviated price competition. We also provide theoretical explanations for the findings and illustrate why the price matching policy did not reduce the price gaps between Amazon and Best Buy.

Keywords: Showrooming, Price matching, E-commerce, Price competition

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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, Nov 4, 2013*

The rise of e-commerce and mobile shopping has given rise to a new challenge to traditional brick-and-mortar stores – consumer showrooming. Online retailers like Amazon are known for selling products at much lower prices than their brick-and-mortar competitors. Consumers may take advantage of this by using physical stores as a showroom to view a product in person but then buying it online at a lower price. A study from Accenture shows that 73% of consumers have engaged in the practice of showrooming.[1] Another study conducted by Columbia Business School reports a similar 70% of mobile shoppers who have showroomed at least once in the past year.[2] Showrooming poses a great threat to brick-and-mortar stores, because they incur significant costs to maintain the showroom but are unable to convert the foot traffic into revenue. Reports say that brick-and-mortar retailers have been losing out sales for years due to the increase in consumer showrooming.[3] Best Buy has been hit particularly hard because it was among the retailers that Amazon customers visited most as a showroom.[4] The challenge to brick-and-mortar retailers is to persuade shoppers to buy in the store and prevent them from using it only as a showroom.

In the battle for retail shoppers, Best Buy announced a policy in 2012 to match the prices of not only its local competitors, but also several online retailers. In early 2013, the company extended the policy to include 19 major online retailers, including Amazon, Apple

[1] See "https://newsroom.accenture.com/news/accenture-study-shows-us-consumers-want-a-seamless-shopping-experience-across-store-online-and-mobile-that-many-retailers-are-struggling-to-deliver.htm" for details. Accessed August 1, 2016.

[2] Matthew Quint, David Rogers, and Rick Ferguson, "Showrooming and the rise of the mobile-assited shopper."

[3] See http://business.time.com/2013/02/20/best-buy-swears-shoppers-dont-have-to-bother-showrooming-anymore for details. Accessed January 5, 2015.

[4] See http://bits.blogs.nytimes.com/2013/02/27/more-retailers-at-risk-of-amazon-showrooming/ for the article "More Retailers at Risk of Amazon Showrooming." Accessed January 5, 2015.

and Buy.com.[5] Best Buy expected a rebound of its performance from the price match, a policy that was believed to have the ability to put an end to “showrooming”. However, some people argued that it might remind consumers of the general price disadvantage of Best Buy against its online competitors; others warned that open-ended price competition, especially with Amazon, might not be wise (Tuttle, 2012).

A similar debate exists in the economics and marketing literature concerning whether price match guarantees are anticompetitive or procompetitive. Analytical research has provided support for both views (for example, see Salop (1986), Corts (1997), Chen et al. (2001) and Jain and Srivastava (2000)). In the context of online-offline competition, the question becomes even more unclear due to the asymmetry between the two retailers and prevalence of consumer showrooming. The objective of this paper is to empirically investigate the impact of Best Buy’s price-matching policy on the price competition between Best Buy and its major online competitor, Amazon, and provide some theoretical explanations of the results.

Consumers often need to compare different alternatives when shopping for a particular type of product. Showrooming creates value because it gives consumers the opportunity to test out the actual products in the showroom and make a better-informed decision. For instance, when shopping for a new TV, consumers may be unsure about whether a Sharp LED TV or a Samsung LCD TV is a better choice for them. If purchasing directly from an online retailer, they may end up getting an ill-fitting product. Visiting a Best Buy store allows them to have a better assessment of each alternative’s functionality and how well it matches their need. Brick-and-mortar stores also have the advantage of providing in-store assistance and services that consumers value but cannot obtain from online retailers.

The value of showrooming, however, varies for different types of products. For some products, visiting a brick-and-mortar store has limited value either because the variation across brands and models is less important, or because consumers are able to get enough

[5] Best Buy matches 19 online retailers: Amazon.com, Apple.com, Bhphotovideo.com, Buy.com, Crutchfield.com, Dell.com, Frys.com, hhgregg.com, HP.com, HomeDepot.com, Lowes.com, Newegg.com, OfficeDepot.com, OfficeMax.com, Sears.com, Staples.com, Target.com, TigerDirect.com and Walmart.com.

information from online product descriptions. We define such products as "non-showrooming products". Typical examples of non-showrooming products are hard drives, mobile phone accessories, and computers printers. By contrast, the "showrooming products" are those that render a physical store experience and personal inspection of the actual products highly valuable, such as TVs, computers, and digital cameras. We classify the products in our data into these two categories in the analysis. The classification is based on a consumer survey on Amazon Mechanical Turk on the propensity of consumer showrooming for each product category, and is validated through an in-store interview with Best Buy's employees.

To study the impact of Best Buy's price-matching policy on price competition, we compile a unique data set from multiple sources that contains Amazon's and Best Buy's price information for a large number of product categories. We start by comparing the two retailers' price patterns before and after the implementation of the price-matching policy. Then we examine the effect of the policy through regression models that incorporate both item-specific fixed effects and retailer-specific time trends. We find 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 retailers' prices decreased after the policy went into effect. And 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 the opposite pattern — prices went up for both Best Buy and Amazon after the price match. Thus, we conclude that the competitive effect of Best Buy's price-matching policy interacts with a product' showrooming value. We test the robustness of the findings in several ways, by including the interaction effects of price match and product price level, using other products available at Best Buy such as its private label products and products mainly available online, and running the model under alternative price measures. The main finding of the divergent price patterns continues to hold under all the alternative model specifications.

We then propose a model with two retailers – one online and one brick-and-mortar –

competing for consumers under a Hotelling framework to provide a theoretical explanation on why the effects of price-matching policy could depend on the showrooming status of a product category. We show that when the retailers have reference-dependent payoff functions, i.e., when they care about the relative performances to each other, our model yield predictions that are perfectly consistent with the empirical findings.

This paper makes several contributions to the literature. First, we contribute to the literature on price match guarantees by providing new empirical evidence across a wide array of categories. While the idea that price matching can be procompetitive has been raised by several analytical studies, most empirical literature on price matching has found it to be anticommpetitive. Our findings contribute to the understanding of the seeming inconsistency by showing that the effect of price matching depends on consumers' incentive to showroom. To the best of our knowledge, this is the first empirical study that finds price match guarantees to be both anticompetitive and procompetitive. Second, we contribute to the growing interest of the marketing literature in consumer showrooming by studying its implication on the pricing strategies of online and offline retailers. Our paper also provides insights to managers and industry practitioners by investigating the competitive reactions of two major consumer-electronics retailers to a price-matching policy. The results are useful to retailers when deciding whether price match guarantees are a suitable vehicle for themselves.

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 presents the main empirical findings. We provide theoretical explanations for the empirical findings in Section 5, and conclude the paper in Section 6.

2 Relevant Literature

Our research explores the impact of price matching on retail competition between online and offline channels. The paper mainly builds on two streams of research. The first stream investigates how consumers choose between shopping online and offline, and the second examines the impact of price match guarantees on price competition.

The primary benefits of shopping online are convenience and possible lower prices (Chintagunta et al., 2012; Forman et al., 2009). However, consumers shopping online are generally unable to inspect the goods before making a purchase. Therefore, they can benefit from visiting brick-and-mortar stores because many product attributes are non-digital in nature and are difficult to assess online (Lal and Sarvary, 1999). The difference between online and offline shopping channels provides showrooming opportunities for consumers (Balakrishnan et al., 2014). As a result, online retailers are able to free-ride the service provided in brick-and-mortar stores, leaving brick-and-mortar retailers in a disadvantagous position. Mehra et al. (2017) consider several strategies to combat showrooming, including price matching as the short-term strategy and product exclusivity as the long-term strategy. Nevertheless, Shin (2007) showed that allowing free-riding on services from one retailer may actually benefit both retailers due to reduction in price competition. Jing (2018) also shows that showrooming need not benefit the online retailer, as showrooming may increase competition. [6]

Our research is also related to the large literature in economics and marketing on price match guarantees. Many papers have studied the effect of price match guarantees on competition and firm coordination, and the conclusions have been mixed. Some studies have found price matching to be anticompetitive (Salop, 1986; Png and Hirshleifer, 1987; Zhang, 1995; Hviid and Shaffer, 2012). In his pioneering study, Salop (1986) discussed the possibility of using price match guarantees to facilitate coordination and raise competitive prices to the

[6] There are also studies on consumer demand and firm performance in multi-channel environments in which customers can shop online and offline at the same retailer (Gu and Tayi, 2015; Bell et al., 2013; Shriver and Bollinger, 2015).

monopoly level. Matching competitors' prices reduces firms' incentive to undercut competitors, and therefore induces tacit collusion. Png and Hirshleifer (1987) explored the possibility of using price match guarantees as a vehicle to successfully exert price discrimination in the presence of heterogeneous consumer search costs. Although firms would ideally charge different prices to consumers with different search costs, it is not attainable in the absence of price matching because consumer type is not observed. A price match policy allows firms to achieve differential pricing by collecting higher payments from consumers who do not search, leading to an increase in competitive prices and overall firm profits. Using a Hotelling model with endogenous location choices, Zhang (1995) also found that price matching leads to higher market prices. In a different context, Hviid and Shaffer (2012) analyzed the pricing strategy of a local store competing with national chain stores. While either matching or beating competitor's price could be optimal in the equilibrium under different conditions, such a policy inevitably entails a rise in the list price of the local firm.

The idea that price match guarantees facilitate collusion was later challenged because the trade press usually viewed the announcement of a price-matching policy as the initiation of a price war. Researchers have proposed theories from different perspectives on why price match guarantees may not always result in higher prices. Corts (1995) showed that when firms are allowed to employ a policy that not only matches its competitors' prices, but also undercuts it, price matching is no longer anti-competitive, in the sense that it does not lead to monopoly prices in the market. In a separate study, he (Corts, 1997) argued that price-matching policies could also lead to lower prices if there are both sophisticated and unsophisticated consumers in the market, and the former is more price sensitive. Jain and Srivastava (2000) looked at the issue from the perspective of firm differentiation, showing that price matching can result in fiercer competition if there are both informed and uninformed consumers in the market and firms are sufficiently asymmetric. Chen et al. (2001) also demonstrated that price matching can be either anti- or pro-competitive, depending on the proportions of consumer segments exhibiting different search behaviors. Several other studies

(Belton, 1987; Hviid and Shaffer, 1999; Moorthy and Winter, 2006) also provided support for the notion that price matching may not always serve as a facilitating device.

Although most studies in price match guarantees are theoretical, several papers have examined the effects of price match guarantees empirically. The conclusion is mostly unidirectional: strong evidences have been documented to support the anti-competitive role of price match guarantees. Hess and Gerstner (1991) collected price information from a grocery store offering price matching guarantees on specific products. They found that the overall price level of the products included in the program hiked, in contrast to those that were not included. Arbatskaya et al. (1999) examined auto tire prices advertised on U.S. Sunday newspapers and found that the advertised prices were higher in markets where a larger percentage of competitors announced low-price guarantees. In a different paper, Arbatskaya et al. (2006) compared price-matching and price-beating guarantees for advertised tire prices, and discovered that price-matching policies tended to discourage price competition while price-beating did not. Finally, Srivastava and Lurie (2001) used survey methods to find evidence that consumers perceive price match guarantees as a credible signal which essentially would reduce consumer search.

3 Data

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.[7] We develop a computer program to collect historical price information of both retailers from camelcamelcamel.com, a major price-tracking website, and its sub-site camelbuy.com. This website tracks daily price information of hundreds of thousands items sold at major retailers such as Best Buy and Amazon. We compile a list

[7] In 2014, Best Buy was the leading consumer electronic retailer in the United States with sales of 30.55 billion U.S. dollars. Amazon increased its sales in electronics from 9.35 billion in 2010 to 25.04 billion in 2014. Source: www.statista.com.

of the products available on Best Buy's website and local stores in each product category,[8] and then search for each product's price history at both retailers based on the product's UPC. On Amazon.com, products can be sold by Amazon, a third party using Amazon, or both. We collect the prices set by Amazon itself. We include only the products having price histories on the tracking website.[9]

This process results in a total of 13,947 products that have at least a partial price history from Best Buy. We observe 3,092 products' price information both before and after Best Buy's price matching, and 2,749 of them have price information from both retailers. Best Buy's products are sold either online, in its brick-and-mortar stores, or both. Our data record the prices shown on Best Buy's website. We believe using the online price information is a reasonable approach to studying the price competition between Best Buy and Amazon for several reasons. First, according to Best Buy, its online and offline prices are consistent.[10] Best Buy's president of e-commerce Scott Durchslag mentioned in an interview that since he took the position in 2012, the company had integrated the operations of its online division and physical stores, and made more than 200 changes to the online store to fix problems such as price inconsistency between channels.[11] Best Buy is also under the manufacturers' pressure to keep price consistency across channels to maintain their brand image. In addition, in a recent paper, Cavallo (2017)[12] carried out a large-scale comparison of prices between online and offline channels, and found that most of the time (72%), retailers' online and offline prices are identical. This is particularly true for electronic products which have consistent

[8]Since Amazon offers a much larger selection of products, we do not start with Amazon in the collection of product information. In addition, the focus of the paper is on the direct price competition between Amazon and Best Buy. The products carried exclusively by Amazon are less likely to be affected by the new policy.

[9]While some UPCs can not be matched exactly with any product on the tracking website, most of the top-selling products are successfully matched.

[10]In certain cases such as local store clearances, it is possible for Best Buy's local stores to have different prices than its website. We searched extensively on the Internet about media reports and customer complaints on price inconsistencies, but only found a few, and most of them happened in the early years. For example, https://www.techdirt.com/articles/20070209/124307.shtml, https://www.techdirt.com/articles/20070209/124307.shtml, and http://forums.bestbuy.com/t5/Best-Buy-IdeaX/Pricing-in-store-should-be-the-same-online-at-bestbuy-com/idi-p/556460.

[11]See http://www.technologyreview.com/news/520821/best-buy-battles-back-online/.

[12]The Billion Prices Project at MIT. http://www.thebillionpricesproject.com.

prices in 83% of the occasions. We also conduct a comparison of Best Buy's prices using the data provided by Cavallo (2017) and find that 86% of the occasions, Best Buy's online and offline prices are exactly the same. It is noteworthy that Cavallo (2017)'s method could have underestimated the price consistency rate because the scraping server used in the project checked the online prices within seven days of the offline price collection, not instantaneously after it. Third, Best Buy offers Application Program Interfaces (APIs) for developers and partners to directly query its database on products, prices, and stores through the developer portal. In the API documentation[13], the price information is always returned as a single value and is recorded at sku level, instead of sku-channel/store level. This is in contrast with the inventory information which is at sku-store level. If Best Buy routinely offers different prices across channels or stores, the returned price should be channel- or store-specific in order for the partners and developers to synchronize the price information on their websites or mobile applications. Based on these reasons, we believe that the prices on Best Buy's website are largely consistent with those in its physical stores, and that the data we use are reasonable in studying the competition between Best Buy and Amazon.

In our analysis, we mainly focus on the products with price histories from both retailers. We distinguish the products widely available in Best Buy's local stores from those sold at a limited number of stores and those sold exclusively online. We check the availability of each product at all Best Buy stores in the USA through the APIs provided by the Best Buy Developer Portal. Products carried by fewer than 200 of the 1149 operating stores are defined as "Best Buy major online products". We define the rest as "Best Buy major store products."[14] In addition, Best Buy's private label brands like "Dynex," "Rocketfish" and "Insignia" are classified as "Best Buy private label products." The number of products across different departments in our data is summarized in Table 1. In total, there are 899 major store items, 1,850 major online items, and 343 private label items. Since the main purpose of

[13] See https://bestbuyapis.github.io/api-documentation.

[14] The store availability information is available on Best Buy's website. We checked the availability of the products twice, first in August 2013 and the again in May 2014. We defined an item as "available" at a particular store if it was available in at least one of the two observations.

Best Buy's price-matching policy is to defeat showrooming, the impact of the policy is likely to be the strongest for products sold in its brick-and-mortar stores. Therefore, we focus our analysis on "Best Buy major store products" and use the other two types of products for robustness checks.

Insert Table 1 Here

To complement the historical price information, we conduct a consumer survey on Amazon Mechanical Turk to better understand consumers' shopping behavior. Details of the survey are provided in Appendix A. We find that 116 out of the 126 respondents have engaged in showrooming, and 33% of them do it regularly.

Next, we use the responses to Question 2 — "How likely are you going to check the actual products at a Best Buy local store before making the purchase decision?" — to classify the products as either "showrooming products" or "non-showrooming products". The classification is based on the median split (3.8) of the average consumer rating from all respondents (Appendix B). Product categories with a higher average rating than the median are classified as "showrooming" categories, while those with a lower rating "non-showrooming" products. Table 2 displays the detailed classification. We also ask questions about consumers' showrooming behavior in different product categories before and after knowing the price-matching policy. Results show that consumers are significantly more likely to visit a Best Buy store after being aware of the policy.

We validate the classification through an interview with two employees at a Best Buy store. We ask them to rate each category as either showrooming or non-showrooming based on two factors: whether consumers can easily experience the products in store, and how frequently consumers ask questions about the products. Their evaluations, as reported in the fourth column of Appendix B, are highly consistent with the survey result. For instance, digital cameras are considered a typical showrooming product category because, according to Best Buy's employees, they have "open display; are operational and consumers can play through the settings and compare different models." Camera lenses, on ther other hand, are classified as a non-showrooming product, because they are "shown in glass display cases, and therefore consumers can see but cannot touch or use them; most consumers know which brand and type they want to buy."

The classification of showrooming vs. non-showrooming products is largely based on empirical evidence. Although it is not the focus of the paper to delve into the theoretical foundation of the classification, it is more or less related to the conceptual framework of search quality and experience quality proposed by Nelson (1974), albeit with a nuance. Nelson (1974) defined search qualities as qualities that "the consumer can determine by inspection prior to purchase of the brand" and experience qualities as those that "are not determined prior to purchase." In the context of showrooming, we could divide search qualities further into online search qualities — qualities that can be determined based on online product information alone — and offline search qualities that can only be determined by physically examining the actual products. Showrooming products tend to be prominent in experience or offline search qualities that prompt a physical store visit, while non-showrooming products are characterized more by online search qualities that make physical inspection either unhelpful or unnecessary.

Insert Table 2 Here

4 Empirical Patterns

4.1 Price Comparisons Between Best Buy and Amazon

In this section, we present the empirical patterns of price competition between Best Buy and Amazon. We are particularly interested in the comparisons of prices before and after the price-matching policy. The original data record prices at the daily level.[15] For the empirical analysis, we study several variables that closely reflect the nature and degree of price competition between the two retailers: Best Buy price index, Amazon price index, and the price dispersion between them. We use the monthly average of each product's price to construct the price measures. The *Best Buy price index* and *Amazon price index* are constructed based on the ratio of the monthly average price to the introductory price (regular price) at Best Buy when a product was launched. The advantage of using price indexes instead of raw prices is that the measures are implicitly normalized and directly comparable across items and categories. The third variable, *price dispersion*, is defined as the ratio of the price difference between Amazon and Best Buy to the average of the two prices. Note that the price difference (the numerator) is equal to Amazon's price minus Best Buy's price, so a negative price dispersion means that, on average, Amazon has lower prices than Best Buy in a particular month for a particular product.

As we are interested in the impact of the price-matching policy and its interaction with the showrooming status of the category, we define two dummy variables to capture these effects. The first dummy variable, *price-matching*, indicates whether it is before or after the implementation of the price-matching policy. Specifically, January 2010 to October 2012 is the pre-price-matching period while November 2012 to April 2014 is the post-price-matching period.[16] The *showrooming* variable, as defined in Table 2, indicates whether a product is classified as a showrooming category. In addition, we define *month* as the number of months since the product's initial launch to the market, and use it as a control for time trends. The variables used in the analysis are explained in Table 3.

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[15]The listing prices do not include taxes and shipping costs since these additional costs vary with shoppers' location. In our main analysis, we include product fixed effects in the regression model. Therefore, the estimates of the impact of the price-matching policy should not be affected when there are no systematic changes in the additional shopping costs over time.

[16]Best Buy started to experiment with the price-matching policy in the holiday season of 2012. It was made as a permanent policy in March 2013. As the gap between the temporary and permanent policy is only two months, we defined the start of pride-matching as November 2012.

Insert Table 3 Here

A common question about the price competition between Best Buy and Amazon is whether Amazon always has a lower price. This question becomes even more relevant and important with the introduction of the price-matching policy. We provide a simple analysis of price differences between the two retailers in Table 4. The table summarizes the percentage of product-month observations in which Amazon had a lower price, Best Buy had a lower price, or both had the same price across product categories. We also provide before and after comparisons. The table shows that Amazon had lower average prices most of the time. In about 60%—75% of the instances, Amazon had a lower price than Best Buy.[17] Best Buy and Amazon had the same average monthly price only about 5%—10% of the time. This is true for both Best Buy's major store products and major online products, and in both pre- and post-price-matching time periods. Notably, compared to the pre-price-matching period, Amazon was more likely to have a lower price than Best Buy in the post-price-matching period, especially for Best Buy major store products. Amazon's chance of having a lower price increased by 4% for the non-showrooming categories and 12% for the showrooming categories.

Insert Table 4 Here

Since larger price gaps encourage consumer showrooming, we are also interested in the price dispersion between the two retailers . Figures 1 and 2 depict the price difference. Most of the time, the average monthly price of Amazon is 0%-20% lower than that of Best Buy. The dispersion distribution shrinks towards the middle for non-showrooming products and shifts towards the left for showrooming products in Best Buy major store categories after the

[17] Our findings are consistent with some industry reports 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/.

price match began. These patterns suggest that the effect of the policy on price competition may vary across product categories.

Insert Figures 1, 2 Here

4.2 Impact of Price Match Guarantee on Pricing Strategies

The changes in price dispersion may be attributed to reactions from either Amazon, Best Buy, or both. For a clearer picture of the competitive effect of the price-matching policy, we use multiple regressions to examine the direction and magnitude of the two retailers' responses. For all the regression analyses, we include item-level fixed effects, retailer-specific monthly fixed effects and time trend variables (month and month squared) to control for product heterogeneity, seasonality effect, and potential time trends of product prices at each retailer. These factors are particularly important for electronic products, a industry where dynamic pricing and seasonal pricing strategies are commonly used. We run three regressions for Best Buy major store products, because the price-matching policy potentially has the largest impact on these products and Best Buy launched the price-matching policy to defeat showrooming for these products. The dependent variables in the three regressions are *Amazon Price Index*, *Best Buy Price Index*, and *Price Dispersion* respectively.

Table 5 presents the estimation results of the three regression models. Note that we do not include the main effects of the showrooming variable because these effects cannot be separately identified from the retailer-product fixed effects when a product's showrooming status does not change over time. The interaction terms between price matching and showrooming, which represent the difference between the effect of the policy in the showrooming and non-showrooming categories, are the focus of the analysis. The variation in price changes across different product categories before and after the price matching allows us to identify the focal effects. First, for the Amazon price index, we find a positive but insignificant price effect (0.06%) for the non-showrooming products. The pattern is different for showrooming products; average prices reduced by 4.37% and the effect was significant. Best Buy adopted the same strategies as Amazon, at least directionally. On average, price changes are significant: the average prices increased by 4.70% for non-showrooming products and decreased by 1.71% for showrooming products after the price match. These divergent price change patterns have different implications for showrooming and non-showrooming products. For non-showrooming categories, the price-matching policy served as a mechanism of tacit price collusion and resulted in an anti-competitive outcome. For showrooming products, however, the price-matching policy caused both retailers to reduce prices – a pro-competitive outcome.

Comparing the magnitude of price adjustments between Amazon and Best Buy, we find that Amazon responded more aggressively for the showrooming products, while Best Buy made more drastic changes for the non-showrooming products. The price adjustments from the two competitors led to changes in price dispersion, which are captured in the third regression equation. Both interaction variables show a significantly negative effect, meaning that the average price gap between Best Buy and Amazon increased after Best Buy introduced the price-matching policy. The magnitude is similar for both showrooming and non-showrooming products. This is, to some degree, a surprising finding. Even though the price-matching policy was intended to deliver a low-price image to consumers, Best Buy failed to close the price gap.

Insert Table 5 Here

4.3 Showrooming and Price Level

The classification of showrooming vs. non-showrooming products is based on how much value consumers can derive from experiencing a product in a physical store. This classification positively correlates with a product's price level. Figure 3 displays the distribution of the regular prices of products carried by both Amazon and Best Buy. It is evident that there is a large price overlap between the two classes; but on average, showrooming products are much higher in prices than non-showrooming products. Thus, we want to examine whether the divergent pricing patterns in the showrooming and non-showrooming categories found in the previous section could merely be driven by different price levels.

Insert Figure 3 Here

We extend the regression models by adding interaction terms between the showrooming indicator and the logarithm of a product's regular price to examine how these factors contribute to the effect of the price-matching policy. The results are reported in Table 6. The table shows that the interaction term between price and price matching is insignificant for Best Buy price index but negative and statistically significant for Amazon price index. Most importantly, after controlling for price level, the direction and magnitude of the estimates for the price-matching policy's effects on showrooming and non-showrooming products remain consistent with those of the main model reported in Table 5. This provides strong evidence that the showrooming status of a product is indeed playing an important role in the retailers' pricing strategies.

Insert Table 6 Here

4.4 Robustness Checks

To further validate our results, we carry out a series of robustness check of our empirical findings. The first robustness check is to run the same analysis on the products carried mainly by Best Buy's online channel but with limited local store presence (i.e., carried by fower than 200 stores). The results are presented in Table 7. Overall, the focal estimates are in the same directions as in the main model. The price dispersion of showrooming products increased after the price matching policy, while that of non-showrooming products did not change significantly. In addition, the R-squared measures are much smaller than those of the previous section, implying that price adjustments occurred more randomly for Best Buy's major online products.

Insert Table 7 Here

We also conduct an analysis on Best Buy's private label products - products that are not offered by Amazon. If the price-matching policy reduced showrooming and increased store traffic, Best Buy would be able to take advantage of the opportunity to cross-sell more of its private label products to consumers, leading to a motivation to raise these products' prices. Table 8 confirms this prediction. Prices of the private label products in both non-showrooming and showrooming categories increased significantly after the price match, with as much as 18.70% for the latter.

Insert Table 8 Here

To assess the robustness of our empirical patterns to data aggregation and measurement methods, we test several alternative model specifications, starting from changing the dependent variable from monthly average price indexes to daily price indexes. The results are summarized in Table 9. All the parameter estimates of the price-matching effects are in the same directions as in the main analysis. Moreover, the estimate of Amazon's price adjustment in the non-showrooming product categories becomes statistically significant. The price dispersion changes also closely resemble those of the main analysis, suggesting that the results are robust to data aggregation level.

We then replace the monthly price indexes with the logarithm of raw prices, the results of which are presented in Table 10. Although the products in our dataset cover a wide spectrum of prices, the analysis still shows consistent effects of the price matching policy on non-showrooming and showrooming product categories, reinforcing our findings. According to the estimates, on average, prices of non-showrooming products increased by 1.4% at Amazon and 5.8% at Best Buy, while those of showrooming products decreased by 2.7% at Amazon.

To test whether showrooming and non-showrooming products have different time trends, we modify the main regressions to include interactions between the time trend variables Month and Month squared and the showrooming indicator. Results (Table 11) show that none of those interactions terms are statistically significant at 5% confidence level, and likelihood ratio tests favor the parsimonious model. Parameter estimates remain qualitatively consistent with the main model.

Insert Tables 9, 10, 11 Here

5 Theoretical Explanations

Our empirical results showed that the price-matching policy has divergent effects on price competition in different product categories. In addition, the price-matching policy did not reduce the price gap between the Amazon and Best Buy. We further seek theoretical explanations on the results. Table 12 summarizes a list of analytical studies on price matching and whether their findings are consistent with our empirical findings. Although some of the studies predict both anticompetitive and procompetitive effects of price matching guarantees, the conditions they model is mainly along the dimension of consumer segments but not product categories, which quite different than our context, for example, see, Chen et al. (2001); Zhang (1995); Jain and Srivastava (2000). We thus propose a model that better fits our research context. We use the Hotelling framework and provide theoretical explanations as to why the showrooming status of a product category may confound the effect of the price-matching policy offered by Best Buy. A key assumption of our model is that the retailers not only care about their own profits but also their competitors' performances.

Insert Table 12 Here

Consider a model with 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 comfortable with shopping online. 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. 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.

To capture the idea that physical store exhibition adds value to consumers, we assume that consumers obtain a value of V if they purchase from the online retailer 2 but obtain $V+\delta$ ($\delta \geq 0$) from visiting the physical retailer 1. A larger value of δ provides consumers with a stronger incentive to visit the physical store before deciding whether and where to purchase the product. Non-showrooming products are those product categories with relatively small δ, while showrooming products are categories with relatively large δ. 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 π_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 θ ($\theta \geq 0$) captures the reference dependence level of retailers, and is the same for both retailers. As a special case, when $\theta = 0$, the model reduces to a traditional model with profit maximization as the sole objective of the retailers. Firms may have reference-dependent payoff functions for several reasons. First, beating competitors may serve a firm's long-term profit-maximization objective even though it might be suboptimal for short-term profits. If a firm can hurt its competitor's profit hard enough, the competitor may be forced to exit the market, increasing the firm's expected profit in the long run. In fact, Bendle and Vandenbosch (2014) show in a series of evolutionary game theory models that competitor-oriented managers can survive and thrive in a market that rewards only profitability. Second, firms' relative performance to their competitors' has practical appeal to managers. Business analysts, for example, frequently compare a firm's financial statistics to industry benchmarks to assess the firm's performance. This, in turn, affects investors' evaluation of the firm and their investment decisions. Third, a number of empirical studies in the strategic management literature have provided evidence that firms, like consumers, have reference-dependent payoff functions (e.g. 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).

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 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.

This is justified by the fact that retailer prices are easily accessible by consumers due to the latest mobile technology. 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 consumer segments. One segment of the consumers (size α) do not respond to the price-matching policy, either because they are not aware of the policy offered by physical retailer 1 or because their cost of redeeming the policy is too high. We call this segment the unsophisticated consumers. The other segment of the consumers, the sophisticated consumers with size $1-\alpha$, are aware of price matching and will use it if online retailer 2's price is lower and 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. For ease of presentation, we will present and discuss the result for a specific value of α: $\alpha = 1/2$. However, this assumption is not essential to the intuition of the model.

The aforementioned model predicts divergent effect of price matching that is consistent with our empirical findings. Solving the model using backward induction, we find that when $\theta > 0$, price matching leads to higher equilibrium prices if $\delta < 1/(2\theta + 1)$ and lower equilibrium prices if $\delta > 1/(2\theta + 1)$. When $\theta = 0$, price matching leads to higher price if $\delta < 1$ and no change in equilibrium prices if $\delta \geq 1$. That is, when the additional value offered by physical retailer 1 is relatively small (non-showrooming products), the presence of the price match guarantee facilitates coordination between the two retailers and leads to higher equilibrium prices. When the additional value offered by physical retailer 1 is large enough (showrooming products), the presence of price matching from physical retailer 1 intensifies competition between the two retailers. A complete proof of the result is given in the appendix.

To understand the intuition, note that retailers in the model can maximize their payoff in two ways – either by increasing its own profit or by decreasing the competitor's profit. By adjusting its own price, retailers are able to control the number of consumers who shop at each retailer and therefore influence both its own profit and its competitor's profit. When a price matching guarantee is in effect, the retailer not offering price matching can also influence its competitor's profit in a second way. A group of consumers will take advantage of the price-matching guarantee when making the purchase. They will shop at the retailer with the price-matching guarantee but pay the price offered by its competitor. Therefore, by lowering its own price, the retailer not offering price-matching guarantee is able to reduce its competitor's profit even though such a move does not influence demand.

When no price matching is offered, some consumers will visit the physical store first but eventually purchase from the online retailer because the latter offers a lower price. Others will buy directly from the online retailer without even visiting the physical store because the cost of traveling back and forth between stores is too high. When retailer 1 offers a price-matching guarantee, some of the aforementioned consumers will optimally switch from purchasing online to purchasing in-store, because they are able to secure the same price no matter where they make the purchase. Since price is no longer a concern, their purchase decision will be affected solely by the additional benefit of showrooming as well as their travel cost. The larger the additional value of showrooming, the more consumers will choose to make the switch and purchase the product from retailer 1 using the price-matching guarantee. For the non-showrooming products that offer relatively small benefits, not many consumers will use price matching at retailer 1. Therefore, online retailer 2's attempt to reduce its competitor's profit by cutting price will not be very effective. Instead, retailer 2 can enhance its payoff more by focusing on maximizing its own profit. Because the purchase decision of sophisticated consumers is not affected by the prices of the two retailers, retailer 2 will optimally increase its price without having to worry about losing too much demand. This leads to the anti-competitive effect of price-matching for the non-showrooming products. For the showrooming products that offer relatively large value of in-store visit, a large number of sophisticated consumers 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 4.

Insert Figure 4 Here

However, it should be noted that the competition-enhancing effect of price matching is observed only when $\theta > 0$, or, in other words, when retailers have reference-dependent payoffs. 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.

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 the attempts to defeat showrooming is important to both retail managers and academic researchers. 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 for a wide spectrum of product categories from the two retailers before and after the introduction of the policy. We identify an interactive effect between price matching 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 provide theoretical explanations for the empirical findings. We propose a theoretical model that incorporates consumer's showrooming behavior and retailers' incentive to defeat competitors. We show that when retailers focus only on maximizing their own profits, a price-matching policy offered by the brick-and-mortar retailer always has an anti-competitive effect on firms' pricing strategy. When retailers also have an incentive to beat competitors, the price-matching policy will have an anti-competitive effect if the showrooming value of the product is small, but a pro-competitive effect if the showrooming value of the product is large enough. The proposed model offers an explanation of not only the interaction between the competitive effect of price matching and the showrooming value of the category, but also the change in price disparity between Best Buy and Amazon.

There are a few important questions that call for future research. First, most of the theoretical work on price match guarantees assumes that consumers shop for a single product when, in reality, they may purchase multiple products when visiting a retailer. If the price-matching policy helps increase the brick-and-mortar store's traffic, it may benefit from cross-selling other product categories. Although we find some empirical evidence on the price increase of Best Buy's private label products, we do not focus on this issue in the current paper. Second, our study focuses on the price competition between online and offline retailers, but not on the strategic reactions from the manufacturers. Consumers' showrooming behavior could hurt the profit of the retailer that provides the service (Anderson and Coughlan, 2002; Carlton and Chevalier, 2001), which creates incentives for retailers to cut service levels when there is free riding in the market . A manufacturer may respond strategically by changing its wholesale price and sale allowance to encourage Best Buy to keep providing additional services to consumers (Kuksov and Liao, 2018). However, we don't have any empirical evidence to support this conjecture. Lastly, our research follows most other studies on price matching in focusing on the impact of such policies on products commonly available at multiple sellers. The impact of price matching on other marketing strategies, such as product assortment decisions are also important. Coughlan and Shaffer (2009) have done pioneer work on this topic. Future research could build on their insights to empirically test such an impact. Also, because of the lack of sales data from either retailer, we are unable to directly investigate the profitability implications of the price-matching policy or its impact on consumer substitution behavior between products. Incorporating sales information directly into the investigation would further deepen our understanding of this issue. Finally, responding the fast changing landscape of retail, Best Buy and Amazon has recently entered into a partnership to further enrich customer experience utilizing the competitive advantages of each other[18]. Examining the implications of such strategic alliance would be an important emerging research topic.

[18]https://www.fool.com/investing/2018/04/25/why-best-buy-is-literally-becoming-an-amazon-showr.aspx. Accessed April 25, 2018.

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

Department	Major Online Products	Major Store Products	Private Label Products
Accessories	64	20	83
Appliance	85	50	6
Audio	92	104	25
Computers	755	227	39
Digital Communication	66	141	77
Interactive Software	47	61	17
Mobile Audio	71	32	1
Photo/Commodities	610	184	58
Video	60	80	37
Total	1850	899	343

Table 2: Showrooming and Non-Showrooming Product Classifications

Classification	Product Categories
Showrooming Products	Car Stereo, Computer Monitors, Desktop Computers, Digital Cameras, Digital Camcorders, Flat Panel TV, Game Peripherals, GPS Navigation, Headphones, Home Theater, Kitchen, Laptops, Laundry Appliances, Speakers, Tablet, Video Game Hardware
Non-showrooming Products	Battery, Computer Accessories, Digital Camera Accessories, Digital Memory, DVD Players, GPS Accessories, Hard Drives, Home Theater Accessories, Ink and Paper, Lenses, Microwave, MP3/Phone Accessories, Network Cables, Personal Clock/Radio, Printers, Scanners, Tablet Accessories

Table 3: List of Model Variables

Variable	Explanation
Dependent Variables	
Best Buy price index	A product's monthly average price from Best Buy divided by its regular price
Amazon price index	A product's monthly average price from Amazon divided by its regular price
Price dispersion	2×(Amazon Price Index - Best Buy Price Index)/(Amazon Price Index + Best Buy Price Index)
Independent Variables	
Month dummies	Month dummies of January to December
Month	Number of months since initial launch
Month squared	Month squared
Price-matching	Indicator for the Best Buy price-matching policy, 1 being periods after October 2012
Showrooming	Indicator for whether it is a showrooming product

Table 4: Best Buy and Amazon Price Advantage Comparisons

	Pre Price Matching			Post Price Matching		
	Amazon	Best Buy	Equal	Amazon	Best Buy	Equal
Best Buy major store products						
Showrooming	0.58	0.31	0.11	0.70	0.24	0.06
Non-showrooming	0.70	0.24	0.06	0.74	0.17	0.09
Best Buy major online products						
Showrooming	0.63	0.31	0.06	0.66	0.28	0.06
Non-showrooming	0.74	0.21	0.05	0.70	0.24	0.06

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

Table 5: Effect of Price Matching on Product Prices: Best Buy Major Store Products

	Amazon Price Index	Best Buy Price Index	Price Dispersion
Product fixed effects		Included	
Month dummies		Included	
Month	-0.0000	$\mathbf{0.0024}^{**}$	$\mathbf{-0.0030}^{**}$
	(0.0006)	(0.0007)	(0.0010)
Month squared	$\mathbf{-0.0001}^{**}$	$\mathbf{-0.0001}^{**}$	0.0000
	(0.0000)	(0.0000)	(0.0000)
Price matching × Non-showrooming	0.0063	$\mathbf{0.0470}^{**}$	$\mathbf{-0.0408}^{**}$
	(0.0043)	(0.0046)	(0.0069)
Price matching × Showrooming	$\mathbf{-0.0437}^{**}$	$\mathbf{-0.0171}^{**}$	$\mathbf{-0.0228}^{*}$
	(0.0061)	(0.0066)	(0.0098)
R^2	0.1705	0.1029	0.0315
Adj. R^2	0.1606	0.0969	0.0297
Num. obs.	15613	15613	15613

$^{**}p < 0.01$, $^{*}p < 0.05$; R^2 and Adj. R^2 are incremental values with respect to a simple model with only fixed effects.

Table 6: Extension: Effect of Price Matching on Product Prices: Best Buy Major Store Products

	Amazon Price Index	Best Buy Price Index	Price Dispersion
Product fixed effects		Included	
Month dummies		Included	
Month	-0.0001	$\mathbf{0.0024}^{**}$	$\mathbf{-0.0029}^{**}$
	(0.0006)	(0.0007)	(0.0010)
Month squared	$\mathbf{-0.0001}^{**}$	$\mathbf{-0.0001}^{**}$	0.0000
	(0.0000)	(0.0000)	(0.0000)
Price matching × Non-showrooming	0.0033	$\mathbf{0.0454}^{**}$	$\mathbf{-0.0341}^{**}$
	(0.0045)	(0.0048)	(0.0072)
Price matching × Showrooming	$\mathbf{-0.0417}^{**}$	$\mathbf{-0.0161}^{*}$	$\mathbf{-0.0271}^{**}$
	(0.0062)	(0.0067)	(0.0099)
Price matching × Price	$\mathbf{-0.0058}^{*}$	-0.0031	$\mathbf{0.0126}^{**}$
	(0.0024)	(0.0026)	(0.0038)
R^2	0.1708	0.1030	0.0322
Adj. R^2	0.1197	0.0477	-0.0274
Num. obs.	15613	15613	15613

$^{**}p < 0.01$, $^{*}p < 0.05$; R^2 and Adj. R^2 are incremental values with respect to a simple model with only fixed effects. Price measurement is in log of dollars.

Table 7: Effect of Price Matching on Product Prices: Best Buy Major Online Products

	Amazon Price Index	Best Buy Price Index	Price Dispersion
Product fixed effects		Included	
Month dummies		Included	
Month	$\mathbf{-0.0139}^{**}$	-0.0005	$\mathbf{-0.0052}^{**}$
	(0.0009)	(0.0005)	(0.0006)
Month squared	$\mathbf{0.0001}^{**}$	$\mathbf{-0.0000}^{**}$	$\mathbf{0.0000}^{**}$
	(0.0000)	(0.0000)	(0.0000)
Price matching × Non-showrooming	$\mathbf{0.0425}^{**}$	-0.0023	0.0074
	(0.0074)	(0.0036)	(0.0047)
Price matching × Showrooming	$\mathbf{-0.0622}^{**}$	$\mathbf{-0.0245}^{**}$	$\mathbf{-0.0239}^{**}$
	(0.0080)	(0.0039)	(0.0050)
R^2	0.0333	0.0298	0.0174
Adj. R^2	0.0316	0.0283	0.0165
Num. obs.	34734	34734	34734

$^{**}p < 0.01$, $^{*}p < 0.05$; R^2 and Adj. R^2 are incremental values over a simple model with only fixed effects.

Table 8: Effect of Price Matching on Product Prices: Best Buy Private Label Products

	Best Buy Price Index
Product fixed effects	Included
Month dummies	Included
Month	**0.0065****
	(0.0018)
Month squared	$-$**0.0001****
	(0.0000)
Price matching × Non-showrooming	**0.0539****
	(0.0141)
Price matching × Showrooming	**0.1870****
	(0.0212)
R^2	0.0291
Adj. R^2	0.0275
Num. obs.	5981

$^{**}p < 0.01$, $^{*}p < 0.05$; R^2 and Adj. R^2 are incremental values over a simple model with only fixed effects.

Table 9: Robustness Check: Daily Price Indexes of Best Buy Major Store Products

	Amazon Price Index	Best Buy Price Index	Price Dispersion
Product fixed effects		Included	
Month dummies		Included	
Month	0.0002	**0.0026****	$-$**0.0032****
	(0.0001)	(0.0001)	(0.0002)
Month squared	$-$**0.0001****	$-$**0.0001****	**0.0000****
	(0.0000)	(0.0000)	(0.0000)
Price matching × Non-showrooming	**0.0061****	**0.0468****	$-$**0.0407****
	(0.0008)	(0.0009)	(0.0013)
Price matching × Showrooming	$-$**0.0423****	$-$**0.0161****	$-$**0.0237****
	(0.0012)	(0.0013)	(0.0019)
R^2	0.1359	0.0908	0.0254
Adj. R^2	0.1356	0.0906	0.0254
Num. obs.	439188	439188	439188

$^{**}p < 0.01$, $^{*}p < 0.05$; R^2 and Adj. R^2 are incremental values with respect to a simple model with only fixed effects.

Table 10: Robustness Check: Logarithm of Monthly Average Prices of Best Buy Major Store Products

	Amazon Price	Best Buy Price
Product fixed effects	Included	
Month dummies	Included	
Month	0.0013	**0.0040****
	(0.0008)	(0.0008)
Month squared	**−0.0001****	**−0.0001****
	(0.0000)	(0.0000)
Price matching × Non-showrooming	**0.0135***	**0.0572****
	(0.0054)	(0.0055)
Price matching × Showrooming	**−0.0270****	−0.0047
	(0.0077)	(0.0078)
R^2	0.1729	0.0866
Adj. R^2	0.1628	0.0815
Num. obs.	15613	15613

$^{**}p < 0.01$, $^{*}p < 0.05$; R^2 and Adj. R^2 are incremental values with respect to a simple model with only fixed effects.

Table 11: Robustness Check: Separate Time Trends for Showrooming vs. Non-showrooming Products

	Amazon Price Index	Best Buy Price Index	Price Dispersion
Product fixed effects		Included	
Month dummies		Included	
Month	0.0000	**0.0026****	**−0.0029****
	(0.0007)	(0.0007)	(0.0011)
Month × Showrooming	−0.0013	−0.0019	−0.0002
	(0.0016)	(0.0017)	(0.0025)
Month squared	**−0.0001****	**−0.0001****	0.0000
	(0.0000)	(0.0000)	(0.0000)
Month squared × Showrooming	−0.0000	0.0000	0.0000
	(0.0000)	(0.0000)	(0.0000)
Price matching × Non-showrooming	−0.0006	**0.0414****	**−0.0388****
	(0.0046)	(0.0050)	(0.0074)
Price matching × Showrooming	**−0.0247****	−0.0006	**−0.0276***
	(0.0079)	(0.0086)	(0.0128)
R^2	0.1715	0.1035	0.0315
Adj. R^2	0.1615	0.0975	0.0297
Num. obs.	15613	15613	15613

$^{**}p < 0.01$, $^{*}p < 0.05$; R^2 and Adj. R^2 are incremental values with respect to a simple model with only fixed effects.

Table 12: Predictions of existing studies on price match guarantees

	Showrooming products		Non-showrooming products	
	Direction	Dispersion	Direction	Dispersion
Png and Hirshleifer (1987)			✓	
Zhang (1995)			✓	
Hviid and Shaffer (1999)			✓	
Moorthy and Winter (2006)			✓	✓
Coughlan and Shaffer (2009)			✓	✓
Corts (1995)	✓			
Belton (1987)	✓			
Corts (1996)	ND		ND	
Chen, Narasimhan and Zhang (2001)	ND		ND	
Jain and Srivastava (2000)	✓		✓	

Note: ✓: model prediction consistent with empirical findings; ND: hard to match model predictions with empirical findings.

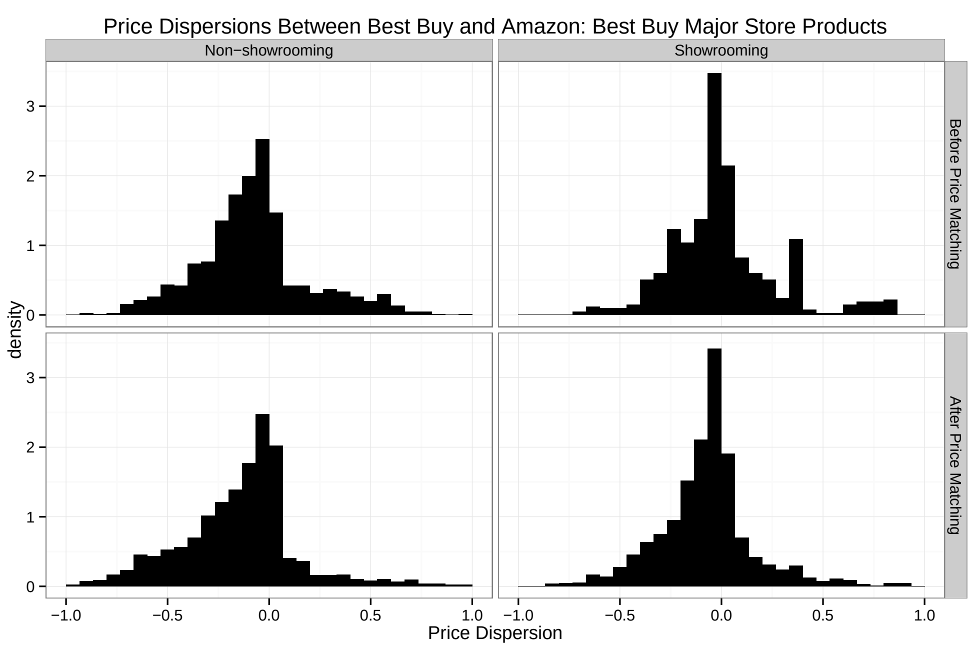

Figure 1: Price Dispersions Between Best Buy and Amazon: Best Buy Major Store Products

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

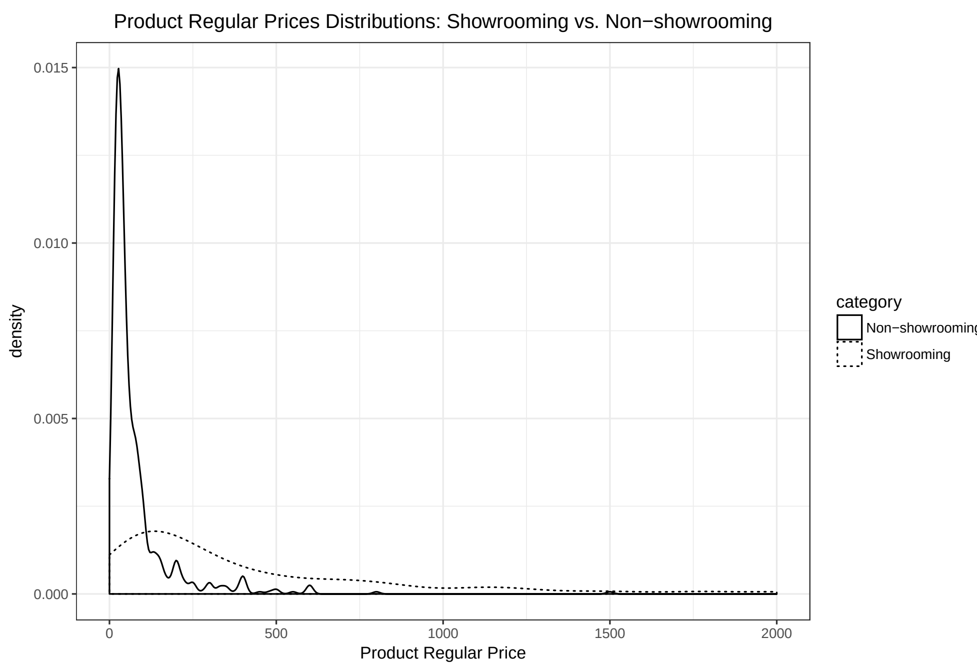

Figure 3: Product Regular Price Distributions: Showrooming vs. Non-showrooming

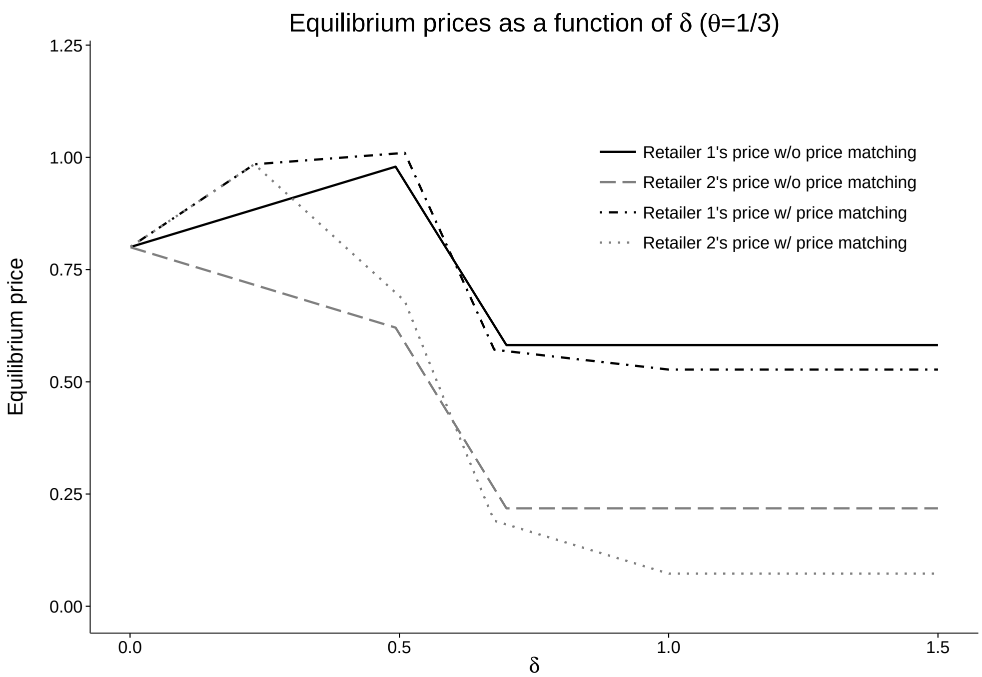

Figure 4: Equilibrium prices as a function of δ ($\theta = 1/3$)

Appendices

A: Consumer Survey Design

- Q1: "Showrooming" is the practice of examining a product in brick-and-mortar stores such as Best Buy and then buying it from an online retailer such as Amazon. How often do you engage in such practice? (Please rate on a scale of 1 to 5, with 1 being "Never" and 5 being "Always".)
- Q2: You are shopping for a product that is available at both Best Buy local stores and Amazon.com. For each of the following product categories, how likely are you to check the actual products at a Best Buy local store first before making your purchase decision? (Please rate on a scale of 1 to 7, with one being "extremely unlikely" and 7 being "extremely likely". If you are unable to answer because you have not heard about the product category or have never shopped for the product category, please choose the "unable to answer" option.)
- Q3: Please indicate the strategy you are most likely to adopt when shopping for the following product categories, assuming that you are only considering between Best Buy and Amazon.
  - Go to a Best Buy local store and buy directly from there
  - Go to Amazon.com and buy directly from there
  - Go to a Best Buy local store first to look at the products and then buy from Amazon
  - Check online information first and buy from a Best Buy local store
  - Other strategy
- Q4: Best Buy has a "Price Match Guarantee (PMG)" policy that matches the prices of all local competitors and six major online competitors, including Amazon.com. If the customer is able to show a proof of a lower price found at a recognized competitor, Best Buy will honour the lower price. Were you aware of this policy? (Yes/No)
- Q5: Taking into account Best Buy's Price Match Guarantee (PMG), what is the strategy you are most likely to adopt when shopping for each of the following products? Assume again that you are only considering between Best Buy and Amazon.
  - Buy directly from a Best Buy local store without using the PMG policy
  - Buy directly from a Best Buy local store using the PMG if Amazon has a lower price
  - Go to Amazon directly and buy from there
  - Go to a Best Buy local store first to check the actual products and buy from Amazon
  - Check online information first and buy from a Best Buy local store
  - Other strategy

B: Product Classifications

The Table reports the ratings across different product categories. Consumer rate is from Questions 2 in our consumer survey. A higher rating indicates that a consumer is more likely to visit a brick-and-mortar store before making a purchase. Employee rate is from our employee interview, "Y" is for showrooming and "N" is not.

Product Category	Product Classes	Consumer Rate	Employee Rate
Battery	BATTERIES	2.9	N
Car Stereo	CAR STEREO	4.2	Y
Computer Accessories	INPUT DEVICES; COMPUTER ACCESSORIES; MOBILE COMP. ACCESS.; CARDS/COMPONENTS	3.5	N
Computer Monitors	MONITORS	4.9	Y
Desktop Computers	DESK TOP COMPUTERS	4.9	Y
Digital Cameras	DSLR DIGITAL SLR; DIGITAL CAMERAS	4.9	Y
Digital Camcorders	DIGITAL CAMCORDERS	4.6	Y
Digital Camera Accessories	DIGITAL CAMERA ACCY	3.4	N
Digital Memory	MEMORY; USB FLASH DRIVES	2.4	N
DVD Players	BLU RAY PLAYERS; PORTABLE DVD PLAYERS	3.3	N
Flat Panel TV	SMALL FPTV 0-31'; MID FPTV 32-45'; LARGE FPTV 46'	5.6	Y
Game Peripherals	GAME PERIPHERALS	3.8	N
GPS Accessories	GPS ACCESSORIES	3.2	N
GPS Navigation	GPS NAVIGATION	3.9	Y
Hard Drives	HARD DRIVES	2.9	N
Headphones	HEADPHONES–SPKRS	4.9	Y
Home Theater	HOME THEATER IN A BOX	5.1	Y
Home Theater Accessories	HT ACCESSORIES; HT MOUNTS; HOME COMPONENTS	3.4	N
Ink and Paper	INK & PAPER	2.5	N
Kitchen	KITCHEN; TRAFFIC APPLIANCES	4.4	Y
Laptops	LAPTOPS	5.3	Y
Laundry Appliances	LAUNDARY	4.2	Y
Lenses	LENSES	3.6	N
Microwave	MICROWAVE	3.6	Y
MP3/Phone Accessories	MOBILE PHONE ACCY; MP3 ACCY; C-PAB	3.4	N
Network Cables	NETWORKING	2.4	N
Personal Clock/Radio	PERSONAL PORTABLES	3.1	N
Printers	COMPUTER PRINTERS; LASER PRINTERS	3.7	Y
Scanners	SCANNERS	3.6	N
Speakers	SPEAKERS; COMPUTER SPEAKERS	3.8	Y
Tablet	TABLET	5.0	Y
Tablet Accessories	TABLET ACCESSORIES	3.3	N
Video Game Hardware	VIDEO GAME HARDWARE	3.9	Y

C: Proof of Solution of the Theoretical Model

We will proceed with the proof in several steps. We first prove the result of the model without a price match guarantee.

Result 1. When there is no price matching, the equilibrium prices are as follows.

1. When $\delta \leq \frac{(2-\sqrt{2})(4\theta-1)}{4\theta-2+\sqrt{2}}$, $p_{1n} = \frac{\theta(4\theta+\delta-1)}{4\theta-1}$ and $p_{2n} = \frac{\theta(4\theta-\delta-1)}{4\theta-1}$
2. When $\delta \geq \frac{(6-2\sqrt{2})\theta-1}{4\theta-1}$, $p_{1n} = \frac{2\theta^2}{4\theta-1}$ and $p_{2n} = \frac{\theta(2\theta-1)}{4\theta-1}$
3. When $\frac{(2-\sqrt{2})(4\theta-1)}{4\theta-2+\sqrt{2}} < \delta < \frac{(6-2\sqrt{2})\theta-1}{4\theta-1}$, no pure strategy equilibrium exists. The equilibrium is in mixed strategy with $p_{1n} = (1+\sqrt{2})(1-\delta)\theta$, and the average price of retailer 2 is $p_{2n} = \frac{(1+\sqrt{2})(8\theta^2-8\delta\theta^2-24\theta+14\sqrt{2}\theta+12\delta\theta-6\sqrt{2}\delta\theta+\sqrt{2}\delta-2\delta+2-\sqrt{2})}{2(4\theta-\sqrt{2})}$.

Proof. First, consider consumers' store visit and purchase decision at the second stage of the model. For a consumer located at x, 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 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 $y_{12} = V + \delta - x - (1-x) - p_2$. It is clear that the consumer will switch to retailer 2 if and only if her travel cost to retailer 2 is smaller than the price difference between the two retailers, or $1 - x < p_1 - p_2$. So, when $x > 1 - p_1 + p_2$, the consumer will compare y_{12} and y_2, and decide to visit retailer 2 if $x \geq \delta$ and retailer 1 otherwise. No matter what her decision is, she will always purchase from retailer 2 in the end. When $x \leq 1 - p_1 + p_2$, the consumers will compare p_1 and p_2 when deciding which store to visit. She will visit and buy from retailer 1 if $x \leq (1 + \delta - p_1 + p_2)/2$ and retailer 2 otherwise. Define $x_1 = (1 + \delta - p_1 + p_2)/2$, $x_2 = \delta$ and $x_3 = 1 - p_1 + p_2$. The market shares of the two retailers are summarized below.

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.

Now back to the retail pricing stage of the model. 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. 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.

$$u_1 = \theta p_1(1 - p_1 + p_2) - (1 - \theta)p_2(p_1 - p_2) \tag{1}$$

$$u_2 = \theta p_2(p_1 - p_2) - (1 - \theta)p_1(1 - p_1 + p_2) \tag{2}$$

Solving the first-order conditions of the two payoff functions together, we have $p_{1sn1} = \frac{2\theta^2}{4\theta-1}$ and $p_{2sn1} = \frac{\theta(2\theta-1)}{4\theta-1}$. 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, $p_1 - p_2 = \frac{\theta}{4\theta-1}$. Because $0 < \frac{\theta}{4\theta-1} < 1$ when $\theta > 1/2$, the boundary condition is satisfied. Equilibrium profits and payoffs of the two retailers are given below.

$$\pi_{1sn1} = \frac{2\theta^2(3\theta - 1)}{(4\theta - 1)^2} \tag{3}$$

$$\pi_{2sn1} = \frac{\theta^2(2\theta - 1)}{(4\theta - 1)^2} \tag{4}$$

$$u_{1sn1} = \frac{\theta^2(8\theta^2 - 5\theta + 1)}{(4\theta - 1)^2} \tag{5}$$

$$u_{2sn1} = \frac{\theta^2(8\theta^2 - 9\theta + 2)}{(4\theta - 1)^2} \tag{6}$$

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 the solution of the second stage, 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 $\delta \geq \frac{3\theta-1}{4\theta-1}$. Define $d_1 = \frac{3\theta-1}{4\theta-1}$.

Now, suppose that the equilibrium is in region 2. According to the solution of the second stage, 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.

$$u_1 = \frac{1}{2}\theta p_1(1 + \delta - p_1 + p_2) - \frac{1}{2}(1 - \theta)p_2(1 - \delta + p_1 - p_2) \tag{7}$$

$$u_2 = \frac{1}{2}\theta p_2(1 - \delta + p_1 - p_2) - \frac{1}{2}(1 - \theta)p_1(1 + \delta - p_1 + p_2) \tag{8}$$

Using first-order conditions to solve the two equations, we have $p_{1sn2} = \frac{\theta(4\theta+\delta-1)}{4\theta-1}$ and $p_{2sn2} = \frac{\theta(4\theta-\delta-1)}{4\theta-1}$, which are the prices given in item 1 of the result. We still need to check the boundary condition that $\delta - 1 < p_1 - p_2 \leq 1 - \delta$, which is satisfied when $\delta \leq \frac{4\theta-1}{6\theta-1}$. The equilibrium profits and payoffs of the two retailers are given below.

$$\pi_{1sn2} = \frac{\theta(4\theta+\delta-1)(4\theta+2\theta\delta-\delta-1)}{2(4\theta-1)^2} \tag{9}$$

$$\pi_{2sn2} = \frac{\theta(4\theta-\delta-1)(4\theta-2\theta\delta+\delta-1)}{2(4\theta-1)^2} \tag{10}$$

$$u_{1sn2} = \frac{\theta(8\delta\theta^2+4\delta^2\theta^2-4\delta^2\theta+32\theta^3-32\theta^2+10\theta-2\delta\theta+\delta^2-1)}{2(4\theta-1)^2} \tag{11}$$

$$u_{2sn2} = \frac{\theta(32\theta^3-32\theta^2-8\delta\theta^2+4\delta^2\theta^2-4\delta^2\theta+10\theta+2\delta\theta+\delta^2-1)}{2(4\theta-1)^2} \tag{12}$$

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 $p_{2d1} = \frac{4\theta^2+2\theta-4\delta\theta+\delta-1}{2(4\theta-1)}$ when $p_1 = p_{1sn1}$. The boundary condition of $\delta - 1 < p_1 - p_2 \leq 1-\delta$ is satisfied when $\delta < \frac{10\theta-3}{3(4\theta-1)}$ and $\delta < \frac{6\theta-1}{4\theta-1}$. Since the latter condition is always satisfied when $\delta < 1$, only the former condition is an effective constraint. So, when $\delta < \frac{10\theta-3}{3(4\theta-1)}$, retailer 2 may potentially deviate to the internal point in region 2 p_{2d1}. When $\delta \geq \frac{10\theta-3}{3(4\theta-1)}$, retailer 2 will not deviate from p_{2sn1}. Note that $\frac{10\theta-3}{3(4\theta-1)} - d_1 = \frac{\theta(3-2\sqrt{2})}{4\theta-1} > 0$ when $\delta > 1/2$, 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 $\delta < \frac{(6-2\sqrt{2})\theta-1}{4\theta-1}$. 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 $\delta \geq \frac{(6-2\sqrt{2})\theta-1}{4\theta-1}$. This proves the second item of the result.

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

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 $\frac{\partial u_1}{\partial p_1} > 0$ in region 2, $\frac{\partial u_1}{\partial p_1} < 0$ in region 3, $\frac{\partial u_2}{\partial p_2} < 0$ in region 2 and $\frac{\partial u_2}{\partial p_2} > 0$ in region 3. If such an equilibrium exists, then it could be shown that the following conditions need to be satisfied.

$$3\theta(1-\delta) \leq p_1 \leq 2\theta(1-\delta)$$

$$\theta(2\delta-1) \leq p_2 \leq \theta(3\delta-1)$$

Because $3\theta(1-\delta) > 2\theta(1-\delta)$, 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 $p_{1sn3} = (\sqrt{2}-1)(1-\delta)/2$ for sure. Retailer 2 charges price $p_{2snh} = (\sqrt{2}+1)(1-\delta)(2\theta+\sqrt{2}-2)/2$ with probability $n = \frac{2(4\delta\theta+2\sqrt{2}\theta-6\theta-\delta+1)}{(1-\delta)(\sqrt{2}-4\theta)}$ and $p_{2snl} =$

$(\sqrt{2}+1)(1-\delta)(2\theta-1)/2$ 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_{2snl} in region 3. It can also be verified that $\delta - 1 < p_{1sn3} - p_{2snh} \leq 1 - \delta$ and $1 - \delta < p_{1sn3} - p_{2snl} \leq 1$, so p_{2snh} and p_{2snl} are the local maximal in regions 2 and 3, respectively. Retailer 2's payoffs at p_{2snh} and p_{2snl} are both equal to $\theta(3+2\sqrt{2})(1-\delta)(4\sqrt{2}\theta - 4\theta - \delta + 5 - 4\sqrt{2})/4$. This means that retailer 2 is indifferent between p_{2snh} and p_{2snl}, 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 $[p_{2snl} + 1 - \delta, p_{2snh} + 1 - \delta]$. 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 equal to $\theta(n-2) < 0$. 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.

$$\pi_1 = \frac{\theta(1+\sqrt{2})(1-\delta)(2\delta\theta + \sqrt{2}\theta - \delta + 1 - \sqrt{2})}{4\theta - \sqrt{2}} \tag{13}$$

$$\pi_2 = -\frac{(1+\sqrt{2}(1-\delta)[(8\delta - 16 + 4\sqrt{2})\theta^2 + (4\sqrt{2}\delta - 8\delta + 16 - 8\sqrt{2})\theta - (2-\sqrt{2})(1-\delta)]}{4(4\theta - \sqrt{2})} \tag{14}$$

$$\begin{aligned} u_1 = &\frac{(2\sqrt{2}+1)(1-\delta)[(48+16\sqrt{2})\theta^3 + (28\delta - 68 - 4\sqrt{2})\theta^2]}{28(4\theta - \sqrt{2})} \\ &+ \frac{(2\sqrt{2}+1)(1-\delta)[(5\sqrt{2}\delta - 20\delta - 9\sqrt{2} + 36)\theta - (4-\sqrt{2})(1-\delta)]}{28(4\theta - \sqrt{2})} \end{aligned} \tag{15}$$

$$u_2 = \theta(3+2\sqrt{2})(1-\delta)(4\sqrt{2}\theta - 4\theta - \delta + 5 - 4\sqrt{2})/4 \tag{16}$$

This concludes the proof of Result 1.

□

In the second step, we will prove the result of model when retailer 1 offers a price match guarantee.

Result 2. When retailer 1 offers price matching, the equilibrium prices of the two retailers are as follows.

1. When $0 < \delta \leq \frac{2\theta-1}{2\theta+1}$, the equilibrium prices are $p_{1m} = \theta + \delta\theta$ and $p_{2m} = \theta + \delta\theta$.
2. When $\frac{2\theta-1}{2\theta+1} < \delta \leq \frac{(5-3\sqrt{2}(56\theta^2-24\theta-8\sqrt{2}\theta+2+3\sqrt{2}))}{7(8\theta^2+8\theta+6\sqrt{2}\theta-4-3\sqrt{2})}$, the equilibrium prices are $p_{1m} = \frac{8\theta^2-5\theta-\delta\theta+1+\delta}{4\theta-1}$ and $p_{2m} = \frac{\theta(8\theta-3-3\delta)}{4\theta-1}$.
3. When $\frac{(2-\sqrt{2})(32\theta^2-16\theta+2\sqrt{2}\theta+2-\sqrt{2})}{2(8\theta^2+8\theta-6\sqrt{2}\theta-3+2\sqrt{2})} \leq \delta \leq 1$, the equilibrium prices are $p_{1m} = \frac{8\theta^2-4\theta-2\delta\theta+1+\delta}{2(4\theta-1)}$ and $p_{2m} = \frac{\theta(4\theta-2-\delta)}{4\theta-1}$.
4. When $\delta > 1$, the equilibrium prices are $p_{1m} = \frac{4\theta^2-3\theta+1}{4\theta-1}$ and $p_{2m} = \frac{\theta(4\theta-3)}{4\theta-1}$.

5. When $\frac{(5-3\sqrt{2}(56\theta^2-24\theta-8\sqrt{2}\theta+2+3\sqrt{2}))}{7(8\theta^2+8\theta+6\sqrt{2}\theta-4-3\sqrt{2})} < \delta < \frac{(2-\sqrt{2})(32\theta^2-16\theta+2\sqrt{2}\theta+2-\sqrt{2})}{2(8\theta^2+8\theta-6\sqrt{2}\theta-3+2\sqrt{2})}$, no pure strategy equilibrium exists. The equilibrium is in mixed strategy with retailer 1 charging $p_{1m} = \frac{1}{2}(1+\sqrt{2})(6\theta - 2\delta\theta - 2\sqrt{2}\theta + \sqrt{2}\delta - 2\delta + \sqrt{2} - 2)$.

Proof. The proof for result 2 is very similar to that of result 1. The only difference is item 1, a scenario that was not present in result 1. 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 the model without price matching. 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

$$u_1 = (\theta - \frac{1}{2})p_2 \tag{17}$$

$$u_2 = (\theta - \frac{1}{2})p_2 \tag{18}$$

Because retailer 1's payoff does not depend on p_1, retailer 1 is indifferent everywhere in this region. For retailer 2, $\frac{\partial u_2}{\partial p_2} = \theta - 1/2 > 0$, 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.

$$u_1 = \frac{1}{2}\theta[p_2 + p_1(1 - p_1 + p_2)] - \frac{1}{2}(1-\theta)p_2(p_1 - p_2) \tag{19}$$

$$u_2 = \frac{1}{2}\theta p_2(p_1 - p_2) - \frac{1}{2}(1-\theta)[p_2 + p_1(1 - p_1 + p_2)] \tag{20}$$

Solving the first-order conditions of the two functions leads to $p_{1sm1} = \frac{4\theta^2-3\theta+1}{4\theta-1}$ and $p_{2sm1} = \frac{\theta(4\theta-3)}{4\theta-1}$, which are the prices given in item 4. It can be verified that $0 < p_{1sm1} - p_{2sm1} \leq 1$, so the boundary condition is satisfied. This proves item 4 of the result. The equilibrium profits and payoffs of retailers in item 4 are as follows.

$$\pi_{1sm1} = \frac{32\theta^3 - 36\theta^2 + 13\theta - 2}{2(4\theta-1)^2} \tag{21}$$

$$\pi_{2sm1} = \frac{\theta(4\theta-3)}{2(4\theta-1)^2} \tag{22}$$

$$u_{1sm1} = \frac{\theta(32\theta^3 - 32\theta^2 + 6\theta + 1)}{2(4\theta-1)^2} \tag{23}$$

$$u_{2sm1} = \frac{32\theta^4 - 64\theta^3 + 46\theta^2 - 15\theta + 2}{2(4\theta-1)^2} \tag{24}$$

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 result 1. 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 $\frac{(2-\sqrt{2})(32\theta^2-16\theta+2\sqrt{2}\theta+2-\sqrt{2})}{2(8\theta^2+8\theta-6\sqrt{2}\theta-3+2\sqrt{2})} \leq \delta \leq 1$, which is the condition given in item 3. The equilibrium profits and payoffs in this region are given below.

$$\pi_{1sm2} = \frac{32(\delta+3)\theta^3 - 8(\delta^2+7\delta+10)\theta^2 + 4(\delta^2+6\delta+6)\theta - \delta^2 - 4\delta - 3}{8(4\theta-1)^2} \tag{25}$$

$$\pi_{2sm2} = \frac{\theta(4\theta-2-\delta)(2\theta-2\delta\theta+\delta}{2(4\theta-1)^2} \tag{26}$$

$$u_{1sm2} = \frac{\theta(128\theta^2(\theta-1) - 8(\delta^2+\delta-5)\theta + 3\delta^2 + 4\delta - 3)}{8(4\theta-1)^2} \tag{27}$$

$$u_{2sm2} = \frac{128\theta^4 - 64(\delta+3)\theta^3 + 8(\delta^2+9\delta+13)\theta^2 - (5\delta^2+28\delta+27)\theta + \delta^2 + 4\delta + 3}{8(4\theta-1)^2} \tag{28}$$

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

$$\pi_{1sm3} = \frac{16(3\delta+5)\theta^3 - (14\delta^2+64\delta+66)\theta^2 + (7\delta^2+26\delta+19)\theta - 2\delta^2 - 4\delta - 2}{4(4\theta-1)^2} \tag{29}$$

$$\pi_{2sm3} = \frac{\theta(8\theta-3-3\delta)(6\theta-6\delta\theta+3\delta-1)}{4(4\theta-1)^2} \tag{30}$$

$$u_{1sm3} = \frac{\theta(128\theta^3 + 4(\delta^2+2\delta-35)\theta^2 - 4(5\delta^2+\delta-12)\theta + 7\delta^2 + 2\delta - 5)}{4(4\theta-1)^2} \tag{31}$$

$$u_{2sm3} = \frac{128\theta^4 + 4(\delta^2-22\delta-43)\theta^3 + (12\delta^2+84\delta+88)\theta^2 - 3(3\delta^2+10\delta+9)\theta + 2\delta^2 + 4\delta + 2}{4(4\theta-1)^2} \tag{32}$$

The proof of item 5 is analogous to that of item 3 in result 1. Retailer 1 charges the price given in the result for sure, and retailer 2 plays mixed strategy in the equilibrium. The average price of retailer 2 in the equilibrium is equal to $p_{2sm4} = m * p_{2smh} + (1-m) * p_{2sml}$, where

$$p_{2smh} = \frac{(\sqrt{2}+1)[4(3-\sqrt{2}-\delta)\theta^2 - (16-10\sqrt{2})\theta - (3\sqrt{2}-4)(\delta+1)]}{4\theta}$$

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

$$m = \frac{2[8(4-2\sqrt{2}-\delta)\theta^2 + (6\sqrt{2}\delta - 8\delta + 10\sqrt{2} - 18)\theta + (3-2\sqrt{2})(\delta+1)]}{8(3-\sqrt{2}-\delta)\theta^2 + (6\sqrt{2}\delta - 8\delta + 4\sqrt{2} - 12)\theta + (2-\sqrt{2})(\delta+1)}$$

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 result. The equilibrium prices in this region are $p_{1sm5} = p_{2sm5} = \theta + \delta\theta$. 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 $u_2 = \frac{1}{2}\theta p_2(1-\theta+p_1-p_2) - \frac{1}{2}(1-\theta)p_1(1+\delta-p_1+p_2)$ and $\frac{\partial u_2}{\partial p_2} = -\delta\theta < 0$ 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

$$\pi_{1sm5} = \theta(\delta+1)^2/2 \tag{33}$$

$$\pi_{2sm5} = \theta(1-\delta^2)/2 \tag{34}$$

$$u_{1sm5} = \theta(1+\delta)(2\theta-1+\delta)/2 \tag{35}$$

$$u_{2sm5} = \theta(1+\delta)(2\theta-1-\delta)/2 \tag{36}$$

This concludes the proof of Result 2. □

Direct comparison of the previous two results leads to following solution discussed in the main text.

Result 3. When $\theta < 1$, price matching leads to higher equilibrium prices when $\delta < 2\theta - 1$ and lower equilibrium prices when $\delta > 2\theta - 1$. When $\theta = 1$, 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 Result 1 and 2. □