Most-Favored Customer Clauses Facilitate Competition*

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Abstract

We study the effects of a Most-Favored Customer (MFC) clause on price competition among major consumer electronics retailers. Our data span the periods before and after Best Buy introduced an MFC clause between April 1, 2003 and March 31, 2004. After controlling for a number of factors (including *product life-cycle effects*), we find that on average Best Buy lowered its prices by 1.1% post-change. Its competitors (except for Sears) responded by cutting prices further, Buy.com by 2.6%, Circuit City by 1.9%, and CompUSA by 2.2%. Our empirical results are robust to a variety of measures and estimation methods. We conclude that Best Buy's MFC adoption is pro-competitive.

JEL Classification Codes: D43, L13, L81

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1 Introduction

Retailers advertise and occasionally revise low-price guarantees (LPGs) to encourage store patronage, adapting to the ever-changing marketplace. In the summer of 2003, Best Buy, the leading electronics chain, added a most-favored customer (MFC) clause to its LPGs through the following statement,[1]

> "Our price-matching policy applies to the current week's prices compared to the previous week's prices, ..."

Prior to this incident, Best Buy had only promised to match rivals' prices. With the new MFC clause, it promised to refund the difference if customers found a lower price at Best Buy within two weeks of the purchase. How would this policy change affect the competitiveness in the market for consumer electronics? In this paper, we study the strategic effects of Best Buy's MFC adoption on competition.

MFC clauses may appear pro-competitive in that they entitle a buyer the same favorable terms as other customers. The impacts of MFCs on competition have been of interest to antitrust authorities and academia alike. For instance, GE and Westinghouse introduced MFC policies in the electronic turbine generator industry in the 1960s. Despite profitability, both firms discontinued the policies by the mid-1970s after being challenged by antitrust authorities, who also challenged the practice of MFC clauses in various other industries including health care (e.g., the Ocean State case) and fuel additives (e.g., the Ethyl case) (Martin, 2000).

Meanwhile, research findings on the competitiveness of MFCs are mixed. The differences are often attributed to different MFC types and to whether or not sellers automatically issue rebates. Empirically, Crocker and Lyon (1994) find that MFCs in long-term natural gas contracts are used to enhance efficient price adjustment, rather than to collude; Scott Morton (1997) finds that, after an MFC rule was added to the Medicaid program, the price of branded drugs facing generic competition rose. Among theoretical studies, Cooper (1986) and Schnitzer (1994) show that retroactive MFC clauses facilitate collusion by raising prices, while both Degraba (1987) and Besanko and Lyon (1993) show that contemporaneous MFC clauses may intensify competition and lead to lower prices.[2]

In this paper, we focus on the industry of consumer electronics, which provides an ideal setting for studying MFC clauses for several reasons: (1) Prices of electronics generally fall

[1] Details about this policy change can be found in Section 3.2.

[2] Different types of MFCs are defined in Section 2.

over time, as newer models are released.[3] In contrast, the prices of pharmaceutical drugs (Scott Morton, 1997) and natural gas (Crocker and Lyon, 1994) usually increase over time. It is interesting to explore the role of this distinct feature of electronics in investigating the impact of Best Buy's new policy, especially because it promises to rebate customers the difference should prices go down after the purchase. (2) Consumers can easily identify an electronics product with the same brand and model across stores, and request refunds if there is a price difference. (3) Consumer electronics are relatively expensive – the average price is $586.87 in the sample, indicating a high likelihood of requesting a refund. (4) MFC clauses adopted by electronics stores usually apply to all products in the store, not just to a subset.[4] Taken together, this product selection allows us to examine the motives and effects of Best Buy's MFC from a different perspective from the existing literature.

To disentangle the strategic effects of Best Buy's MFC policy, we have assembled a unique data set of 23,145 daily price quotes for 55 consumer electronics products and LPG policy information between April 1, 2003 and March 31, 2004.[5] Our sample focuses on large electronics retailers including three national retail chains (Best Buy, Circuit City, and CompUSA), a department store (Sears), and an Internet-based retailer (Buy.com). After controlling for various factors, such as product, holiday, and product life-cycle fixed effects, we find that Best Buy's MFC implementation *facilitates* competition in the product market. Specifically, Best Buy lowers its prices by 1.1% on average after the policy change. In response, Buy.com cuts its average prices by 2.6%, Circuit City by 1.9%, CompUSA by 2.2%, and Sears by 0.1%, respectively. We argue that the observed policy change has a price-reducing effect. Our empirical results are similar using both parametric and semiparametric estimations. As a robustness test, we assemble two subsamples *only* consisting of observations before (subsample 1) or after (subsample 2) the policy change. We then introduce a "pseudo policy change" dummy in each subsample. Since there is no actual policy change in either subsample, we should expect the above-mentioned effects on pricing to disappear when applying the same model specifications. Our estimation confirms this expectation.

Intuitively, Best Buy's MFC adoption yields two competing effects on prices in the market. First, the newly added MFC enhances the appeal of Best Buy's LPG and, in turn, its products. With the "improved" products, Best Buy has an incentive to raise its prices (a *positive* effect). Second, competing stores respond by lowering prices to retain customers,

[3] The recent incident of iPhone price slash from $599 to $399 within three months in 2007 was an extreme but perfect real-world example.

[4] For example, Best Buy's MFC applies to all products except for cellular, digital, and PCS phones and pagers in California.

[5] Our original sample has 125 consumer electronics products. We explain the selection procedure of the final sample in Section 3.3.

which adds pressure to Best Buy's prices (a *negative* effect). Our empirical evidence suggests that the negative effect outweighs the positive effect. Furthermore, aside from the favorable effects on prices, consumers may receive an additional benefit: Those who would otherwise delay the purchase at Best Buy may now enjoy the product earlier, because they can always request a refund should the price drop in two weeks. Thus, we conclude that Best Buy's MFC adoption appears pro-competitive.

The rest of the paper proceeds as follows. Section 2 reviews the related literature. In Section 3, we describe the data and provide detailed information on the observed policy change. We conduct the empirical analysis in Section 4, and offer concluding remarks in Section 5.

2 Literature Review

There is an extensive theoretical literature on MFC clauses. One strand of the literature focuses on the "retroactive" MFC, through which a firm promises to refund consumers the difference should its price fall later.[6] Cooper (1986) analyzes a two-period duopoly model with differentiated products, where one firm adopts a MFC policy.[7] He finds that if the adopting firm prices slightly above the Bertrand level in the first period, it has no incentive to lower price in the second period because it would otherwise issue refunds to former customers. In another word, the MFC softens competition and consequently both firms earn higher profits, compared to the case where the MFC is absent. Schnitzer (1994) considers the effect of MFC on collusion in a two-period duopoly model with homogeneous durable goods.[8] Without an MFC clause, collusion is not sustainable and firms earn zero-profit. However, when both firms adopt MFC, positive profits can be sustained, conditional on that no new consumers enter the market in the second period. She concludes that MFC clauses can facilitate collusion but their role is limited.

The MFC documented in this paper belongs to this type. Our analysis suggests that Best

[6] Spier (2003 a, b) and Daughety and Reinganum (2004) consider "most-favored-nation" (MFN) clauses when a defendant settles with different plaintiffs at different time, and plaintiffs with the MFN in the early settlement are entitled to the difference should the later settlement amount be larger. Png (1991) compares MFC to price discrimination in a setting where a capacity-constrained monopolist learns about the demand over time.

[7] Using a similar framework, Neilson and Winter (1993) find that, under reasonable assumptions about demand, there is no equilibrium where both firms adopt MFC.

[8] Typically in a finite-period model, collusion unravels due to backward induction. However, in Schnitzer, consumers purchase only once, and receive the same life-time utility regardless of the timing of their purchase. This makes punishment possible in periods before the last period, and thus collusion can potentially be sustained.

Buy's MFC adoption facilitates competition among major electronics retailers. This finding deviates from the general consensus of theoretical studies on the retroactive MFC. This departure may be due to the fact that electronics have a unique feature of declining prices over time, which is not considered in the theoretical studies. Another plausible explanation is that consumers have to request for rebates in ours while refunds are assumed to be automatic in the literature. That is, Best Buy could potentially use the MFC to price discriminate against consumers with high hassle costs.[9]

Under the second type or the "contemporaneous" MFC clauses, firms cannot price discriminate among consumers. In contrast to the retroactive MFC, the contemporaneous MFC clauses are often found to encourage competition. Degraba (1987) employs a Hotelling model to analyze competition between a national firm and two local firms in two separated markets. When the national firm adopts a contemporaneous MFC clause and thus cannot price discriminate across the two markets, the local firms engage in more aggressive nonprice competition by locating closer to the national firm. In equilibrium, prices are lower in both markets. Besanko and Lyon (1993) consider two types of buyers: "non-shoppers" who only purchase from a specific firm, and "shoppers" who always purchase from the low-price firm. They find that not adopting contemporaneous MFC can be a dominant strategy, and the MFC is adopted voluntarily only when they serve to raise average industry prices. Grether and Plott (1984) show, through lab experiments, that the industry-wide MFC adoption has a negative but insignificant effect on prices.

Another type is the "meet-or-release" (MOR) policy, or the "three-party" MFC used in Butz (1990). By adopting a MOR clause, firm i promises to refund its consumers the difference if firm j lowers its price in the future (e.g. if $p_{j,t+1} < p_{i,t}$). In a homogeneous-good setting, Holt and Scheffman (1987) find that the combination of the retroactive MFC, the MOR, and advance list price notification allows firms to adopt quantity-choice strategies and earn up to the Cournot profit. Schnitzer (1994) argues that the MOR alone is more likely to sustain collusion than the retroactive MFC in a duopoly model.

Empirical studies on MFC clauses are relatively scarce. Studying long-term contracts between natural gas wells owners and pipeline purchasers, Crocker and Lyon (1994) examine firms' motivation of adopting MFC clauses.[10] The MFC clause allows both parties to choose flexible prices over time to reflect the cost of substitute supplies (e.g. use fuel oil to replace natural gas), and to make efficient production and consumption decisions. They find

[9] For future research, it would be interesting to theoretically investigate the effect of retroactive MFCs on competition when both declining product prices and hassle costs are accounted for.

[10] These contracts often contain a most-favored-nation (MFN) clause, which is similar to the contemporaneous MFC, as defined in this paper.

evidence that such a clause is used as a non-discriminating device for facilitating efficient price adjustments rather than for tacit collusion.

Scott Morton (1997) is the study most closely related to ours. She investigates the impact of the MFC rule, added to Medicaid program in 1991, on pharmaceutical prices. Specifically, the MFC rule allowed Medicaid to pay either (1) 87.5% of average manufacturer price (AMP) or (2) the manufacturer's "best price", whichever is lower in each calendar quarter. Under the new rule, manufacturers have incentive to increase the prices non-Medicaid buyers pay – thus increase the prices in (1), and to refrain from giving discounts – thus increase the prices in (2). She finds that, consistent with the theoretical predictions, the MFC rule raised some pharmaceutical consumers' In particular, prices of branded drugs facing generic competition rise after the MFC adoption.

Our paper differs from these two empirical studies in the following aspects: (i) MFC types, (ii) whether or not buyers have to submit a rebate request, and (iii) whether product prices decline over time. In Scott Morton (1997), a buyer (Medicaid) adopts the MFC, and is the *only* qualified beneficiary in the rebate program. The main purpose of the policy is to allow Medicaid recipients to enjoy preferential prices and to reduce government spending on pharmaceuticals. Note that these rebates are automatic, and drug prices usually do not fall over time. In our paper, a seller (Best Buy) introduces an MFC which applies to all buyers, aiming to improve its store policy and to induce consumers to buy early rather than wait. Moreover, consumers need to initiate the refund process if prices go down after the purchase. In Crocker and Lyon (1994), the MFC may have a secondary effect on the intensity of competition. However, their sample does not cover the periods before and after the MFC was adopted, rendering infeasible the analysis on this secondary effect – a departure from Scott Morton (1997) and our paper.

Our analysis is also related to the literature on price-matching concerning competitors' concurrent prices.[11] Hess and Gerstner (1991) and Manez (2006) both evaluate the effects of price-matching policies on competition, but arrive at somewhat different conclusions.[12] The former find that the introduction of price-matching (PM) by a local supermarket leads to a higher degree of price coordination among the competing stores, and thus discourages competition. The latter reports that after Tesco introduces a price-beating policy which only applies to the products for which it enjoys a price advantage, average prices decline at

[11] Baye and Kovenock (1994) is one of the early studies analyzing the potential collusion-facilitating role of price-matching policies. Corts (1997) argues that price-matching policies should be more appropriately viewed as means of price discrimination. For excellent surveys of the literature, see Moorthy and Winter (2006) and Manez (2006).

[12] Using data on retail tire prices, Arbatskaya et. al. (2006) find that price-matching policies, not price-beating policies, facilitate higher prices.

competing stores in the same market. He concludes that price-beating is used to signal low prices, and can be pro-competitive.

3 Data

3.1 Products and Prices

We collected daily price quotes of 125 consumer electronics products sold at Best Buy, Buy.com, Circuit City, CompUSA, and Sears between April 1, 2003 and March 31, 2004.[13] These listing prices exclude taxes and shipping charges, which may vary across shoppers.[14] We gathered the information from each store's website by running a so-called "spider" program, which downloaded and saved all relevant web pages daily during the sample period. Price information on saved web pages was then extracted, along with store and product information such as model number, rebate, discount, and whether the product was in stock.

Here we discuss the rationale of choosing these five stores.[15] First, these stores are among the largest electronics retailers (except for Sears) and are close competitors during our sample period. A policy change by Best Buy is more likely to have an impact on itself and its close competitors (especially Circuit City) than on smaller stores. Second, we focus on large retailers to minimize heterogeneity in store reputation. Moreover, big-box retailers typically do not directly compete with less reputable stores.[16] Especially for large-item purchases – the average price is $586.87 in our sample, seller reputation and the quality of customer service is crucial. Finally, focusing on these large retailers eases data collection burden, and gives us a relatively balanced panel data in which each store carries a significant fraction of the sampled products.

[13] These five stores were among the largest consumer electronics retailers during the sample period. Based on the companies' annual SEC filings, their 2003 sales (in $ million) were: Best Buy 24547; Circuit City 9745.4; CompUSA 8221.8; Sears 41124; Buy.com 238.2. We do not have the specific information on Sears' electronics sales. According to the U.S. Census Bureau's statistics, electronics and appliances e-commerce sales as percent of total sales were 52.7% in 2003 and 59.2% in 2004. (Source: http://www.census.gov/eos/www/2004/2004tables.html). Much of the industry has changed since the sample period. Wal-Mart has been gaining significant presence in electronics retailing, while CompUSA and Circuit City filed for chapter 11 bankruptcy in 2007 and 2008, respectively. Subsequently, Systemax's subsidiary TigerDirect took control of CompUSA in the early 2008. In May 2009, the same company acquired the liquidated Circuit City.

[14] Baye et al. (2004) find that their results are robust to incorporating shipping costs, inventory and various other variables (see footnote 19 in Baye et al. (2004)).

[15] It is common to use only a handful of stores in the empirical literature on LPGs. For example, Hess and Gerstner (1991) study five supermarkets, and Manez (2006) only three supermarket chains.

[16] Less reputable retailers may offer seemingly attractive store policies but consumers often find that the redemption process can be rather complex, involving hidden terms and conditions.

In this study, we use online prices, which generally match the prices of the same products sold in local stores. For example, as Best Buy discloses at its web site, "Online prices and selection generally match our retail stores, but may vary." Multi-channel retailers usually keep online and offline prices close to each other to avoid internal competition and channel conflict (Xing, Tang and Yang, 2004). Even in the absence of national competition among each other's online stores, national retailers may not have incentive to price-discriminate across their respective local stores (Dobson and Waterson 2005). Moreover, we use online, rather than local, prices not only to ease data collection burden, but also to better reflect the fact that Best Buy's policy change occurred at the national level, not the local level. To the extent that prices at a local store may differ from online prices, unfortunately, our data are unable to capture the difference. Therefore, one needs to take caution when interpreting our empirical results, since they indicate the pricing effects at the national level, rather than what might have occurred at local stores.

3.2 Information on LPGs

We also manually collected detailed store LPG information from their web sites about every other week during the same period. Subsequently, we retrieved the policy information from the saved web pages. These LPGs apply to advertised prices of new, unopened, identical products, excluding special offers.[17] Examining the policy information, we found that while LPGs vary across stores at any given time, they are fairly stable over time for a given store. However, there is one exception: during weeks 13 and 14 in the sample, Best Buy changed its LPG by introducing an MFC clause.[18] From April to June 2003, our records show the following LPG policy at Best Buy:[19]

"*If within 30 days,. . . , you find a local competitor . . . offering a lower price on an available product of the same brand and model, we'll refund the difference plus another* 10% *of the difference.*"

The description indicates that Best Buy had only promised not to be undersold by competitors, without any indication whether or not it would match its own prices. However, from the policies recorded on and after July 8, 2003, the following statement was added to the previous LPG policy:[20]

[17] For example, at Best Buy, special offers include gift-with-purchase and financing offers.

[18] This is the only policy change at Best Buy we recorded during the sample period.

[19] Refer to the Appendix for a detailed comparison between Best Buy's LPG policies before and after the change. We also include Circuit City's policy, which remained unchanged throughout the sample period.

[20] Given the fact that we collected biweekly policy information, it is unlikely to pinpoint the exact date when the change had occurred. However, our findings are robust to different dates of the policy change

"*Our price-matching policy applies to the current week's prices compared to the previous week's prices, and to how our prices compare with our competitors'.*"

We interpret the first part of the statement as an MFC clause, with which consumers may request a price-match should Best Buy's own prices drop within two weeks of the purchase. Thus, by comparing prices before and after the policy change, we are able to test the effects of the MFC adoption on competition.

To examine the effect of this policy change on prices, we define a policy dummy variable MFC which takes value 1 if an observation was collected after the policy change, and 0 otherwise.[21] Table 1 compares average prices for matched products sold at a given store before and after the policy change. Across all stores, average prices decline over time, and the differences are statistically significant. Buy.com has the smallest average price reduction of $18.74, followed by Circuit City of $25.24, while Sears has the largest of $51.04.

3.3 Information on Product Life-Cycle

The price reductions in Table 1 stem in part from product life-cycle effects. As technology advances, newer models of electronics products are released to the market continuously, leading prices of older models to fall steadily. Therefore, it is essential to control for product life-cycle effects when studying consumer electronics. Baye et al. (2006) use interactions between product and month dummy variables to proxy such effects. However, this approach is not applicable here, because our key variable of interest, MFC, can be expressed as a perfect linear combination of the month dummy variables. Therefore, we turn to the alternatives. Akimoto and Takeda (2009) model product life-cycle effects directly – including a quadratic function of "age" in the regression model, where age is defined as the number of days since a product was first released to the market. We adopted this approach and tried to recover the initial product market release date for each product.

With the aid of customer service representatives from various manufacturers, we were able to fill out this crucial information for 86 (out of 125) products in the original sample. After dropping products which only appear before or after the change, our final sample consists of 23,145 daily price quotes for 55 products. Table 2 provides summary statistics of the final sample. The average price of these products is $586.87, ranging from $44.87 to $2,999.99. 54% of the observations are from after the policy change. Among five stores, roughly the same number of observations are from Best Buy, Buy.com and Sears, while Circuit City

within this time window.

[21] For the rest of the paper, we refer to weeks 1 through 13 as "before the policy change" ($MFC = 0$), and the remaining weeks as "after the policy change" ($MFC = 1$).

has the most and CompUSA has the least observations. Only 6% of the observations are during the holiday shopping season. Among three promotional activities, mail-in rebates are the most frequently used, instant store discount the second, and giftcard the least. In our sample, usually two or three stores carry a given product. Finally, the average age of these products is approximately 380 days. We have one product released to the market on the first day of the sample, i.e., $age = 1$.

4 Analysis

Our goal is to examine the effects of Best Buy's MFC adoption on price competition. As a preliminary step, we estimate the following store-pair price difference regression model

$$\Delta P_{ijt} = \gamma_0 + \gamma_1 * MFC + \varepsilon_{ijt} \tag{1}$$

The left-hand-side of the above equation is the price difference for product i sold at day t between Best Buy and another store j (i.e., Best Buy's price less store j's price).

Table 3 reports the results for store-pair price difference regressions. For each store-pair, Model (1) only includes a constant term (i.e., restricting $\gamma_1 = 0$). All the estimates are positive and statistically significant at the 5% level, indicating that Best Buy charges higher prices than its competitors. We observe the largest disparity between Best Buy – the leading electronics retailer, and Buy.com – a Web-based retailer. In Figure 1, the histograms of average price differences in matched products by store pair further confirms this observation.

Model (2) includes the policy change indicator, MFC. Here the focus is the effect of the policy change on price differentials between Best Buy and its competitor. A positive coefficient for MFC ($\gamma_1 > 0$) indicates greater disparity in prices between paired stores after the policy change, and smaller disparity otherwise. After the policy change, price differences between Best Buy and Buy.com as well as Circuit City rise (i.e., $\gamma_1 > 0$), while those between Best Buy and the other two stores decline ($\gamma_1 < 0$). These findings provide preliminary evidence of different responses across stores to Best Buy's policy change.

4.1 Model

For the main analysis, we estimate the following equation

$$\begin{aligned}\ln(P_{ijt}) &= \alpha_0 + \alpha_1 * MFC + \beta_1 * Buy + \beta_2 * Circuit\ City + \beta_3 * CompUSA + \beta_4 * Sears \\ &+\gamma_1 * Buy * MFC + \gamma_2 * Circuit\ City * MFC + \gamma_3 * CompUSA * MFC \\ &+\gamma_4 * Sears * MFC + \theta_1 * Discount_{ijt} + \theta_2 * Rebate_{ijt} + \theta_3 * Giftcard_{ijt} \\ &+\theta_4 * Holiday_t + \delta * \mathbb{X}_{ijt} + f(Age_{it}) + \varepsilon_{ijt} \qquad (2)\end{aligned}$$

The left-hand-side of the above equation $\ln(P_{ijt})$, is the natural logarithm of a price quote for product i sold at store j at day t. Dummy variable MFC is the policy change indicator. It equals one if t falls in week 14 or later, and zero otherwise. If $\alpha_1 < 0$, Best Buy lowers its average prices after the policy change.[22]

The next set of variables are four store dummies. *Buy* is defined as one if the observation comes from Buy.com and zero otherwise. The other three store dummies (*Circuit City*, *CompUSA* and *Sears*) follow in the same fashion. *Best Buy* is omitted in the regression equation. β_1 captures the average difference in log prices between Buy and Best Buy before the policy change, β_2 captures that between Circuit City and Best Buy, and so on. If Best Buy enjoys a store premium, we expect β_1, β_2, β_3 and β_4 to be negative.

The interactions between store dummies and the policy change dummy MFC measure the relative price change at store j to that at Best Buy.[23] $(\alpha_1 + \gamma_1)$ measures the effect of Best Buy's policy change on Buy.com's average price; a negative coefficient indicates that Buy.com lowers average prices in response after the policy change. Similarly, the estimates of $(\alpha_1 + \gamma_2)$, $(\alpha_1 + \gamma_3)$, and $(\alpha_1 + \gamma_4)$ gauge the other three stores' responses to the policy change, respectively.

Equation (2) takes into consideration a number of factors. In our sample, stores sometimes offer promotions such as mail-in rebates, gift card, and instant store discounts. For instance, at Best Buy and Circuit City, one occasionally has to add a product to the visual "shopping cart" to obtain a final price quote after an instant store discount.[24] Our electronic agent was unable to determine such discounts. However, our sample does have the information indicating whether promotions were offered. Accordingly, we construct three

[22] Here, we treat the observed policy change as exogenous, in the absence of a proper instrument variable.

[23] It's possible that prior to the actual policy change, Best Buy had already honored consumers' requests for MFC rebates. If this is the case, then our estimates might underestimate the effects of MFC.

[24] The snapshots from Circuitcity.com on March 27, 2006 in Figure 2 illustrate an example of such offers.

dummy variables, *Discount*, *Rebate*, and *Giftcard* to measure the effects of these offers.[25] Promotion dummy variable $Discount_{ijt}$ ($Rebate_{ijt}$ or $Giftcard_{ijt}$) is defined as one if store j offers an instant store discount (a mail-in rebate or a gift card) for product i at day t, and zero otherwise. To capture the potential holiday effects, we define a dummy variable $Holiday_t$ as one if day t falls between Thanksgiving (or week 35) and New Year Day (or week 40), and zero otherwise. Following Baye *et al.* (2006), we use vector $\mathbb{X}_{ijt}$ to control for the number of competing stores and product fixed effects.

We define product i's age at day t (Age_{it}) as the number of days since its initial market release. First, we assume a nonlinear parametric relationship between Age_{it} and product price (lnP_{ijt}), or $f(Age_{it}) = Age_{it} + Age_{it}^2$ (see in Akimoto and Takeda, 2009). Next, to allow for a more flexible statistical relationship between the two variables, we apply semiparametric regression techniques to equation (2), with $f(Age_{it})$ being a nonparametric term. In search for a smooth fit, we consider penalized spline models in our analysis (Keele, 2008). More details on these estimations are offered in the next section.

Finally, ε_{ijt} is the error term in the regression model.

4.2 Estimation Results

Table 4 reports the results for price-level regressions. To show the effects of product life-cycle, we consider four different model specifications. In Model (1), the baseline model, we exclude the variable Age_{it} from the estimation. In Model (2), we include Age_{it} and Age_{it}^2 to control for product life-cycle effects. In Models (3) through (5), we estimate the product-life cycle effects nonparametrically, using penalized spline smoothing (Ruppert, Wand and Carroll, 2003), allowing a different intercept for each product.[26]

The model specifications in Table 4 allow us to examine the strategic effects of the policy change on competition. Our variables of interest are the policy dummy MFC, and its interactions with the store dummies. Recall that the coefficient of MFC measures the average price difference at Best Buy before and after its policy change, and those of the interaction between MFC and the store dummies indicate each store's relative price change to Best Buy. In Model (1), we report heteroskedasticity and autocorrelation-consistent

[25] Eliminating these observations from our analysis does not change our main findings.

[26] Keele (2008) (see Chapter 3, p.49) offers a detailed discussion on different nonparametric regression techniques. He argues that splines enjoy several advantages over local polynomial nonparametric regression (LPR) models. For example, "a spline smoother will provide the best mean squared error fit" and "is designed to prevent overfitting, a prominent concern with nonparametric smoothers". One solution to overfitting is to use penalized estimation, a concept similar to the adjusted R^2.

(HAC) standard errors. Our analysis shows that average prices at Best Buy decline by 7.4% after it adopts the MFC ($\alpha_1 = -0.074$). Competing retailers all respond with price reductions. In particular, CompUSA lowers its average prices by 8.4% (i.e., $\alpha_1 + \gamma_3$), Circuit City by 6.9% (i.e., $\alpha_1 + \gamma_2$), Buy.com by 7.8% (i.e., $\alpha_1 + \gamma_1$), and Sears by 5% (i.e., $\alpha_1 + \gamma_4$), respectively.[27] Best Buy charges a store premium of up to 4.4% (β_1) over its rivals, while CompUSA's average prices are 1.5% (β_3) higher than Best Buy's. Note that the economic magnitude in the coefficient for Circuit City is almost negligible, indicating that at the time of data collection, two stores were close competitors in the market.

Model (1) also considers three store promotion variables, $Discount$, $Giftcard$, and $Rebate$. As discussed earlier, these variables measure the effects of various store promotions. Everything else equal, having a mail-in rebate raises average prices by 1.6% and having a store discount raises average prices by 2.3%, while offering a gift card lowers prices by 1.8%, all significant at the 1% level. Moreover, dummy variable $Holiday$ has a negative significant effect on average prices. Other control variables include the number of stores and a set of product fixed effects.

One may argue that the observed declining prices may simply be due to the nature of consumer electronics products, which typically entails falling prices over time.[28] To control for these potential factors, we add the variable, Age_{it} and its quadratic term in Model (2) (Akimoto and Takeda, 2009). Now the coefficient of MFC becomes -0.8% (compared to -7.4% in Model (1)). The reduction in the magnitude of this estimate indicates the need for additional control for product life-cycle effects in the regression model. This finding is consistent with that in Model (1), indicating that Best Buy lowers its average prices after changing its LPG policy. In response, Buy.com, Circuit City, and CompUSA lower average prices by 2.8%, 1.3% and 2.4%, respectively. However, Sears actually raises prices by 0.8%. It may be due to the fact that Sears is the only department store and may behave differently from Best Buy's other competitors.

Negative store dummies in Model (2), except that for CompUSA, again suggest that Best Buy enjoys a store premium in the market (up to 3.6%). In addition, the estimated store promotion variables are similar to the ones in Model (1). Everything else equal, having a mail-in rebate raises average prices by 1.9% and having an instant store discount raises prices

[27] We also perform F-tests to see whether all coefficients involving MFC in Table 4 jointly equal zero, and whether all interactions with MFC in Table 4 jointly equal zero. The test results indicate that these joint price responses are statistically significant.

[28] With an unbalanced panel data, one also has to check for the possibility of different product composition after the policy change, i.e. some products may appear mainly before or after the policy change. As mentioned earlier, to reduce the noise of production composition change, our final sample excludes 31 products which were sold only before or after the policy change.

by 2.1%, while offering a gift card with purchase lowers prices by 1.3%, all significant at the 1% level. These findings suggest that various store promotions are important control factors in the analysis. Contrast to that in Model (1), average prices during the holiday shopping season are 2.2% higher than the non-holiday season. The estimate of Age is negative, while that of Age^2 is positive, suggesting that average prices decline at a decreasing rate during a product's life cycle.

Moving to Model (3), one may notice some differences between parametric and semi-parametric regression results.[29] For example, for the key variable MFC, the estimate is $\alpha_1 = -0.011$ in Model (3) instead of -0.008 in Model (2), indicating that Best Buy lowers average prices by 1.1% after introducing the MFC. Its competitors respond by cutting down their prices as well. Specifically, Buy.com lowers prices by 2.6%, Circuit City by 1.9%, CompUSA by 2.2%, and Sears by 0.1%. Based on the estimation in Model (3), Figure 3 plots the effects of product age on the log of prices with the penalized spline smoothing fit.

As a robustness test, we assembled two subsamples spanning the periods before (weeks 1 through 13) and after (weeks 14 through 52) Best Buys' policy change. In particular, subsample 1 includes all the observations before the policy change and subsample 2 includes those after the policy change. Without loss of generality, we split each subsample into two by introducing a "pseudo policy change" dummy – "MFC", which equals zero if day t is within the first half of the subsample and one otherwise. In the absence of any actual policy change, we should expect the prior observed effects of MFC to disappear when we replicate the regression analysis of Model (3) using the subsamples. This expectation is confirmed in Model (4) and (5). Apparently, the effects of MFC disappear in Models (4) and (5), both in terms of the magnitude and the statistical significance. Thus, we conclude that the control of product life-cycle effects in the analysis is satisfactory.[30]

4.3 Discussions

Since the MFC adoption leads to lower prices at Best Buy and competing stores, one natural question is why Best Buy would adopt such a policy. Putting differently, does this policy change help Best Buy gain market share at the expenses of its competitors? Figure 4 indicates that the sales gap between Best Buy and its closest competitor then, Circuit

[29] Models (3) through (5) are estimated using the "SemiPar" package in R (Wand et al., 2005).

[30] Although some of interactions between MFC and store dummies are statistically significant, it seems to lack a coherent message. Some interactions are insignificant, and some even change signs between Models (4) and (5). This echoes the fact that there is indeed no actual policy change in either subsample.

City, substantially widened during the year 2003-2004.[31] This suggests that the newly implemented MFC clause may have contributed to the boost in Best Buy's market share.

Intuitively, Best Buy's policy change generates two effects. On the one hand, the MFC adoption improves Best Buy's LPG policy, making its products more attractive. This allows Best Buy to charge higher prices (a *positive* effect). On the other hand, Best Buy's rivals need to lower prices to retain their customers, which in turn forces Best Buy to lower its price (a *negative* effect). Our results suggest that the second effect dominates the first one, and the MFC adoption intensifies competition. Meanwhile, consumers benefit from the MFC in two aspects. First, they enjoy the overall lower market prices after the adoption. Second, the MFC allows consumers to request a rebate when Best Buy lowers its prices over time, so they may choose to buy early rather than delay purchasing. In conclusion, Best Buy's policy change is pro-competitive.

5 Conclusion

In this study, we document an LPG policy change in the consumer electronics market. Our analysis suggests that the introduction of an MFC clause by Best Buy enhances competition. We have assembled a unique data set spanning the periods before and after Best Buy's policy change between April 2003 and March 2004. After controlling for a number of factors including product life-cycle effects, we find that Best Buy lowers its average prices by 1.1% following the policy change. In response, the competing stores also lower their prices. Specifically, Buy.com decreases its average prices by 2.6%, Circuit City by 1.9%, CompUSA by 2.2%, and Sears by 0.1%. These findings are robust to a variety of model specifications and controls.

Our empirical findings deviate from those of the previous theoretical studies, which often suggest that retroactive MFC discourages competition. We offer three plausible explanations. One distinct feature of electronics which may play an important role in explaining the difference in findings is that their prices, unlike those of most commodities, tend to decline over time. Moreover, in the MFC literature, rebate is typically assumed to be automatically issued. In our case, however, consumers need to request for rebates from Best Buy, thus hassle costs may play a role. Finally, the difference may accrue to the fact that we consider retailer stores while theoretical studies typically include manufacturers. In summary, this departure raises important questions about how to correctly capture the underlying story

[31] Source: "Circuit City Rewires" by Meridith Levinson, CIO Magazine, July 1, 2005 (http://www.cio.com/archive/070105/circuit.html).

relating to Best Buy's policy change, and suggests the need of new theoretical work.

Our findings have important policy and managerial implications. On one hand, policy makers need to use caution while making decisions on whether or not to intervene in a policy adoption since the use of MFC clauses can be pro-competitive as we demonstrate in this paper. On the other hand, in the midst of dynamic technological and market structural changes, it is essential for firms to secure a set of strategies. Understanding how competitors react to a policy change helps managers better design pricing strategies in the changing business world.

Note that we only consider the strategic effects of Best Buy's new MFC policy on a handful of large retailers during the sample period. A more comprehensive analysis would use a larger sample with more stores and products. Also, we treat the policy change decision as exogenous in the model. Endogenizing this decision is undoubtedly more realistic with appropriate instrumental variables.

Appendix

Best Buy's policy on 06/16/2003

In-Store Price Guarantee — If, within 30 days (14 days for computers, monitors, printers and notebooks, camcorders, digital cameras and radar detectors) of your purchase from Best Buy, you find a local competitor (excluding Internet competitors) offering a lower price on an available product of the same brand and model, we'll refund the difference plus another 10% of the difference. Just bring us a current ad or other verifiable written proof of the lower price, plus your original Best Buy sales receipt to claim your refund. This offer good only on all new in-the-box products of the same brand and model that is available in-store at any other local authorized retailer. It does not apply to competitor's one-of-a-kind or other limited quantity offer, or when a bonus or free offer (such as special financing program or manufacturer's rebate) is included in the purchase. Offer does not apply to BestBuy.com pricing. All returns exchanges and price adjustments must be made in the country of original purchase. See a Customer Service Representative for details.

Best Buy's policy on 07/08/2003

Will you match someone else's price?

Our price-matching policy applies to the current week's prices compared to the previous week's prices, and to how our prices compare with our competitors'.

Store Price Guarantee

If, within 30 days* (14 days for computers, monitors, printers and notebooks, camcorders, digital cameras and radar detectors) of your purchase from Best Buy, you find a local competitor (excluding Internet competitors) offering a lower price on an available product of the same brand and model, we'll refund the difference plus another 10% of the difference. Just bring us a current ad or other verifiable written proof of the lower price, plus your original Best Buy sales receipt to claim your refund. This offer good only on all new in-the-box products of the same brand and model that are available in-store at any other local authorized retailer. It does not apply to competitor's one-of-a-kind or other limited quantity offer, or when a bonus or free offer (such as special financing program or manufacturer's rebate) is included in the purchase. Offer does not apply to BestBuy.com pricing. All returns exchanges and price adjustments must be made in the country of original purchase. Go to the customer service counter for details.

Circuit City's policy throughout our sample period

Price Match Plus Guarantee

Nothing's worse than paying too much. That's why we do everything in our power to make sure you don't pay a penny more than you should for anything you buy at Circuit City. If you've seen a lower advertised price from a local store with the same item in stock, we want to know about it. Bring it to our attention, and we'll gladly beat their price by 10% of the difference. Even after your Circuit City purchase, if you see a lower advertised price (including our own sale prices) within 30 days, we'll refund 110% of the difference.

Our Price Match Plus Guarantee means you don't have to wait for a sale to know you're getting the best price. You can buy it now, when the selection is at its best, and get exactly what the people on your list really want! We've got the best prices on the things you're looking for-Guaranteed!

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Table 1. Price level comparison for matched products

Store	# of Products	Before ($)	After ($)	ΔP ($)	t-value	p-value (one-side)
Best Buy	26	621.64	577.82	43.82	3.624	0.001
Buy	19	615.82	597.08	18.74	2.073	0.026
Circuit City	46	600.60	575.36	25.24	4.580	0.000
CompUSA	11	627.16	577.70	49.46	3.191	0.005
Sears	18	567.03	515.99	51.04	3.752	0.001
Overall	120	604.97	570.64	34.33	7.655	0.000

*These results are based on observations at the store-product level

Table 2. Summary Statistics of the Final Sample

Variable	Obs	Mean	Std. Dev.	Min	Max
Price	23145	586.87	569.34	44.87	2999.99
Ln(Price)	23145	6.06	0.78	3.80	8.01
MFC	23145	0.54	0.50	0	1
Store Dummies					
Best Buy	23145	0.17	0.37	0	1
Buy.com	23145	0.17	0.38	0	1
Circuit City	23145	0.40	0.49	0	1
CompUSA	23145	0.09	0.28	0	1
Sears	23145	0.17	0.38	0	1
Interactions between Store and MFC					
Buy.com*MFC	23145	0.10	0.30	0	1
Circuit City*MFC	23145	0.22	0.41	0	1
CompUSA*MFC	23145	0.05	0.22	0	1
Sears*MFC	23145	0.10	0.30	0	1
Promotion Dummies					
Holiday	23145	0.06	0.23	0	1
Mail-in Rebate	23145	0.19	0.39	0	1
Giftcard	23145	0.05	0.23	0	1
Instant Store Discount	23145	0.12	0.33	0	1
Number of Stores Selling the Same Product Dummies					
1 Store	23145	0.13	0.34	0	1
2 Stores	23145	0.44	0.50	0	1
3 Stores	23145	0.37	0.48	0	1
4 Stores	23145	0.06	0.24	0	1
Product Life-Cycle					
Age	23145	379.64	173.66	1	963
Age^2	23145	174279	153801	1	927369

Table 3. Difference in Prices Regressions by Store-Pair

Dependent Var:	Best Buy vs. Buy		Best Buy vs. Circuit City		Best Buy vs. CompUSA		Best Buy vs. Sears	
$\Delta P = P_{\text{Best Buy}} - P_{\text{Another Store}}$	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)
MFC (Weeks 14 through 52)		164.136		8.138		-49.139		-10.893
		(14.707)**		(3.040)**		(4.945)**		(1.990)**
Constant	110.197	49.816	10.156	7.204	13.549	35.370	8.017	11.585
	(6.955)**	(6.698)**	(1.266)**	(1.181)**	(2.789)**	(4.674)**	(1.105)**	(1.499)**
Observations	859	859	3141	3141	1153	1153	1157	1157
Adjusted R-squared	0.0000	0.1500	0.0000	0.0000	0.0000	0.0700	0.0000	0.0200

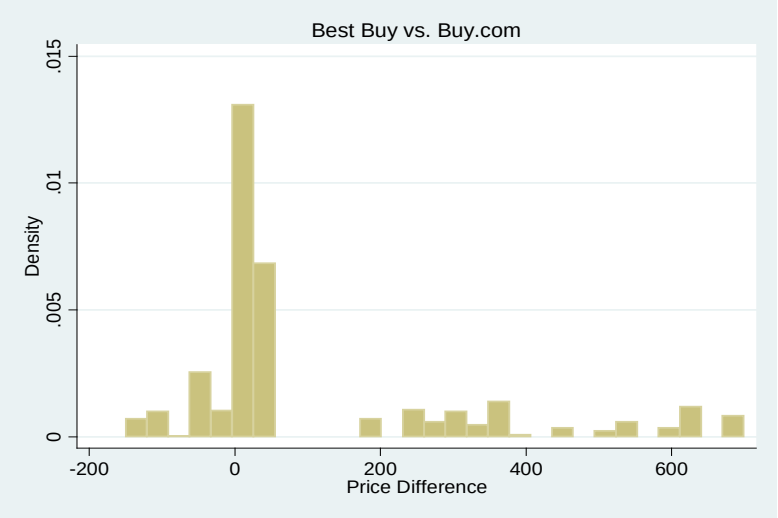
Robust standard errors in parentheses
* significant at 10%; ** significant at 5%; *** significant at 1%

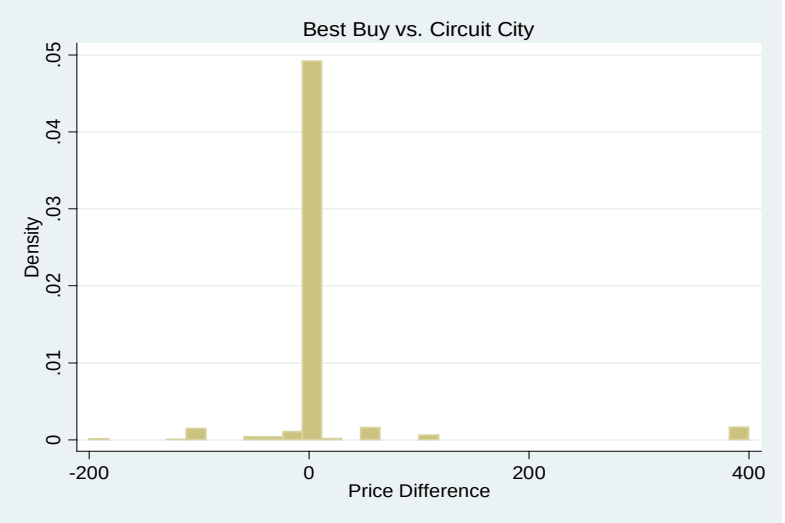
Table 4. Effects of Best Buy's Policy Change on Average Prices

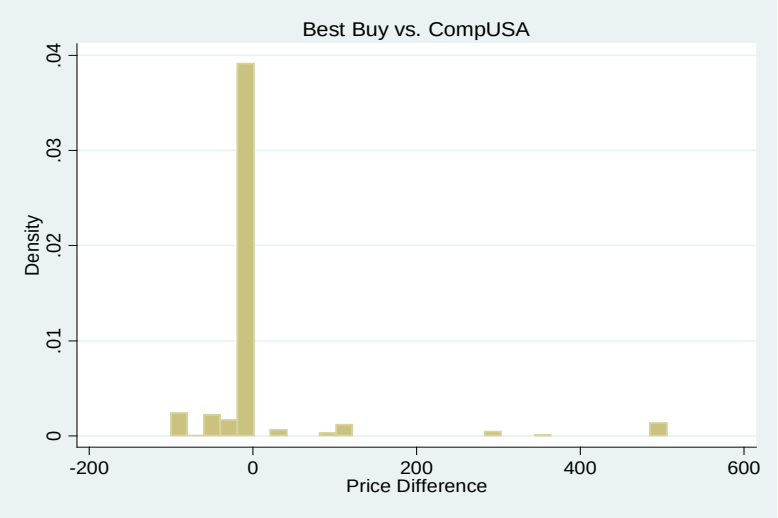
Dependent Var: Ln(Price)	Full Sample Linear	Full Sample Quadratic	Full Sample	Before Only	After Only
			Semi-parametric with random intercepts for each product		
	(1)	(2)	(3)	(4)	(5)
MFC	-0.074***	-0.008**	-0.011	-0.002	-0.005
	(0.004)	(0.004)	(0.002)***	(0.003)	(0.004)
Circuit City	-0.003	-0.002	-0.002	-0.007	-0.017
	(0.002)	(0.002)	(0.002)	(0.002)***	(0.003)***
Buy.com	-0.044***	-0.036***	-0.040	-0.048	-0.051
	(0.005)	(0.005)	(0.002)***	(0.002)***	(0.003)***
CompUSA	0.015***	0.013***	0.011	0.009	0.012
	(0.004)	(0.004)	(0.003)***	(0.003)***	(0.003)***
Sears	-0.034***	-0.033***	-0.032	-0.020	-0.033
	(0.003)	(0.003)	(0.002)***	(0.002)***	(0.003)***
Circuit City * MFC	0.005	-0.005	-0.008	0.014	0.018
	(0.004)	(0.004)	(0.003)**	(0.003)***	(0.003)***
Buy.com * MFC	-0.004	-0.020***	-0.015	0.007	0.001
	(0.006)	(0.006)	(0.003)***	(0.004)**	(0.005)
CompUSA * MFC	-0.010*	-0.016***	-0.011	-0.017	0.016
	(0.006)	(0.005)	(0.004)***	(0.004)***	(0.004)***
Sears * MFC	0.024***	0.016***	0.010	0.001	0.011
	(0.005)	(0.004)	(0.003)***	(0.003)	(0.004)**
Mail-in Rebate	0.016***	0.019***	0.020	0.016	0.020
	(0.003)	(0.003)	(0.001)***	(0.002)***	(0.002)***
Giftcard	-0.018***	-0.013***	-0.014	-0.014	-0.007
	(0.003)	(0.003)	(0.002)***	(0.003)***	(0.003)**
Instant Store Discount	0.023***	0.021***	0.021	0.023	0.009
	(0.002)	(0.002)	(0.002)***	(0.002)***	(0.002)***
Holiday	-0.007***	0.022***	0.015		0.011
	(0.002)	(0.002)	(0.002)***		(0.002)***
Age		-0.001***			
		(0.000)			
Age^2		0.000***			
		(0.000)			
Constant	5.924***	6.065***	6.316	7.832	6.022
	(0.006)	(0.008)	(12.36)	(5.205)	(0.739)
Number of Obs	23145	23145	23145	10751	12394

Note: Significance levels: 0.01 '***' 0.05 '**' 0.10 '*'.
All model specifications include dummy variables for the number of stores and product fixed effects.

Figure 1. Histograms of Price Difference by Store-Pair







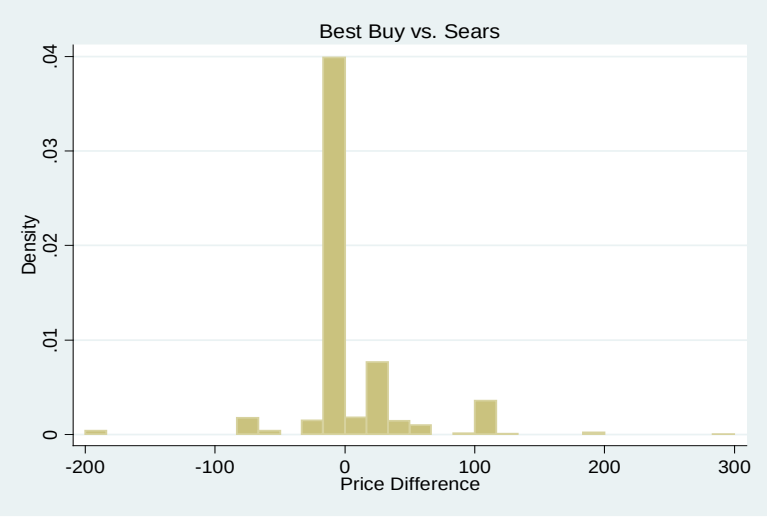


Figure 2. An Example of Instant Store-Discount and Mail-in Rebate

(before and after the click-through)

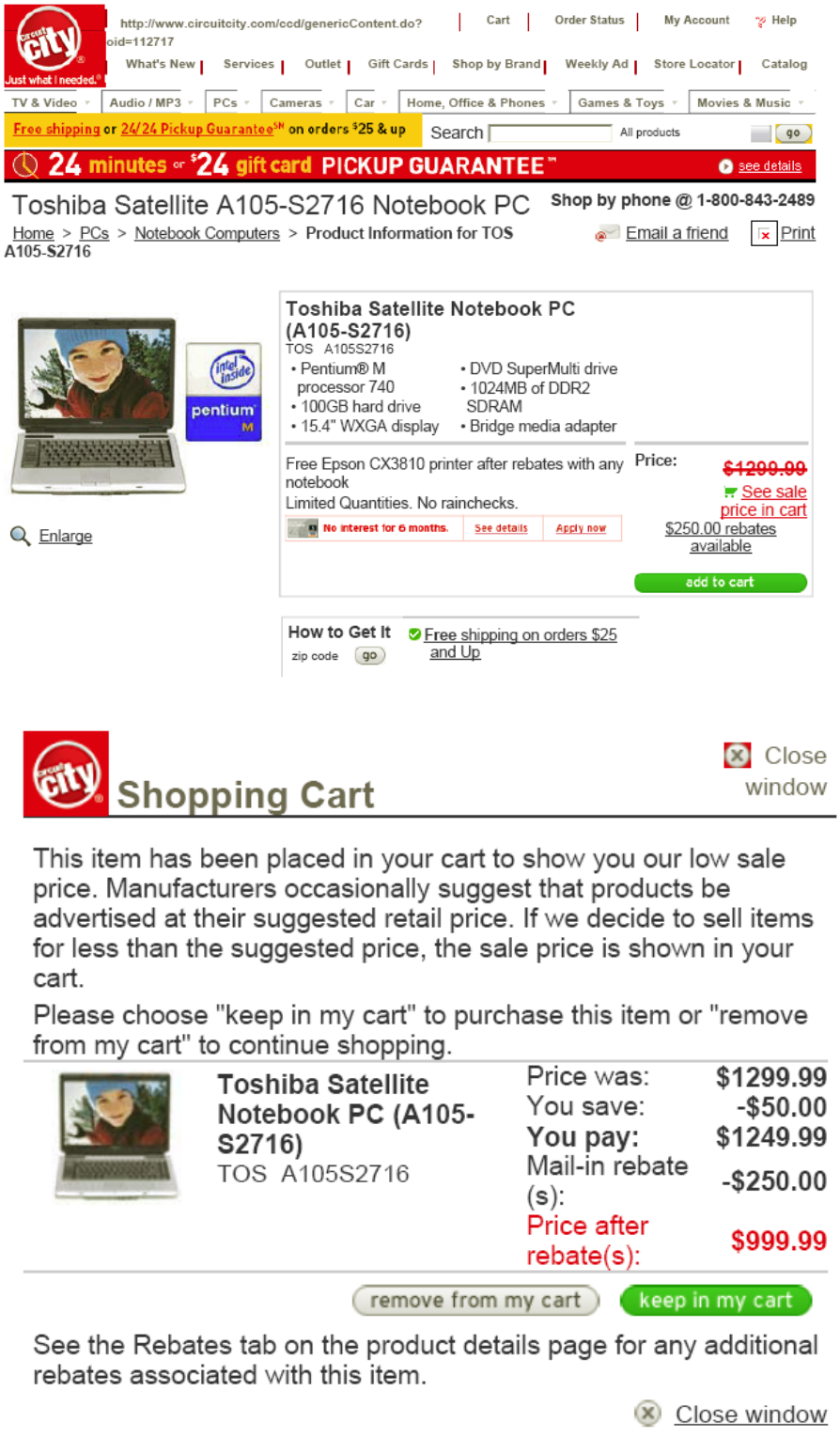
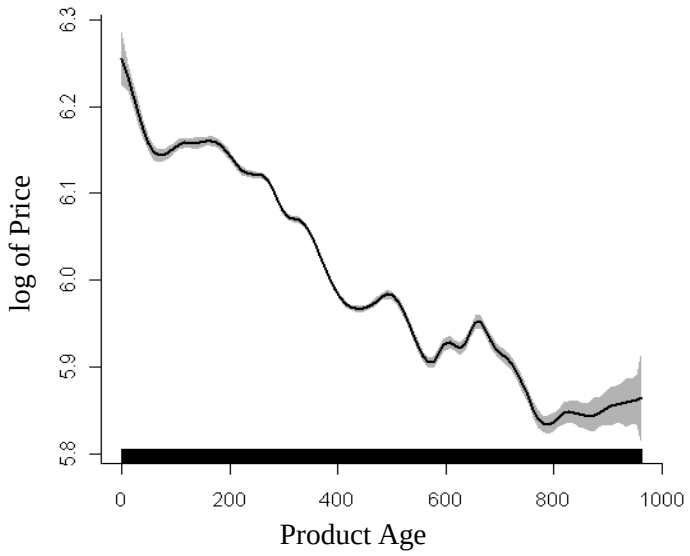


Figure 3. The Effect of Age on Ln(Price) with the Penalized Spline Smoothing



Estimates from Model 3 in Table 4

Figure 4. Evolution of Revenues at Best Buy and Circuit City in 2000-2004