Left-digit bias and inattention in retail purchases:

Evidence from a field experiment†

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Abstract

Using data from a unique experiment designed by Chetty et al. (2009), I am able to estimate and compare the effect of a perceived price increase of the same percentage magnitude on products whose dollar-value increases (products with "sensitive dollar-value" prices or SDV-products) versus products whose dollar-value remains the same (products with "rigid dollar-value" prices or RDV-products). Chetty et al. (2009), find that consumers perceive tax-salience as a price increase. I test whether the estimates of this effect are significantly different between SDV-products and RDV-products, even though the perceived price increase (i.e. tax rate) is the same for all products, 7.375%. The effect on demand for SDV-products is consistently statistically significant and ranges between -11.1% and -17.9%, while the effect on demand for RDV-products appears to be statistically insignificant and ranges between -1.09% and -5.32%. This suggests there might be a substantial level of consumer inattention to price digits to the right of the decimal point (e.g. price cent-value), at least for relatively small prices (i.e. less than $10). Differences between the consumer's perceived price of a good and the actual price of a good (i.e. if consumers are inattentive to certain visible components of the price) may lead to unexpected demand behavior.

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1. Introduction

If you were to visit your favorite coffee shop and realize that the price for one cup of coffee has increased from \$3.20 to \$3.52 (call this scenario A), would you still buy that one cup of coffee? What if the price of that same cup of coffee at your favorite coffee shop was initially \$2.60 and the new price was \$2.86 (call this scenario B)? Would you still buy one cup of coffee? Now, imagine that the price of that same cup of coffee had increased from an initial \$2.90 to \$3.19 (call this scenario C); would you still buy that same cup of coffee? While the proportional increase in price in each scenario is always the same, 10 percent, some people would answer yes to the first two questions and no to the latter[1]. This is an example of left-digit bias and inattention that affects agents' economic decisions.

In scenarios A and B, the prices leftmost-digit does not change, while in scenario C the prices leftmost-digit increases by one unit. If economic agents limit their attention to the leftmost-digit, they would perceive a price increase under scenario C, but not under scenarios A and B. Given that attention is a scarce resource, it is understandable to find situations as previously described, where individuals may based their decisions on a limited amount of the "available" information (DellaVigna, 2009) or solve complex problems using heuristics (Gabbaix and Laibson, 2003) .

In the past decade economist have shown an increased interest in the implications of inattention on consumers' behavior[2]. Hossain and Morgan (2006) use a set of field experiments on eBay auctions to show that different framing of the same price as a sum of different attributes may significantly affect consumer behavior. Brown, Hossain and Morgan (forthcoming) later combine those field experiments with a natural experiment to show that "shrouded" shipping

[1] Some might even argue that the difference would persist even if the price increase in the first two scenarios was smaller than the increase in price in the third scenario (e.g. an increase from 2.50 to 2.80 dollars [12 percent] vs. an increase from 1.95 to 2.09 dollars [10 percent]).

[2] See DellaVigna (2009), for a review of the literature. Also, a significant amount of evidences has shown that salience and cognitive costs play an important role in consumers' decisions in markets such as: Medicare plans (Chetty et al., 2008), credit cards (Ausubel ,1991; Kling et al. ,2008); and retirement investments (Hastings and Tejeda-Ashton, 2008).

charges may lead to higher revenue for sellers. Lee and Malmendier (2009) use data from eBay auctions with simultaneous fixed prices and find that, in 42 percent of the auctions, the final price is higher than the simultaneous fixed price. Chetty et al. (2009), use data from a field experiment on retail sales and observational data on alcohol sales to show that consumers underreact to taxes that are not salient. Also, Lacetera et al. (forthcoming) analyze over 22 million wholesale used-car transactions and find that sale prices drop discontinuously as the odometer mileage on used cars crosses the 10,000-mile threshold.

The current literature has explored the effect of consumers' inattention in "opaque" or "hard to find" components of the final price of a good (shipping charges, alternative fix prices and non-salient taxes), and while some have tried to estimate the effects of inattention when the information is relevant and clearly visible, this has only been accomplished using quality metrics that we expect consumers to incorporate into their decision making process (odometer mileage on used cars). This study differs from the current literature since it will test whether inattention affects consumer decisions even in the extreme case where all components of the final price are clearly visible.

In section 2, I motivate the empirical analysis by proposing an extension of the partial inattention framework introduced by DellaVigna (2009), to partial inattention to digits to the right of the decimal point of the price. DellaVigna (2009), defines the value of a good, V (inclusive of price), as the sum of a visible component v and an opaque component o: $V = v + o$. Due to inattention, the perceived value of the same good is given by $\widehat{V} = v + (1-\theta)o$. The parameter θ denotes the degree of inattention, thus when $\theta = 0$ there is full attention to the opaque signal and $\widehat{V} = V$. Following this framework, I define the price of a good as the sum of its dollar-value (or units to the left of the decimal point) and its cent-value (or units to the right of the decimal point). In terms of DellaVigna's framework, the dollar-value of the price can be seen as the v component of the perceived price and the cent-value of the price can be seen as the o component of the perceived price. Thus, the model assumes that the digits to the left of the decimal point receive full attention, while people may pay only partial attention to the digits to the right of the decimal point[3].

To test this hypothesis I use data from an experiment designed and used by Chetty et al. (2009), who show that posting tax inclusive prices cause demand to decrease by almost the same amount (about 7.6 percent) as a price increase of the same magnitude as the tax rate (7.375 percent). Under the assumption of consumers perceiving tax salience as a price increase as argued by Chetty et al. (2009), I test whether the estimates of such an effect are significantly different between products whose digits to the left of the decimal point change versus those whose digits to the left of the decimal point do not change when posting tax inclusive prices, even though the tax rate is the same for all products. In the context of this study, I will refer to the first type of product as products with a sensitive dollar-value (SDV) price[4] and second type of product as products with a rigid dollar-value (RDV) price[5].

This study also differs from the "99-cent" economics and marketing literatures (Ginzberg, 1936; Basu, 1997 and 2006) since the unique experimental design does not restrict us from only considering one cent differences around the zero threshold of the price cent-value[6].

In Section 3, I discuss the details of the experiment and data. The experiment was implemented at a supermarket over a three-week period in early 2006. As in most other retail stores in the United States, prices posted on the shelf exclude the sales tax, of 7.3575 percent, which is added to the bill only at the register. To test if consumers incorporate sales taxes in

[3] Lacetera et al. (forthcoming) use a similar framework to model how people with left-digit bias process large numbers using a quality measure.
[4] Scenario C, from our initial example, is a case of sensitive dollar-value price.
[5] Scenarios A and B, from our initial example, are cases of rigid dollar-value prices.
[6] Appendix 1 shows the cent-value distribution for sold items.

purchasing decisions, tags showing the tax-inclusive price were displayed below the original pre-tax price tags (shown in Appendix 2). All products, roughly 450, in 13 taxable categories were treated (e.g. cosmetics, hair care accessories and deodorants). Weekly-product level scanner data was collected for the 13 treated categories and 96 other control categories, in treated store as well as two other control stores in nearby cities. This design allows me to use a difference-in-difference (DD) research design and verify the common trends conditions for the validity of our estimates by calculating difference-in-difference-differences (DDD).

The results obtained using this experimental data and research design are presented and discussed in Section 4. The DD results show that in treated categories products with SDV prices seem to have a large and statistically significant decrease in sales (about 10.7%), while sales for products with RDV prices have a small and statistically insignificant decrease (about 2.44 percent). When taking into account changes (DD) in sales for control categories and computing the DDD we find that the decrease in sales for products with SDV prices continue to be large (about 11.8%) and statistically significant and the decrease for products with RDV prices becomes continues to be small and statistically insignificant (about 1.09%). These results are robust[7] when limiting the analysis to products with relatively small prices[8]. We also limit our analysis to products whose pre-tax price is 20 cents below and above the unit threshold. Interestingly, the point estimate (DDD) for products with SDV prices become more statistically significant and larger in magnitude (a decrease of about 17.9% in sales), and although the point estimate for products with RDV become greater in magnitude (a decrease of about 5.32% in sales) it remains statistically insignificant. Section 5, concludes, discusses the implications of the results and suggests ideas for future research.

[7] The difference-in-difference-differences show that products with SDV prices have significant decrease of 11.1 percent, while sales for products with RDV have an insignificant decrease of 2.21 percent.

[8] Prices of most of the products sold are less than $10 at least once in the week-store-category observations (about 84.4 percent).

2. Empirical Framework

As introduced by DellaVigna (2009), consider the value of a good, V (inclusive of price), as the sum of a visible component v and an opaque component o, $V = v + o$. Due to inattention, the perceived value of the same good is given by $\widehat{V} = v + (1-\theta)o$. The parameter $\theta \in [0,1]$ denotes the degree of inattention to the opaque component o. Thus, if $\theta = 0$ there is full attention, if $\theta = 1$ there is complete inattention, and if $\theta \in (0,1)$ there is patial attention to the opaque component o.

Following this framework, we can define the price of a good p, as the sum of its integer part (or dollar-value), $D \in \mathbb{Z}$; and its fractional part (or cent-value), $C \in [0,1)$: $p = D + C$. In terms of DellaVigna's framework, the integer part of the price can be seen as the v component of the perceived price and the fractional part of the price can be seen as the o component of the perceived price. Thus, this framework assumes that the digits to the left of the decimal point receive full attention, while people may pay only partial attention to the digits to the right of the decimal point. Therefore, the perceived price $\hat{p}$ can be denoted as:

$$\hat{p} = D + (1-\theta)C \qquad \text{Equation 1}$$

where θ is the inattention parameter as defined above. For example, consider a good whose price is \$7.79. From Equation 1, its price will be perceived as $\hat{p} = 7 + (1-\theta)\cdot 0.79$.

Differences between the actual price of a good and the perceived price of a good can lead to unexpected demand behavior. In other words, let $X\big(p(.)\big)$ denote the empirically observed demand. Under the proposed framework:

$$dX\big(p(D,C)\big) = \frac{\partial X}{\partial p}\left(\frac{\partial p}{\partial D}dD + \frac{\partial p}{\partial C}dC\right) = \frac{\partial X}{\partial p}(dD + dC)$$

$$dX(\hat{p}(D,C,\theta)) = \frac{\partial X}{\partial \hat{p}}\left(\frac{\partial \hat{p}}{\partial D}dD + \frac{\partial \hat{p}}{\partial C}dC\right) = \frac{\partial X}{\partial \hat{p}}(dD + (1-\theta)dC)$$

Given that the change in the cent-value of the price is being weighted by $(1-\theta)$, if $\theta \neq 0$ we would expect price increases that cause a change in D to have a larger impact on demand than price increases of the same (or larger) magnitude that only affect C. In other words, since perceived price is a function of θ, demand would only behave according to classical economic theory if and only if $\theta = 0$, and as a result $dX(p(D,C)) = dX(\hat{p}(D,C,\theta))$.

As noted by Lacetera et al. (forthcoming), there is no reason to believe that the exact functional form in Equation 1 is appropriate for larger prices. We could redefine $\hat{p}$ as:

$$\hat{p} = \sum_{l=0}^{L}(1-\theta)^{L-l}d_l 10^l + \sum_{m=-1}^{M}(1-\theta)^{L-m}d_m 10^m \qquad \text{Equation 2}$$

where L is the base-10 power of the non-zero leftmost-digit of p; M is the base-10 power of the non-zero rightmost-digit of p; d_n is the value of the digit in each base-10^n power, such that $d_n \in \{1,2,\ldots,9\}$ for $n = N$ and $d_n \in \{0,1,\ldots,9\}$ for all $n < |N|$; and θ is the inattention parameter as defined before, such that $\theta \in [0,1]$.

Note that Equation 2 considers the possibility of decreasing attention to digits further to the right, in both the integer and fractional part of the price[9]. Also, as L increases attention to the fractional part of the price practically disappears.

The current study does not precise to estimate the actual value of theta, but rather to present evidence that such parameter is not equal to zero as expected by classic economic theory. In order test this hypothesis, of partial attention to digits to the right of the decimal point, I will test whether the effect of a perceived price increase is different for products whose dollar-value increases (SDV-products) versus products whose dollar-value not change (RDV-products) given a perceived price increase of the same magnitude.

[9] However, with regard to consumer prices, digits smaller than cent-units may be irrelevant, as is common knowledge, this is the customary subunit used in retail prices and mill-units are only used for accounting purposes.

3. Data[10]

a. Experiment

The experiment was conducted in store, in a Northern California middle-income suburb, of a national grocery chain. The store floor space is about 42,000 sq. ft. and has weekly revenue of approximately $300 thousand. About 30 percent of the products sold in the store are subject to the local sales tax of 7.375 percent, which is added at the register. Tax inclusive prices were posted on all the products, roughly 450, in 13 categories that occupied about half of the toiletries aisle (e.g. cosmetics, hair care accessories and deodorants). The criteria used to select such categories were: (1) not "sales leaders", given that the grocery chain managers were expecting the treatment to reduce sales; (2) products with relatively high prices, so that the dollar amount of the sales tax is nontrivial; and (3) products that exhibit high price elasticities, so that the demand response to the intervention would be detectable.

The intervention lasted three weeks, beginning in February 22, 2006 and ending on March 15, 2006. Appendix 2 shows how the price tags were altered. The original tags, which show pre-tax prices, were left untouched on the shelf and a tag showing the tax-inclusive price was attached directly below this tag for each product. In order to avoid giving the impression that the price of the product had increased, the original pre-tax price was repeated on the new tag and the font used in the new tag was exactly matched to the font used by the store for the original tags. The store changes product prices on Wednesday nights and leaves the prices fixed (with rare exceptions) for the following week. This period is known as a "promotional week". To synchronize with the stores' promotional weeks, a team of researchers and research assistants printed tags every Wednesday night and attached them to each of the 450 products. The tags were changed between 11 pm and 2 am, which are low-traffic times at the store. The tags were

[10] Due to the nature of the data, some parts of this section are heavily borrowed from Chetty et al. (2009).

printed using a template and card stock supplied by the store (often used for sales or other additional information on a product) in order to match the color scheme and layout familiar to customers.

b. Empirical Strategy

I estimate and compare the effect of the intervention on demand, using a difference-in-difference (DD) estimate approach, for products with sensitive dollar-value (SDV) prices and products with rigid dollar-value (RDV) prices. I perform the DD analysis by comparing changes in the average weekly sales between the baseline and experimental period in the "treated categories" between the "treated store" and two "control stores". The "treated categories" are considered to be the 13 categories that occupied about half the toiletries aisle with taxable products (e.g. cosmetics, hair care accessories and deodorants) and whose tags were modified. See Appendix 3 for a full list. The two "control stores" were chosen, using a minimum-distance criterion, to match the treatment store prior to the experiment on demographics and other characteristics shown in Table 1Table 1. It is also possible to verify the common trend condition by computing the DD estimates for "control categories". These categories should not have been affected by the treatment. The "control categories" are 96 categories in the same toiletries aisle as the "treated categories" with similar taxable products (e.g. toothpaste, skin care, and shaving products). See Appendix 3 for a full list. Lastly, the DD estimates for treated and control categories can be used to compute difference-in-difference-differences (DDD) estimates. As noted by Gruber (1994), as long as there are no shocks that affect the treated store during the experimental period, which is likely to be satisfied given the exogenous nature of the experiment, this estimate should be immune to both store-specific shocks and product-specific shocks (i.e. within-store and within-category time trends are differenced out). Thus, this estimator could be considered a more precise measurement of the effect of the intervention.

c. Data Description[11]

The raw scanner data provided by the grocery chain contains information on weekly quantity sold, gross revenue, and net revenue (i.e. gross revenue minus markdown amount) for each product[12] that was sold among the 109 categories listed in Appendix 3, in the three stores from the first promotional week of 2005 to the fourteenth promotional week of 2006. The original dataset contains a total of 326,359 store-week-category-product observations. The quantity and revenue variables are measured net of returns (i.e. returns count as negative sales). I exclude 477 observations where the weekly quantity or revenue was negative, which are cases where more items were returned than purchased in that week[13]; nevertheless, including these observations would not affect the results.

Since the scanner data reports only items that were actually sold each week, if a certain product was not sold during a promotional week I set the quantity sold for such products to be zero during that week[14] and impute prices for unsold items before aggregating the data to the category-week-store level. For such unsold items, I use the price in its last observed transaction; if the product was not sold during the previous week, the price of the product during the following week is imputed; and lastly if neither alternative is possible the average price for that product at each store is used[15]. I categorized each observation as: a) SDV if the dollar-value of its pre-tax unitary price is smaller than the dollar-value of its tax-inclusive unitary price at the category-week-store level, and b) products with RDV prices if the dollar-value of its pre-tax unitary price is the same as the dollar-value of its tax-inclusive unitary price at the category-week-store level. From this point forward I will refer to the first type of observations as SDV-

[11] My strategy for cleaning the data slightly differs from the one used by Chetty et al. (2009). Using their data and code we are able to fully reproduce their results. However, using our own data cleaning strategy we are also able to reproduce their results up to the first decimal point.
[12] Each product is identified by a unique Universal Product Code (UPC).
[13] This is confirmed by grocery store managers.
[14] According to store managers it is not uncommon to have very stable inventories through the calendar year.
[15] Alternative imputation methods give similar results.

products and to the latter as RDV-products. Finally, I aggregate to the category-week-store-SDV/RDV level and compute total sold quantity, gross and net revenue, average gross and net price[16] for each category.

d. Summary Statistics

Table 2 presents summary statistics for the treatment and control categories in the treated, control, and all stores for SDV-products and RDV-products.

a) Products with SDV prices (or SDV-products)

As seen in Table 2, treated categories sold on average 11.84 units per week in all stores while control categories sold on average 17.85 units per week. It is not surprising to find such differences since, as requested by store managers, the treated categories contain none or very little “sale leaders”. The differences in sales between the treated and control categories are also similar between treated and control stores, about 6 units more. Also, as expected, weekly average revenue is greater for control categories than for treated categories ($108.99 and $52.30, respectively). Average prices in the control categories are similar to those in the treated categories ($4.50 and $4.44, respectively), even when weighting prices by quantity sold or when conditioning on sales being greater than zero.

b) Products with RDV prices

As seen in Table 2, treated categories sold on average 15.07 units per week in all stores while control categories sold on average 12.86 units per week. In contrast, SDV-products in treated categories seem to have similar (or slightly greater) average weekly sales volume as control categories. Nevertheless, the differences in sales between the treated and control categories are also similar between treated and control stores, about 3 units less. Given the smaller magnitude of average weekly sales in control categories, weekly average revenue is actually similar for

[16] The average price for each category of goods is defined as $P_{ct} = \sum_{i\epsilon c}(p_{it}\bar{q}_i)/\sum_{i\in c}\bar{q}_i$ where c indexes the category, t time, and i products, $p_{it}$is the price of good i at time t, and $\bar{q}_i$ is the average quantity sold of good i.

control and treated categories ($44.09 and $51.56, respectively). Even though average prices in the control categories are greater ($9.12) than average prices in the treated categories (4.5), when weighting prices by quantity sold this difference decrease and when conditioning on sales being greater than zero prices for control and treated categories are practically the same ($1.50 and $1.83, respectively).

e. Data limitations.

Although ….

4. Results

a. Comparison of Means.

Table 4 shows a cross-tabulation of mean quantity sold. The first quadrant shows data for RDV-products at treated categories, the second quadrant shows data for SDV-products at treated categories, the third quadrant shows data for SDV-products at control categories, and the fourth quadrant shows data for RDV-products at control categories. In each quadrant, the data is split into four cells. The rows split the data by baseline period (week 1 of 2005 to week 6 of 2006[17] and week 11 of 2006 to week 14 of 2006[18]) and experiment period (week 8 to week 10 of 2006). The columns split the data by control stores and treated store. Mean quantity sold, standard deviation of the mean quantity sold, and the number of observations are shown in each cell.

For SDV-products, the mean quantity sold during the experimental period relative to the baseline period increased by an average of 0.18 and 1.45 units in the treated and control stores, respectively. Thus, sales in treated stores relative to the control stores fell by 1.27 units on average with a standard error of 0.70, for SDV-products in treated categories. Meanwhile, for

[17] Week 7 of 2006 was eliminated from the analysis since during this period a pilot, requested by store managers, was conducted to ensure that tags could be placed without disrupting business. During this week, tags were placed for a subset of the treated products. These tags display the legend "This product is subject to sales tax", but did not show tax-inclusive prices. Excluding this pilot week is done to avoid bias; however none of the results are affected if this week is included in the baseline period.

[18] Omitting the post-experimental period (week 11 to week 14 of 2006) from our sample does not affect our estimates.

RDV-products the mean quantity sold during the experimental period relative to the baseline period decreased by an average of 1.43 and 1.07 units in the treated and control stores, respectively. Therefore, on average, sales in treated stores relative to the control stores fall only by 0.37 units, with a standard error of 0.82, for RDV-products in treated categories. Using the base means quantity sold per category, in treated categories, for products with SDV and RDV prices are 11.84 and 15.07 units respectively (Table 3), and the difference-in-difference results from the comparison of means (SDV-DD_{TC}=-1.27 and RDV-DD_{TC}=-0.37), we can estimate the change in demand for SDV-products to be -10.7% while the change in demand for RDV-products was only -2.44%, in treated categories.

In order to consider the DD_{TC} estimates to be valid the common trend condition (i.e. sales for treated products in treated and control stores would have evolved similarly in the absence of the treatment) must hold[19]. Therefore, by comparing the change in sales between treated and control stores in the control categories (i.e. categories with products were no tax-inclusive tags were posted) I can evaluate the validity of DD_{TC} estimates. The third and fourth quadrants of Table 4 show such comparison, DD_{CC}. For SDV-products in the control categories, sales in the treated store relative to the control stores (DD_{CC}) increases by 0.75 units, with a standard error of 0.40; and for RDV-products in control categories sales in the treated store relative to the control stores (DD_{CC}) decreased by 0.22 units, with a standard error of 0.25. The fact that these results are not statistically significantly different from zero (i.e. sales for control categories where no tax-inclusive price tags were posted evolve similarly in treated and control stores), suggest that sales for treated categories at the treatment and control stores would in fact have evolved similarly if the experiment had not taken place.

[19] See Bruce D. Meyer (1995).

Now, using the DD_{TC} and DD_{CC} estimates we can construct a difference-in-difference-differences (DDD) estimator that should be immune to store-specific shocks and product-specific shocks, as discussed above. This estimator, DDD= DD_{CC} - DD_{TC}, is constructed by differencing out within-store and within-category time trends. Table 4 shows that for SDV-products, DDD= -2.02, with a standard error of 0.98; and for RDV-products, DDD= -0.143, with a standard error of 0.98. Table 3 shows that the base means of quantity sold per category in all categories are 17.13 and 13.16 units, for SDV-products and RDV-products respectively. Therefore, using the DDD estimators we can conclude that, consistent with what we had found with the DD estimators, the demand for SDV-products has a statistically significant decrease of 11.8%, with significance at the 5-percent; while the demand for RDV-products only falls by 1.09% percent, and is statistically insignificant.

b. Regression Results.

a) Difference-in-Difference (DD)

In order to evaluate the robustness of the DD_{TC} and DD_{CC} estimates, for both SDV-products and RDV-products, I can estimate the following regression model for products in treated and control categories, separately:

$$\boldsymbol{Y} = \alpha_d + \beta_{1d}\,(\boldsymbol{S}) + \beta_{2d}\,(\boldsymbol{T}) + \gamma_d\,(\boldsymbol{S} * \boldsymbol{T}) + \varepsilon \qquad \text{Equation 3}$$

where $\boldsymbol{Y}$ denotes quantity sold; sub index d denotes type of products (SDV-products and RDV-products); $\boldsymbol{S}$ is a store dummy (indicator that equals 1 if the store was treated, 0 otherwise); $\boldsymbol{T}$ is a time dummy (indicator that equals 1 if the experiment took place during that week, 0 otherwise); and $\boldsymbol{S} * \boldsymbol{T}$ is the interaction of the store and time dummies. The coefficient of interest in the previous regression model is $\gamma =$ DD.

Table 5 shows the regression results from estimating[20] Equation 3 for treated categories and control categories. The regression is estimated for treated and control categories separately and using three different sample definitions to check for the robustness of the results: (a) full sample (the results from this regression should be consistent with the means comparison results in the previous subsection); (b) only products whose price was less than $10 at least in one week-store-category observations in the full sample to eliminate noise from oversampling products whose price is more than $10 in the control categories (about 15.6% of the week-store-category observations) since in the treated categories this type of products only account for about 2.7% of week-store-category observations; and (c) only products whose pre-tax price falls within 20-cents below or above the cent-value zero threshold (about 51.2% of the week-store-category observations) to control for possible differences in products unobservable characteristics. In order to simplify the results, I use the DD estimates (Table 5) and the base means quantity sold per category in all categories (Table 3) to compute demand changes in terms of percentage points, which are reported in the following paragraphs and shown in Table 6.

Table 5, columns 1.a and 2.a, show that, as expected, when estimating Equation 3 for the full sample, γ is equal to the DD estimates in the comparison of means, for both treated and control categories, respectively. Thus, Columns 1.a and 2.a of Table 6, show that based in the full sample: sales for SDV-products in treated categories fell 10.7% and in control categories increased 4.22%, both results statistically significant at the 10-percent confidence level; and sales for RDV-products in treated and control categories decrease 2.44% and 1.74%, respectively and continue to be statistically insignificant. Columns 1.b and 2.b of Table 6, show that limiting our sample to only products whose price was less than $10 at least one week-store-category observation in the whole sample does not significantly affects our results (neither in magnitude

[20] Standard errors are clustered at the by categories.

or statistical significance): sales for SDV-products in treated categories fell 10.15% and in control categories increased 3.54%, both results statistically significant at the 10-percent confidence level; and sales for RDV-products in treated and control categories decrease 2.44% and 1.68%, respectively and continue to be statistically insignificant. On the other hand, Columns 1.c and 2.c Table 6, show the estimated change in demand when limiting the sample to products whose pre-tax price falls within 20-cents below and above the cent-value zero threshold: the effect on demand for SDV-products in treated and control categories becomes not only greater in magnitude (about a 15.68% decrease and a 6.2% increase, respectively), but the p-values for the estimates decrease to less than 0.01 and less than 0.05 each. Interestingly, the effect on demand for RDV-products in treated categories becomes positive, about 5.94%, though it remains statistically insignificant. Although an estimate of this sort could suggest that individual may in fact prefer products whose price is right below the cent-value zero threshold; it is hard to substantiate such a conclusion[21] in this case, given that there may exist some unobserved product characteristics that might be correlated with products being priced around the cent-value zero threshold.

b) Difference-in-Difference-Differences (DDD)

It is also possible to evaluate the robustness of the DDD estimates by estimating the following regression model for SDV-products and RDV-products, separately:

$$\boldsymbol{Y} = \alpha_d + \beta_{1d}\,(\boldsymbol{S}) + \beta_{2d}\,(\boldsymbol{T}) + \beta_{3d}\,(\boldsymbol{C}) + \gamma_{1d}\,(\boldsymbol{S}*\boldsymbol{T}) + \gamma_{2d}\,(\boldsymbol{S}*\boldsymbol{C}) + \gamma_{3d}\,(\boldsymbol{T}*\boldsymbol{C}) + \tau_d(\boldsymbol{S}*\boldsymbol{T}*\boldsymbol{C}) + \varphi\boldsymbol{X} + \varepsilon \qquad \text{Equation 4}$$

where $\boldsymbol{Y}$ denotes quantity sold; sub index d denotes type of products (SDV-products and RDV-products); $\boldsymbol{S}$ is the store dummies (indicator that equals 1 if the store was treated, 0 otherwise); $\boldsymbol{T}$ is the time dummies (indicator that equals 1 if the experiment took place during that week, 0

[21] This phenomenon might be result of an unobservable product characteristics correlated to pricing schemes.

otherwise); $\boldsymbol{C}$ is the treatment category dummies (indicator that equals 1 if the category was treated, 0 otherwise); $\boldsymbol{S} * \boldsymbol{T}$ is the interaction of the store and time dummies; $\boldsymbol{S}$*C is the interaction of the store and category dummies; $\boldsymbol{T} * \boldsymbol{C}$ is the interaction of the time and category dummies; and $\boldsymbol{X}$ denotes a set of additional covariates (e.g. price). The coefficient of interest in the previous regression model is $\tau =$ DDD. Table 7 shows the regression results from estimating[22] Equation 4. In the same way, as it was done for Equation 3, each of the estimates are obtained using three different sample definitions to check for the robustness of the results. Also, in order to simplify the results, I use the DDD estimates (Table 7) and the base means quantity sold per category in all categories (Table 3) to compute demand changes in terms of percentage points, which are reported in the following paragraphs and shown in Table 8.

Table 7, column 1.a, shows that, as expected, when estimating Equation 4 for the full sample, τ is equal to the DDD estimates in the comparison of means. Thus, in Column 1.a of Table 8, we can see that: demand for SDV-products decreased by 11.8%, this result is statistically significant at the 5-percent confidence level; and demand for RDV-products decrease 1.09%, this result is statistically insignificant. Also, Column 1.b of Table 8, shows that as expected estimates are stable (in both magnitude and statistical significance) when limiting our sample to products whose price had was less than $10 at least one week-store-category observation in the whole sample: demand for SDV-products decreased by 11.1%, this result is statistically significant at the 5-percent confidence level; and demand for RDV-products decrease 2.21%, this result is statistically insignificant. On the other hand, Column 1.c of Table 9, shows that when limiting the sample to products whose pre-tax cent-value falls within 20-cents below and above the cent-value zero threshold, the estimated decrease in demand for SDV-products becomes even greater in magnitude and more statistically significant: demand decreases by 17.9% with the result being

[22] Standard errors are clustered at the by categories.

significant at the 1-percent confidence level. Although the estimated decrease in demand for RDV-products also becomes greater in magnitude, to about 5.32%, it remains statistically insignificant.

c) Concerns

1. Price Level

One may be concerned that price level may be highly correlated with how consumers respond to the tax-inclusive price posting and/or with the probability of certain items been priced such that they can be perceived by consumers as SDV or RDV-products. Thus, I estimate Equation 4 controlling for the mean price of the products in each category; using a quadratic specification; and including categories, stores and promotional weeks fixed effects. Column 2 of Table _ shows[23] that the estimates for SDV-products remain practically unchanged and that although the estimated for RDV-products becomes more negative, they remain relatively small and not significantly different from zero. This result is not surprising since there were no unusual price changes during the intervention period.

2. Rounding Behavior

We know that the partial inattention framework allows for consumer to round pre-tax prices downward (e.g. if the price of an item is \$3.99, consumer may actually think of it as \$3.00), this would be the case of $\theta = 1$. Nevertheless, even if $\theta = 0$, the partial inattention framework would not account for consumers who may round pre-tax prices upwards when the cent-value is relatively high (e.g. if the price of an item is \$3.99, consumer may actually think of it as \$4.00). In Table _, I estimate Equations 3 and 4 including an additional dummy for items whose pre-tax cent-value equals to 0.99 cents[24]. If this type of behavior existed, we would expect treatment

[23] Column 1 of Table _ replicates the estimates from Table _ column 1.a to facilitate the comparison of results.

[24] "you do not fool me" type consumers (literature?)

coefficient for products with 99-cents cent-value prices to be not significantly different from zero. It is important to notice that even if consumers actually round up to the next dollar unit prices with 99-cents endings, the SDV-products treatment coefficients would be actually bias toward zero, thus the aforementioned coefficients would actually be a conservative estimate of the intervention.

Although the coefficients on treated categories is not significantly different from zero, as seen on column _, we can see that

3. Valid Counterfactuals

It is a concern that the introduction of the new level of aggregation, SDV and RDV-products, may be introducing noise into the experiment randomization (e.g. price could be highly correlated with whether an item is defined as SDV or RDV-products). Nevertheless, I am able to show that the counterfactuals continue to be valid even under this new level of aggregation. In order to do this, I test the null hypothesis of equality of means between baseline and experimental period, and between control and treated stores using some "observable characteristics"; such as: i) average total number of unique products sold, ii) average gross price, and iii) average net price. Appendix 4 presents the p-values for the following four null hypotheses using two-tailed t-tests on data at the week-store-category level: a) mean "observable characteristic" is equal between the treated and control stores during the baseline period for treated/control categories, b) mean "observable characteristic" is equal between the treated and control stores during the experimental period for treated/control categories, c) mean "observable characteristic" is equal between the baseline and experimental period at the control stores for treated/control categories, and d) mean "observable characteristic" is equal between the baseline and experimental period at the treated store for treated/control categories.

Each aforementioned null hypothesis is tested using the following characteristics at the store-week-category level: mean total number of unique products, mean gross price, and mean net price (i.e. gross price – markdown). The p-values, shown in Tables A4.b-A4.d, suggest that null hypotheses b) - d) cannot be rejected at the 10-percent (or greater) confidence level for any of the observable characteristics, in treated and control stores for both SDV-products and RDV-products. On the other hand, Table A4.a shows that the null hypothesis a) cannot be rejected for most (3 out of 26) panels at the 1-percent (or greater) confidence level. It is not surprising to find such cases (e.g. mean gross price for SDV-products in control categories) due to the greater price variation in baseline period, which expands for 60 promotional weeks more than the treatment period, and the larger number of control categories in the sample, which are about nine times more than the treated categories. The fact that the number of null hypotheses rejected is relatively low (3 out of 144 totals), suggest that our counterfactuals are valid even after introducing the new level of aggregation.

5. Conclusion

Exploiting a unique experiment, and under certain assumptions (i.e. consumers perceive tax salience as a price increase), I am able to estimate and compare the effect of a perceived price increase of the same percentage magnitude on products whose dollar-value increases versus products whose dollar-value remains the same after the increase.

Using a difference-in-difference-differences analysis, I estimate that the effect of a "price increase" (i.e. posting tax-inclusive prices with a tax rate of 7.375) on demand for SDV-products is consistently statistically significant and ranges in between -11.1 and -17.9%, while the effect on demand for RDV-products appears to be statistically insignificant and ranges only in between -1.09% and -5.32%. This suggests that there might be a substantial level of consumer inattention to digits to the right of the price (i.e. inattention to the cent-value in the price of a good), at least for relatively small prices (less than $10). It is important to note that differences between the consumer's perceived price of a good and the actual price of a good (i.e. there is inattention to certain visible components of the price) may lead to unexpected demand behavior.

Future research could be done using larger prices to generalize these results to a broader price spectrum of prices and test for the possibility of decreasing attention to digits to the right. Also an experimental design where only products whose price cent-value is right around the zero threshold could allow to control for unobservable product characteristics that might be correlated with pricing schemes. Lastly, a research design where demand elasticities could be obtained could allow us to estimate the actual θ, or parameter of inattention to right-digits.

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Table 1: Stores Descriptive Statistics.

	Treatment Store	Control Store #1	Control Store #2
Store Characteristics			
Weekly Revenue ($)	307,297	268,193	375,114
Total Floor Space (sq ft)	41,609	34,187	37,251
Store Opening Date	1992	1992	1990
Number of Product Categories	111	110	112
City Characteristics (1999)			
Population	88,625	96,178	90,532
Median Age (years)	33.9	31.1	32.3
Median Household Income ($)	57,667	51,151	60,359
Mean Household Size	2.8	2.9	3.1
Percent bachelor's degree or higher	19.4	20.4	18.2
Percent Married	60.2	56.9	58.1
Percent White	72.1	56.2	65.3
Distance to Treatment Store (miles)	0	7.7	27.4

Note: Store characteristics obtained from grocery chain. Weekly revenue based on calendar year 2005. City characteristics are obtained from the U.S. Bureau of Census, Census 2000. Control stores were chosen using a minimum-distance criterion.

Table 2: Summary Statistics by Stores.

	Treated Categories			Control Categories		
	Control Store	Treated Store	All Stores	Control Store	Treated Store	All Stores
Products with sensitive dollar-value prices						
Product-level summary statistics						
Av. Qty.	12.36	10.78	11.84	18.5	16.54	17.85
	(10.98)	(9.18)	(10.44)	(28.11)	(23.37)	(26.65)
Av. Revenue	53.77	49.35	52.3	113.11	100.69	108.99
	(44.97)	(40.80)	(43.66)	(157.10)	(129.92)	(148.73)
Category-level summary statistics						
Av. Price	4.47	4.39	4.44	4.5	4.5	4.5
	(1.62)	(1.64)	(1.63)	(2.10)	(2.10)	(2.10)
Av. Price [w=qty. sold]	3.88	3.72	3.83	3.86	3.91	3.88
	(1.38)	(1.42)	(1.40)	(1.94)	(1.94)	(1.94)
Av. Qty. [qty. sold>0]	1.65	1.52	1.61	2.18	1.96	2.11
	(1.12)	(0.99)	(1.08)	(2.23)	(1.72)	(2.09)
Total categories	13	13	13	96	96	96
Products with rigid dollar-value prices						
Product-level summary statistics						
Av. Qty.	15.47	14.29	15.07	13.5	11.55	12.86
	(18.57)	(17.03)	(18.08)	(24.67)	(19.02)	(22.99)
Av. Revenue	53.17	48.35	51.56	45.89	40.42	44.09
	(57.20)	(50.84)	(55.20)	(73.91)	(62.01)	(70.27)
Category-level summary statistics						
Av. Price	5.94	5.75	5.88	9.12	9.11	9.12
	(2.22)	(2.28)	(2.24)	(6.41)	(6.51)	(6.45)
Av. Price [w=qty. sold]	4.79	4.98	4.85	6.71	6.65	6.69
	(1.76)	(1.83)	(1.78)	(4.28)	(4.41)	(4.32)
Av. Qty. [qty. sold>0]	1.55	1.4	1.5	1.87	1.74	1.83
	(1.03)	(0.81)	(0.96)	(1.69)	(1.46)	(1.62)
Total categories	13	13	13	87	89	89

Notes: Standard deviations are reported in parenthesis bellow the means. Statistics are computed using the full sample.

Table 3: Summary Statistics by Categories.

	Treated Categories			Control Categories			All Categories		
	(1.a)	(1.b)	(1.c)	(2.a)	(2.b)	(2.c)	(3.a)	(3.b)	(3.c)
Products with sensitive dollar-value prices									
Av. Quantity sold	11.84	11.64	8.82	17.85	16.55	12.49	17.13	15.93	12.05
	(10.44)	(10.45)	(8.74)	(26.65)	(26.35)	(19.07)	(25.33)	(24.96)	(18.18)
Av. Percent of Products with SDV prices	*0.51*	0.5	0.74	0.72	0.65	0.88	0.69	0.64	0.86
	(0.17)	(0.18)	(0.14)	(0.21)	(0.20)	(0.15)	(0.21)	(0.20)	(0.15)
Share of total week-store-products observations	0.32	0.40	0.12	0.49	0.51	0.25	0.35	0.42	0.14
Products with rigid dollar-value prices									
Av. Quantity sold	15.07	15.07	3.03	12.86	12.85	2.81	13.16	13.15	2.84
	(18.08)	(18.08)	(4.52)	(22.99)	(22.99)	(7.12)	(22.40)	(22.41)	(6.76)
Av. Percent of Products with RDV prices	0.49	0.38	0.27	0.32	0.38	0.19	0.34	0.4	0.20
	(0.17)	(0.19)	(0.13)	(0.19)	(0.19)	(0.15)	(0.20)	(0.19)	(0.15)
Share of total week-store-products observations	0.68	0.60	0.88	0.51	0.49	0.75	0.65	0.58	0.86
Total week-store-product observations	1056380	862225	550355	225485	219505	105982	1281865	1081730	656337

Note: Standard deviation in parenthesis. Mean statistics are computed at the category-level. Statistic/results are based in: (a) full sample; (b) only products whose price was less than $10 at least in one week-store-category observations in the full sample; and (c) only products whose pre-tax price falls within 20-cents below or above the cent-value zero threshold. Statistic/results are computed using averages from all stores.

Table 4: Comparison of Means.

		Sensitive dollar-value prices				***Rigid dollar-value prices***			
		Control Stores	Treated Store		*Diff (stores)*	Control Stores	Treated Store		*Diff (stores)*
Treated Categories	Baseline Period	12.297 (0.187) [1612]	10.769 (0.187) [806]	D_{CT}=	*-1.528* *(0.206)* *[2418]*	15.514 (0.237) [1612]	14.356 (0.283) [806]	D_{CT}=	*-1.158* *(0.224)* *[2418]*
	Experimental Period	13.744 (0.499) [78]	10.949 (0.431) [39]	D_{TT}=	*-2.795* *(0.811)* *[117]*	14.449 (1.068) [78]	12.923 (0.823) [39]	D_{TT}=	*-1.526* *(0.962)* *[117]*
	Diff (time)	D_{CS}= *1.447* *(0.452)* *[1690]*	D_{TS}= *0.180* *(0.401)* *[845]*	***DD*** $\boldsymbol{DD_{TC}}$=	***-1.267*** ***(0.696)*** ***[2535]***	D_{CS}= -1.066 (0.910) [1690]	D_{TS}= -1.433 (0.734) [845]	$\boldsymbol{DD_{TC}}$=	***-0.367*** ***(0.820)*** ***[2535]***
Control Categories	Baseline Period	18.540 (0.170) [11842]	16.541 (0.151) [5890]	D_{CT}=	*-2.000* *(0.137)* *[17732]*	13.458 (0.151) [10491]	11.513 (0.137) [5134]	D_{CT}=	*-1.945* *(0.130)* *[15625]*
	Experimental Period	17.733 (0.494) [573]	16.488 (0.707) [285]	D_{TT}=	*-1.245* *(0.467)* *[858]*	14.427 (0.510) [511]	12.258 (0.573) [252]	D_{TT}=	*-2.169* *(0.269)* *[763]*
	Diff (time)	D_{CS}= *-0.807* *(0.441)* *[12415]*	D_{TS}= *-0.053* *(0.601)* *[6175]*	$\boldsymbol{DD_{CC}}$=	***0.754*** ***(0.408)*** ***[18590]***	D_{CS}= 0.969 (0.446) [11002]	D_{TS}= 0.745 (0.491) [5386]	$\boldsymbol{DD_{CC}}$=	***-0.224*** ***(0.257)*** ***[16388]***
				DDD=	**-2.021** **(0.979)** **[21125]**			**DDD=**	**-0.143** **(0.984)** **[18923]**

Notes: Standard deviations are reported in parentheses bellow the means. Number of observations are reported in square brackets bellow the standard errors. See Appendix 3 for description of treated and control categories. Statistics are computed using the full sample.

Table 5: Differences-in-Differences.

	Treated Categories			Control Categories		
	(1.a)	(1.b)	(1.c)	(2.a)	(2.b)	(2.c)
SDV-DD	**-1.267***	**-1.182***	**-1.383*****	**0.754***	**0.586***	**0.774****
	(0.696)	**(0.644)**	**(0.507)**	**(0.408)**	**(0.304)**	**(0.296)**
RDV-DD	**-0.367**	**-0.367**	**0.18**	**-0.224**	**-0.216**	**0.205**
	(0.820)	**(0.820)**	**(0.175)**	**(0.257)**	**(0.263)**	**(0.146)**
SDV*Store	-1.528***	-1.625***	-1.117***	-2.000***	-2.056***	-1.068***
	(0.206)	(0.202)	(0.178)	(0.137)	(0.134)	(0.121)
RDV*Store	-1.158***	-1.158***	-0.694***	-1.945***	-1.941***	-0.552***
	(0.225)	(0.225)	(0.128)	(0.130)	(0.130)	(0.087)
SDV*Time	1.446***	1.414***	1.347***	-0.807*	-1.006**	-0.617*
	(0.452)	(0.442)	(0.328)	(0.441)	(0.470)	(0.322)
RDV*Time	-1.066	-1.066	-0.753***	0.969**	0.963**	-0.337**
	(0.911)	(0.911)	(0.121)	(0.446)	(0.449)	(0.133)
SDV	-3.217***	-3.377***	5.858***	5.082***	3.829***	9.853***
	(0.317)	(0.315)	(0.182)	(0.216)	(0.211)	(0.156)
Constant	15.514***	15.514***	3.295***	13.458***	13.444***	3.009***
	(0.237)	(0.237)	(0.120)	(0.151)	(0.150)	(0.083)
Observations	5070	5070	4927	34978	33934	30768
R-squared	0.01	0.02	0.15	0.01	0.01	0.09

Notes: Robust standard errors in parentheses (clustered at the category level). * significant at 10%; ** significant at 5%; and *** significant at 1%. (a) full sample; (b) only products whose price was less than $10 at least in one week-store-category observations in the full sample; and (c) only products whose pre-tax price falls within 20-cents below or above the cent-value zero threshold. Time is a dummy that equals for weeks when the intervention took place. Store is a dummy that equals to for store where intervention took place.

Table 6: Decrease in demand in treated and control categories (DD).

	Treated Categories			**Control Categories**		
	(1.a)	(1.b)	(1.c)	(2.a)	(2.b)	(2.c)
Products with sensitive dollar-value prices						
Av. Quantity sold	11.84	11.64	8.82	17.85	16.55	12.49
DD=	-1.267*	-1.182*	-1.383***	0.754*	0.586*	0.774**
Δ in Demand	*-10.70%*	*-10.15%*	*-15.68%*	*4.22%*	*3.54%*	*6.20%*
Products with rigid dollar-value prices						
Av. Quantity sold	15.07	15.07	3.03	12.86	12.85	2.81
DD=	-0.367	-0.367	0.180	-0.224	-0.216	0.205
Δ in Demand	*-2.44%*	*-2.44%*	*5.94%*	*-1.74%*	*-1.68%*	*7.30%*

Notes: Average quantity sold is the average of total items sold by categories in all stores (see Table 3). DD estimates equals γ from Equation 3 (see Table 5). * significant at 10%; ** significant at 5%; *** significant at 1%. (a) full sample; (b) only products whose price was less than $10 at least in one week-store-category observations in the full sample; and (c) only products whose pre-tax price falls within 20-cents below or above the cent-value zero threshold.

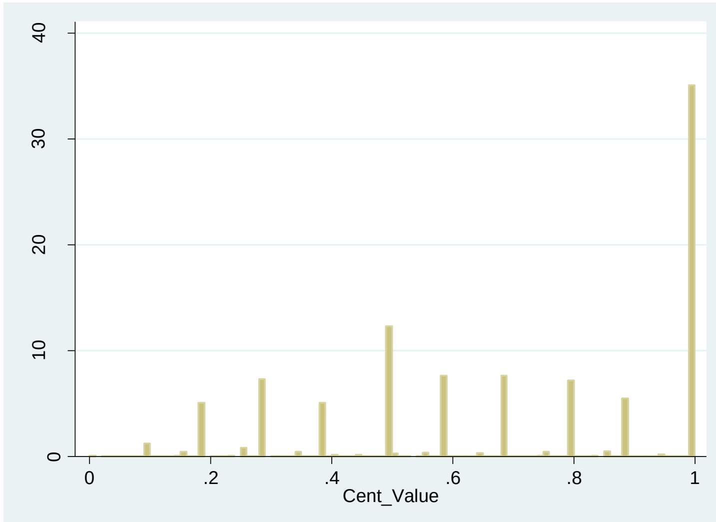
Table 7: Difference-in-Difference-Differences.

Table 8: Decrease in demand (DDD).

	(1.a)	(1.b)	(1.c)
Products with sensitive dollar-value prices			
Av. Quantity sold	17.13	15.93	12.05
DDD=	-2.021**	-1.768**	-2.157***
Δ in Demand	*-11.80%*	*-11.10%*	*-17.90%*
Products with rigid dollar-value prices			
Av. Quantity sold	13.16	13.15	2.84
DDD=	-0.143	-0.291	-0.151
Δ in Demand	*-1.09%*	*-2.21%*	*-5.32%*

Notes: Quantity sold is the average of total items sold by categories all stores (see Table 4). The DDD estimates are equals τ from Equation 4 (see Table 7). * significant at 10%; ** significant at 5%; *** significant at 1%. The statistic/results are based in: (1) full sample; (2) only products whose price was less than $10 at least in one week-store-category observations in the full sample; and (3) only products whose pre-tax price falls within 20-cents below or above the cent-value zero threshold.

Appendix 1: Distribution of cent-values on sold items.



Appendix 2: Exhibit of tax-inclusive price tax.

Appendix 3: Descriptions of treated and control categories.

Id	Category Description	Id	Category Description	Id	Category Description
5001	TOOTHPASTE	5325	HAND & BODY SKIN CARE	5760	EXTERNAL ANALGESICS
5005	DENTAL GUM	5330	LIP CARE	5799	GM/HBC TRIAL SIZE
5010	TOOTHBRUSHES	5335	COTTON	5801	PED - COLD/FLU/COU/ALL/SIN
5012	N/A	5340	DEPILATORIES	5805	ADULT COUGH,COLD,FLU
5015	ORAL RINSE/MOUTHWASH	5345	ADULT SUNCARE	5835	ADULT ALLERGY/SINUS
5020	DENTURE CARE	5350	CHILD/BABY SUN CARE	5840	NASAL PRODUCTS
5025	DENTAL FLOSS	5401	RAZORS	5845	BRONCHIAL ASTHMA
5030	INTERDENTAL IMPLEMENTS	5405	CARTRIDGES	5850	COUGH DROPS/THROAT RELIEF
5035	ORAL ANALGESICS	5410	DISPOSABLE RAZORS	5855	THERMOMETERS/COVERS
5040	BREATH FRESHENERS	5415	SHAVE PREPS	5901	ACID NEUTRALIZERS
*5101	DEODORANT/A-P AEROSOL	5420	MENS SKIN CARE	5905	ACID COMBINATION
*5103	N/A	*5501	FACIAL COSMETICS	5910	ACID BLOCKERS
*5105	DEODORANT/A-P ROLL-ONS	*5505	EYE COSMETICS	5915	PROTON PUMP INHIBITORS (PPI)
*5110	DEODORANT CLEAR SOLIDS	*5510	NAIL CARE	5920	MS GASTRO INTESTINAL RELIEF
*5115	DEODORANT CLEAR SOFT SOL.	*5515	LIPSTICK	5925	GAS RELIEF
*5120	DEODORANT CLEAR GELS	*5520	COSMETIC ACCESSORIES	5930	ANTI-NAUSEA
*5125	DEODORANT VISIBLE SOLIDS	5601	MULTIPLE VITAMINS	5935	ANTI-DIARRHEAL
5201	PROF. DAILY HAIR CARE	5605	JOINT RELIEF	5940	LAXATIVES
5205	PERF. DAILY HAIR CARE	5610	CALCIUM	5945	LACTOSE INTOLERANCE
5210	VALUE DAILY HAIR CARE	5615	LETTERS	5950	RECTAL/HEMMORHOIDAL
5215	DANDRUFF HAIR CARE	5620	SPECIALTY SUPPLEMENTS	5955	PEDIATRIC LAXATIVES
5220	THERAPEUTIC HAIR CARE	5625	A/O MINERALS	6001	SOFT CONTACT LENS CARE
5225	HAIR GROWTH	5630	HERBAL SUPPLEMENTS	6005	RIGID CONTACT LENS CARE
5230	KIDS HAIR CARE	5640	N/A	6010	GENERAL EYE CARE
5235	HAIR COLOR	5701	ADULT ASPIRIN REG&ES	6040	READING GLASSES
*5245	HAIR CARE ACCESSORIES	5703	ANTACID ASPIRIN ADULT	6042	SUNGLASSES
*5250	AFRICAN AMERICAN HAIR CARE	5704	LOW STRENGTH ASPIRIN ADULT	6045	MISC. EYE GLASS ACCESSORIES
5301	BAR SOAP	5705	ADULT ACETAMINOPHEN	6050	EAR CARE/EAR PLUGS
5305	LIQUID HAND SOAP	5710	IBUPROFEN ADULT	6101	INSOLES/INSERTS, FOOT CARE
5308	LIQUID WATERLESS SANITIZER	5715	NAPROXEN SODIUM	6105	CALLOUS/ BLISTER FOOT CARE
5310	BODY WASH	5716	ADULT COMPOUNDS	6110	ODOR CONTROL FOOT CARE
5312	BATH CARE	5718	SPECIALTY INDICATION PAIN	6115	ANTI-FUNGAL FOOT CARE
5314	IMAGE BATH BOUTIQUE	5725	CHILDRENS/INFANTS ANALG.	6120	JOCK ITCH PRODUCTS
5315	ACNE PREVENTION	5730	SLEEPING AIDS	6130	WART REMOVERS
5318	ACNE TREATMENT	5735	STIMULANTS	6190	MISC. FOOT CARE PRODUCTS
5320	BASIC FACIAL CARE	5740	SMOKING CESSATION PROD.		
5322	ANTI-AGING SKIN CARE	5750	NIGHTIME PAIN RELIEF		

Note: * Treatment categories.

Appendix 4: Two-tailed t-test on observable characteristics

A4.a: Mean is equal between the treated and control stores during the baseline period.

	Treated Categories (1)	Treated Categories (2)	Treated Categories (3)	Control Categories (1)	Control Categories (2)	Control Categories (3)
Products with sensitive dollar-value prices						
Total Unique Products Purchased	0.103	0.206	0.175	0.086	0.246	0.861
Av. Unitary Gross Price	0.154	0.015	0.951	0.053	0.000	0.221
Av. Unitary Net Price (Gross-Discount)	0.117	0.051	0.760	0.044	0.000	0.188
Products with rigid dollar-value prices						
Total Unique Products Purchased	0.547	0.547	0.002	0.071	0.077	0.831
Av. Unitary Gross Price	0.012	0.012	0.580	0.020	0.039	0.004
Av. Unitary Net Price (Gross-Discount)	0.078	0.078	0.319	0.046	0.086	0.014

Note: Two-sided p-values are reported.

A4.a: Mean is equal between the treated and control stores during the experimental period.

	Treated Categories (1)	Treated Categories (2)	Treated Categories (3)	Control Categories (1)	Control Categories (2)	Control Categories (3)
Products with sensitive dollar-value prices						
Total Unique Products Purchased	0.373	0.443	0.416	0.707	0.581	0.864
Av. Unitary Gross Price	0.483	0.941	0.375	0.564	0.521	0.977
Av. Unitary Net Price (Gross-Discount)	0.405	0.793	0.333	0.517	0.345	0.992
Products with rigid dollar-value prices						
Total Unique Products Purchased	0.904	0.904	0.670	0.603	0.610	0.968
Av. Unitary Gross Price	0.564	0.564	0.835	0.834	0.882	0.709
Av. Unitary Net Price (Gross-Discount)	0.577	0.577	0.838	0.998	0.980	0.892

Note: Two-sided p-values are reported.

A4.a: Mean is equal between the baseline and experimental period at the control stores.

	Treated Categories (1)	Treated Categories (2)	Treated Categories (3)	Control Categories (1)	Control Categories (2)	Control Categories (3)
Products with sensitive dollar-value prices						
Total Unique Products Purchased	0.292	0.295	0.390	0.723	0.615	0.651
Av. Unitary Gross Price	0.871	0.855	0.664	0.940	0.455	0.741
Av. Unitary Net Price (Gross-Discount)	0.875	0.860	0.727	0.881	0.154	0.890
Products with rigid dollar-value prices						
Total Unique Products Purchased	0.689	0.689	0.230	0.431	0.443	0.226
Av. Unitary Gross Price	0.550	0.550	0.934	0.564	0.517	0.177
Av. Unitary Net Price (Gross-Discount)	0.842	0.842	0.381	0.614	0.537	0.312

Note: Two-sided p-values are reported.

A4.a: Mean is equal between the baseline and experimental period at the treated store.

	Treated Categories (1)	Treated Categories (2)	Treated Categories (3)	Control Categories (1)	Control Categories (2)	Control Categories (3)
Products with sensitive dollar-value prices						
Total Unique Products Purchased	0.896	0.848	0.935	0.731	0.360	0.530
Av. Unitary Gross Price	0.470	0.264	0.370	0.833	0.404	0.996
Av. Unitary Net Price (Gross-Discount)	0.385	0.203	0.307	0.937	0.303	0.801
Products with rigid dollar-value prices						
Total Unique Products Purchased	0.513	0.513	0.798	0.607	0.616	0.308
Av. Unitary Gross Price	0.561	0.561	0.909	0.355	0.324	0.125
Av. Unitary Net Price (Gross-Discount)	0.909	0.909	0.547	0.298	0.275	0.159

Note: Two-sided p-values are reported.