Long-Term Tax Salience Effects Effect*

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Abstract

This paper shows that consumers underreact to taxes that are not salient even in the long run, and reveals the trajectory of such effect over the number of store visits by consumers. Previous studies have suggested that tax salience effect may be persistent, but their evidence relied mostly on intertemporal variation in aggregate data. We use a novel consumer-level panel data in Japanese supermarket stores that include how the supermarket chains displayed their prices. The sample period coincides with the legal reform to relax the regulation that forced retailers to display the total price with sales tax. This regulatory reform provides a unique natural experiment, which allows us to estimate the causal effect on consumer behavior when sales tax is not shown. The difference-in-difference estimation shows that hiding a 5% sales tax increases individual sales value by 9.6% on a consumer's first visit after the change in price tags, but the treatment effect reduces sharply and stays stable around 3.8% on her second visit onwards. Consumers realize that price tags started to show only the base prices of products when they actually pay the total prices at cashiers on their first visits, which causes the sharp decline of the treatment effect. The fact that consumers' underreaction to sales tax remain after multiple store visits suggest that consumers intentionally ignore nonsalient taxes to avoid the cost of calculation. (JEL D12, H25, K34, L11)

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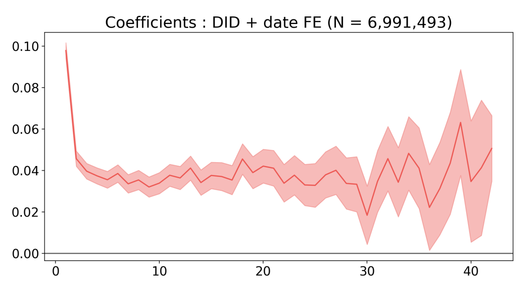
1 Introduction

Conventional consumer theories assume that individuals are rational and correctly take into account base prices and taxes equivalently when making purchase decisions. A number of findings from the past literature, however, suggests that consumers actually fail to fully incorporate less visible taxes in their decision making. For example, Chetty et al. (2009) performed an experiment that attaches tax-inclusive price in adddition to the original tax-exclusive price in a grocery store, and shows that consumers are less likely to purchase personal healthcare and beauty products. Finkelstein (2009) presents evidence that highway drivers are substantially less aware of tolls paid electronically after tollgates adopt electronic toll collection (ETC).

This paper's main purpose is to uncover how consumers' reaction towards a hidden tax transitions in the long run over a number of shopping experiences. Chetty et al. (2009) suggests that tax salience effect are persistent even in the long run by comparing the impact of excise tax, which is included in the retail price, and sales tax, which is added at the cashier, on state-level alcohol consumption. They used observational yearly data. We provide a stronger evidence by tracking repeated visits of individual consumers in a novel panel data that overlaps with a legal reform that allowed retail stores to not indicate sales tax on price tags. This regulatory reform provides a unique natural experiment, which allows us to estimate the causal effect on consumer behavior when sales tax is not shown.

Shown in figure 1.1 is the main result of this paper. It shows that hiding a 5% sales tax increases individual sales value by 9.6% on a consumer's first visit after the change in price tags, but the treatment effect reduces sharply and stays stable around 3.8% on her second visit onwards.

Figure 1.1: Transition of Shrouded-Tax Treatment Effect over Store Visits



Note. (i) The solid line represents the transition of the estimated effect of hiding sales tax in price tags over the number of consumer store visits. (ii) The results were obtained by running a difference-in-difference regression with the log of the sales value of each individual store visit as the dependent variable and the interaction term of the treatment dummy variable and the dummy variable for each number of individual store visit as the explanatory variable. (iii) The shaded area corresponds to the 95% confidence interval of the treatment effect coefficient.

The sharp decline in the level of treatment effect is linked to the consumer's realization that values listed on the price tags are in fact lower than tax-inclusive prices they end up paying for. It is an evidence that in retail stores, most part of consumer learning on tax salience takes place on their first visits to the stores with new price displays. The fact that consumers' underreaction to sales tax remain after numerous store visits also suggests that consumers intentionally ignore nonsalient tax to a certain degree to avoid the cognitive cost of calculation. This enhances the previous results in the past such as Blake et al. (2018), which shows that hidden back-end fees on online ticket marketplace affect even experienced users.

The second purpose of this paper is to uncover how businesses set prices when they start to show tax-exclusive prices. It is an opportunity for a retail store to increase its prices without being noticed to consumers since the list prices on the price tags would still be lower than the previous tax-inclusive prices. Finkelstein (2009) shows that authorities charge significantly higher tolls to highway drivers than they would have been without ETC, providing evidence that suppliers charge higher prices when they are less salient. On the other hand, Cabral and Hoxby (2012) utilizes the fact that property taxes are less salient to people with tax escrow and shows that an increase in tax escrow produces a decrease in property tax rates. Our result from the analysis on price levels after the introduction of tax-exclusive price tags are similar to that of Finkelstein (2009), and the stores of the chain that decided to hide sales tax raised their prices by 1% on average, although the rates of price increase differ by product categories. We found that businesses tend to increase prices more for the categories with products that are more difficult for consumers to refer to the past prices, and with higher price elasticities of demand.

The analysis on pricing is also useful to see how it could be source of endogeneity when estimating the consumer response to the treatment effect. If stores raise their prices at the same time with the treatment, the estimation of consumer's underreaction to the hidden sales tax may be falsely attenuated to zero, since consumer demand would be lower due to higher prices. To address this issue, we limited our sample to the stores of which the fluctuation of the price index stayed within 0.3% over the price display change and repeated the first analysis of the paper. The estimation results stayed the same.

Our paper also contributes to the studies of partitioned pricing. Two of the treated supermarket chains in our data started showing both pre-tax and total prices instead of total prices alone. This situation is similar to online marketplaces showing the product prices and shipping costs seperately, and airline companies posting ticket fees and fuel surcharges seperately. Majority of the past empirical studies on this subject such as Morwitz et al. (1998), Xia and Monroe (2004), and Hossain and Morgan (2006) shows partitioned prices increase consumers' product demand compared with all-inclusive, combined prices. However, our result suggests that posting both prices and letting consumer recognize the base price and sales tax seperately does not increase the sales value of their each visit. They are more in line with the results provided by Bambauer and Gierl

(2008) and Lee and Han (2002).

Recent literature also started focusing on differences across individuals in underreaction to non-salient taxes. Taubinsky and Rees-Jones (2017) implements an online shopping experiment and finds significant individual variation in tax salience effect, claiming that the efficiency costs of taxation are amplified by this heterogeneity. Goldin and Homonoff (2013) investigate income differences in attentiveness to cigarette taxes, and their results suggest that only low-income consumers respond to taxes levied at the register.

The last purpose of this paper is to revisit how income may affect tax salience effect and also to add new individual characteristics that may vary the response towards tax salience, such as individual expenditures on alcohol, and the most frequent times they visit the stores. First, we match the stores with city-level average income and present how the level of tax salience effect depends on it. The result shows that doubling the average income decreases the effect of hiding taxes on individual sales value by 2.5 percentage points. Next, we focus on purchasing pattern of beer-like beverages. Because of a peculiar liquor-tax code in Japan, beer companies sell lower-priced substitutes of beers that are stratified in prices and qualities. We categorize each consumer by what type of these beer-like beverages she purchases the most (if at all) and estimate the response to tax salience of each group. The aim of this estimation is to highlight how cost-consciousness and behavior related to myopia, in this case, alcohol consumption, are correlated to the impact of tax salience effect on individuals. While there were no significant differences in the response towards tax salience among buyers of beer and its alternatives, consumers who have not bought any of them over the past year were affected significantly less. The last part of this section seperate consumers into different groups by the most frequent time of the day they visit the stores. The underreaction to hidden taxes were stronger for consumers who visit the stores in the morning and early afternoon.

Throughout the paper, for identification, we utilize the legal reform in Japan that modified how prices must be displayed in the retail industry and the subsequent changes in the way supermarket chains posted prices in stores. The law that was enforced in October 2013 lifted the rule that required retail stores to post tax-inclusive prices on price tags and advertisements, and supermarket chains responded in two different ways. Some chains started posting tax-exclusive prices, while the others started posting both tax-exclusive and tax-inclusive prices. Our data includes one chain that switched to posting only tax-inclusive prices, two chains that switched to posting both prices, and two chains that we use as controls. We mostly rely on difference-in-differences estimation with log sales of each consumer store visit as the dependent variable.

The next section explains the legal reform concerning price display policies in Japan and how supermarket chains responded. Section 3 gives an overview of the data used in the analysis and section 4 provides the main result of this paper on long-term tax salience effect. Section 5 discusses the price fluctuation during the sample periods and section 6 analyzes the consumer reponse to different types of price tags. Section 7 contains analysis of tax salience effect by individual purchase patterns and average income. Section 8 provides insight on how the number of visitors changes by introducing a new price display method. Section 9 concludes.

2 Price Display Policies in Japan

We use supermarket scanner data from Japan, where a legal reform bill concerning price display was passed on June 5, 2013 and enforced on October 1, 2013. The reform temporarily lifted the rule that any price displayed in price tags and advertisements must be the toal price including sales tax.[1] The intention of this new rule allowing to hide sales tax was to alleviate the cost of retail stores making transitions to a higher sales tax of 8% from 5% that took place on April 1, 2014.

All supermarket stores in the sample data were simply showing tax-inclusive prices before the legal reform as in figure 2.1. After the law was enforced, major supermarket industry organizations provided guidelines suggesting that the member chains should adopt tax-exclusive prices. Some supermarket chains followed the guidelines and switched their price displays to tax-exclusive prices as in figure 2.2. Note that inside the oval in the figure reads "base price" in Japanese. In this paper, this type of change in price tags is refered to as the "shrouded-tax treatment"[2]. The other supermarket chains were more cautious changing their price display policies and first started showing both tax-inclusive and tax-exclusive prices as in figure 2.3. We refer to this type of change in price display policy as the "two-price treatment".

Figure 2.1: Example of Tax-Inclusive Price

Note. (i) There is no explanation on the price tag whether it indicates the tax-inclusive or the tax-exclusive price, since all prices were shown with sales tax before the legal reform.

[1] This temporary legislation has been extended twice and is still valid as of October 2019.
[2] The naming is based on Brown et al. (2010)

Figure 2.2: Example of Tax-Exclusive Price

Note. (i) Inside the blue oval reads “base price” in Japanese.

Figure 2.3: Example of Posting Both Prices

Note. (i) The tax-inclusive price is shown inside brackets in smaller fonts.

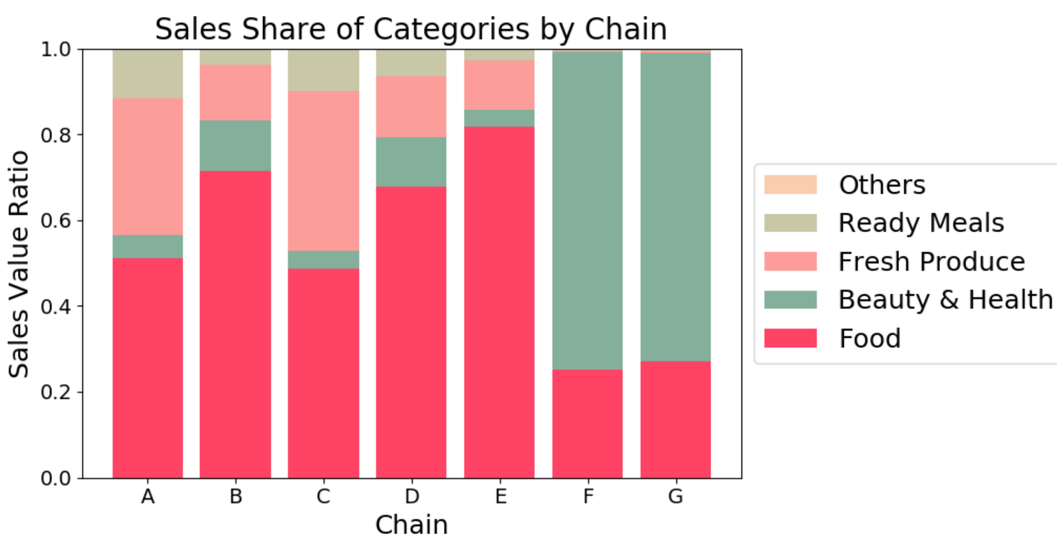
3 Data

We measure consumer response to the sales tax display policies using supermarket sales data supplied by True Data, a leading source of Japanese supermarket scanner data. Sample stores are selected to be broadly representative of the geographic coverage of each chain. All sales transactions of the selected stores between customers with loyalty cards are recorded throughout the sample period. Sales transaction records of consumers without loyalty cards were not provided for business reasons.

Sampled Supermarket Chains

In the data, there are seven store chains categorized as supermarkets by the data provider. Figure 3.1 shows the sales shares of broad product categories within each chain. Notice that there are two chains with distinctively different compositions of sales categories. Although these retailers are classified as supermarkets by the data provider, their business lines actually fall closer to drug stores and discount stores. We drop the sales records in these retailer chains from the sample. The remaining chains are assigned letters "A" to "E" for reference.

Figure 3.1: Sales Share of Each Category by Chain



Treatment and Control Chains

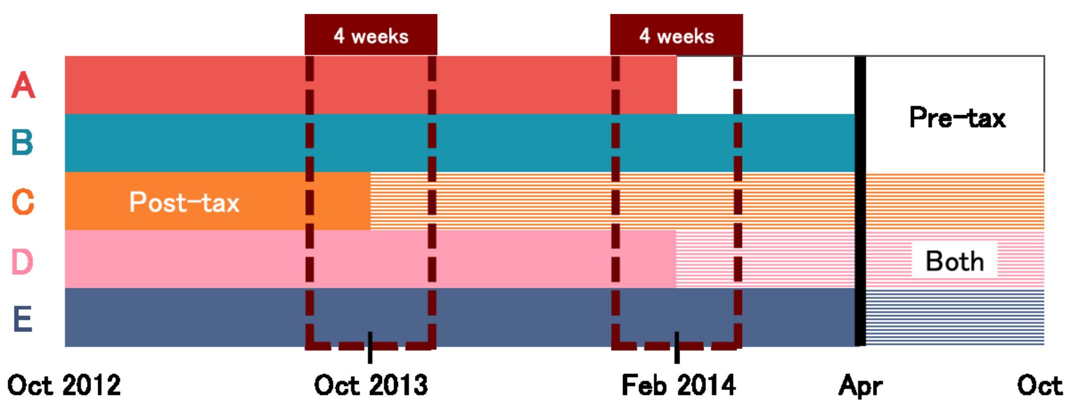
As shown in the diagram of figure 3.2, supermarket chains modified their price tags on different dates, and this variation in timing is what we exploit to identify the tax salience effect. Two chains, B and E, changed their price display policies on April 1, 2014, the exact same day as the sales tax increase from 5% to 8%. We used these two chains as a control group and exclude the samples around the tax increase date, so that we do not confound the treatment effect and the change in demand from the sales tax increase.

The remaining three chains, A, C, and D together consist a treatment group. One of them changed its price display policy on October 1, 2013, to posting both tax-inclusive and tax-exclusive prices. The other two chains changed their price display policies on February 1, 2014. Chain A decided to post tax-exclusive prices only, while Chain D decided to post both prices. To reiterate, Chain A received the shrouded-treatment effect, and Chain C and D received the two-price treatment effect.

Analyses are done with subsamples of the whole data. Most of the estimation are done with recorded transactions within two 4-week time periods that starts two weeks before the change in price displays of each chain and ends two weeks afterwards. The exception is our main analysis on the tax salience effect by the number of previous visits, and we use transactions of 6 weeks after the price display change. For this estimation, it is crucial to take a long enough period that consumers visit the stores multiple times, and track how consumers' response towards the treatment shifts over the number of visits.

Number of stores in the sample differ by chain, but they are stable throughout the sample period.

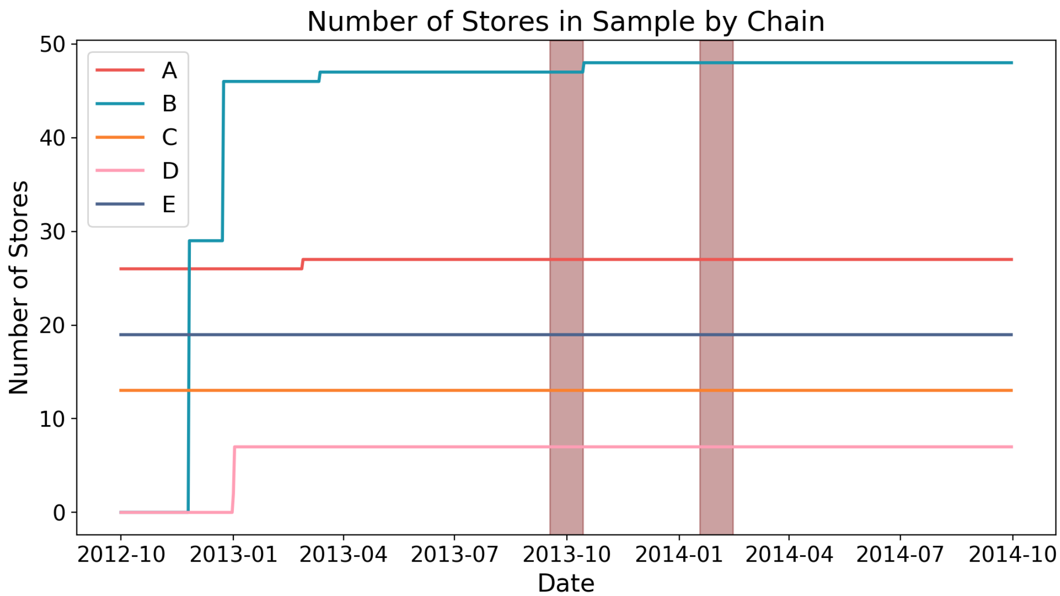
Figure 3.2: Timing and Type of Price Display Adjustments



Note. (i) The colored areas without patterns represent the period where the chains displayed tax-inclusive prices only, the blank areas represent the period where the chains displayed tax-exclusive prices only, and the bordered areas represent the period where the chains displayed both tax-inclusive and tax-exclusive prices. (ii) The vertical line in april indicates the sales tax hike from 5% to 8%. (iii) The area surrounded by dashed lines show the sampe chains and periods used for most estimations in the paper.

Figure 3.3 shows the number of chain throughout the whole data period. The shaded areas are the four-week subsample periods used in the analyses in the following sections.

Figure 3.3: The Transition of Number of Stores in Sample



Note. (i) The two shaded areas indicate the sampe chains and periods used for most estimations in the paper.

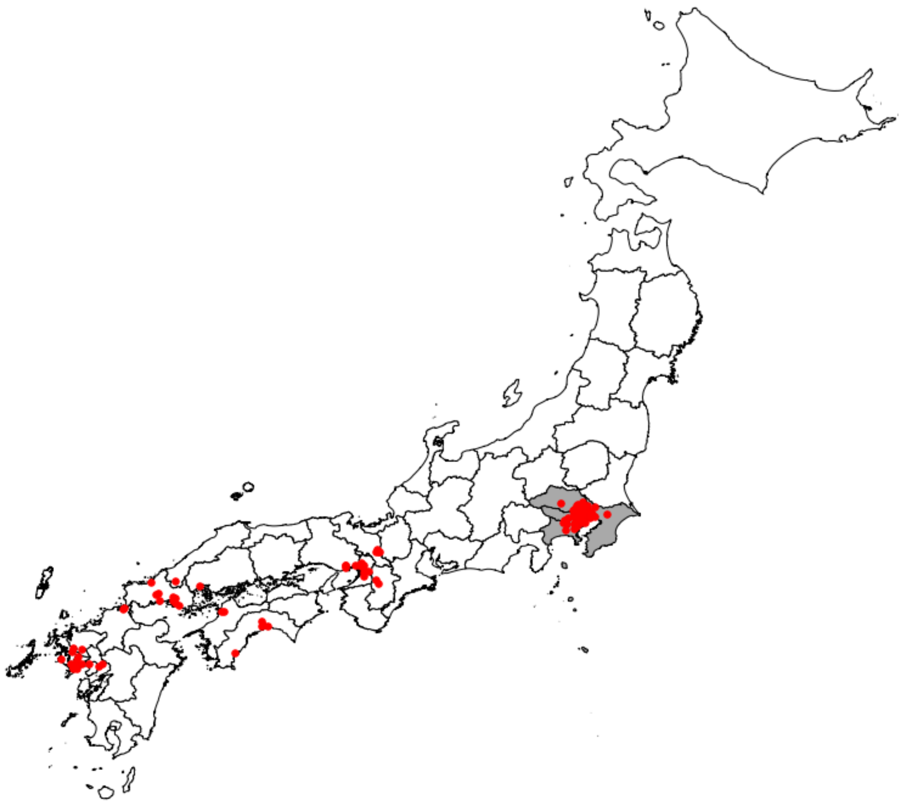
Geographical Coverage

Stores in the data are selected to be broadly representative of the geographic coverage of each chain. Our sample covers total of 114 supermarket stores of 5 chains across 15 prefectures in Japan. Figure 3.4 maps all the 114 sample stores. The grayed area is called the Kanto region, and includes all stores that received the shrouded-tax treatment (chain A) and some stores of a control chain (chain B). Since stores from the only chain with shrouded-tax treatment are all located in Kanto, when we analyze this particular treatment effect, we mainly focus on the samples only from this region in the interest of comparing similar customer bases.

4 Tax Salience Effect in the Long Run

This section provides the main result of the paper, which is the transition of the tax salience effect over individual store visits. It enables us to capture the long-run stationary tax salience effect after

Figure 3.4: Store Locations



Note. (i) The grayed area is the Kanto region, which includes all stores that received the shrouded-tax treatment (chain A) and some stores of a control chain (chain B). (ii) All stores are indicated in same dots to retain anonymity of each chain.

the tax display policy change takes place, and it is of interest to both business managers and policy makers since it has a higher impact on profitability and consumer welfare than the short-run effect. The result also helps us uncover the reason consumers underreact to non-salient taxes. One possible explanation is that consumers simply do not recognize the fact that taxes are not shown in price tags. Under this hypothesis, consumers should fully react to prices once they find out that tax had started to be hidden at the cashier on their first visits. The other possibility is that consumers consciously choose to ignore hidden taxes, which is known as "behavioral inattention"[3], and should sustain even after numerous visits to stores.

Most empirical work on tax salience effect in the past has been limited to short term effects, since in-store experiments require companies to take seemingly suboptimal manegerial actions, and store managers are reluctant to do so over a longer period. Our data contains a chain that started to hide taxes two months before the other control chains followed suit concurrently with the raise in consumption tax, and therefore we are able to capture individual reaction to the policy change over dozens of consumer visits to stores.

The focus is whether the shrouded-tax treatment diminishes. The only supermarket chain that changed its price tags before the tax hike to tax-exclusive prices only is located in the Kanto region, and did so on February 1, 2014. The sampled control stores are also limited to the ones located in Kanto Region in the interest of comparing similar consumers. Since stockpiling behavior by consumers is seen in the data several days before the tax raise on April 1, we limit the sample to eight weeks from January 18 to March 14 to avoid confusion with the actual tax salience effect.

The equation for difference-in-difference estimation is:

$$\log\left(sales_{ik}\right) = \sum_{k=1} \beta_k \cdot shroud_{ik} + \alpha_i + timeFE + \epsilon_{ik}, \tag{4.1}$$

where

- $sales_{ik}$: total sales of individual i at store visit k
- $shroud_{ik}$: indicates that the consumer faced tax-exclusive price tags
- α_i : individual fixed effect.

The term $timeFE$ has variations as follows:

1. $periodFE + weekdayFE$
2. $periodFE + weekdayFE + weekFE$

[3] See Gabaix (2019) for reference.

3. *dateFE*,

where *periodFE* are dummy variables of time periods seperated by the price display changes of treatment chains, and other fixed effects are dummy variables corresponding to their names. The fact that *periodFE* or *dateFE* is included in every specification guarantees that the regression is difference-in-difference. The explained variable is the log of the sales value of each individual visit. The seperate coefficients capture the rate of consumer learning and their adjustments to the new way of price display.

The results of the above diff-in-diff regression are shown in figure 4.1 with the solid line as the estimated coefficients and shaded areas as the corresponding 95% confidence intervals. One interpretation of the last two line graphs in figure 4.1 is that a large portion of consumers notice the change in price tags on the second visit and corresponds by taking the hidden taxes into account, while the other consumers remain prone to the tax salience effect even after a number of visits. The other interpretation is that each consumer has a certain degree of behavioral inattention towards shrouded sales tax, and gets revealed on the second visit onwards. It seems that including more time control variables flattens the estimated line. One possible explanation of this change caused by the included dummy variables is that customers of the control chain visited the stores in the first several visits more often during the period when control chain had larger sales compared to the treatment chain.

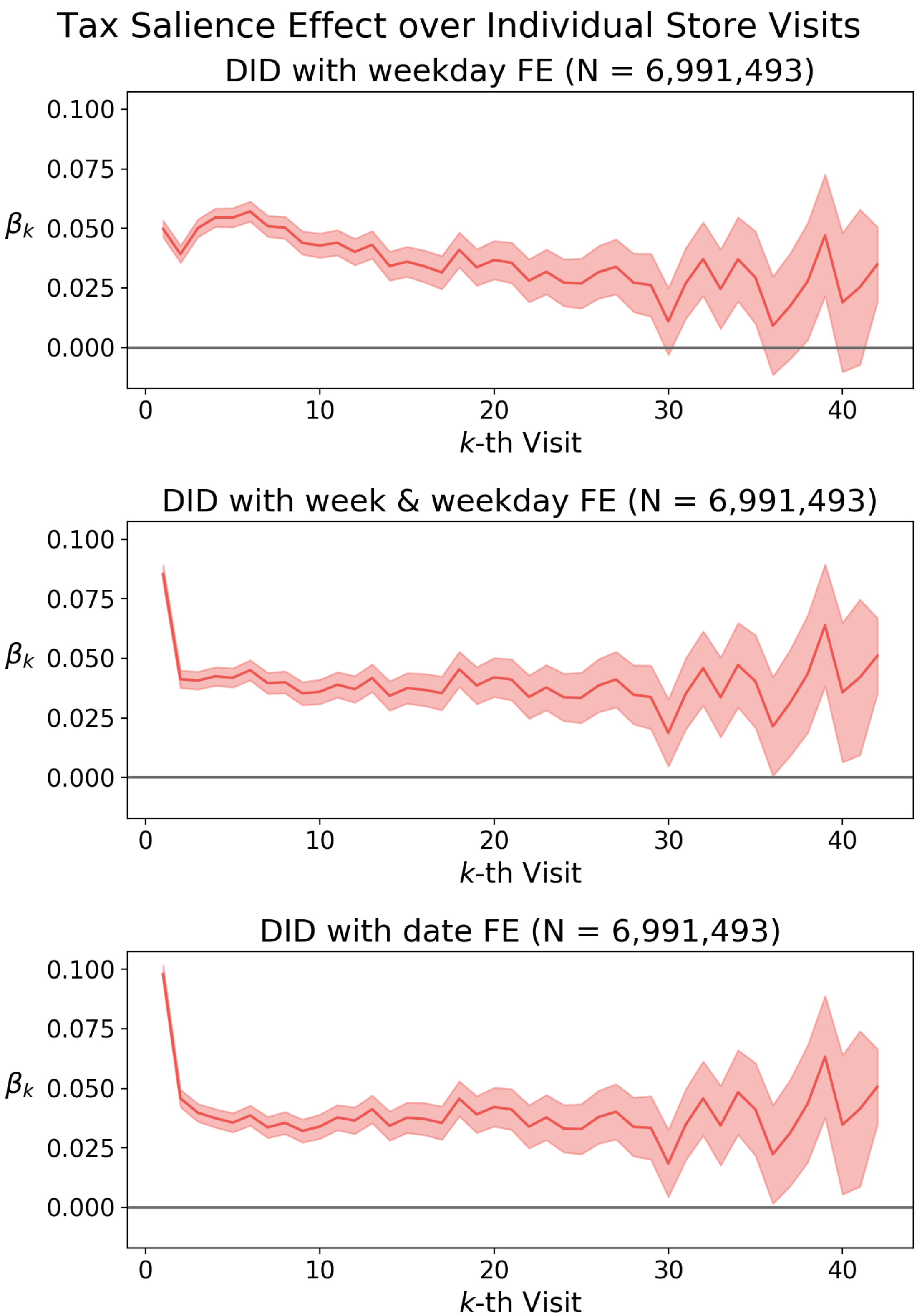
A potential problem of the above analysis is the possibility of sample selection. Shoppers who is recorded to have visited the stores just once during the sample period may be drastically different from the other consumers who visits the stores frequently. The number of one-time shoppers was 141,509 out of 757,136 individuals, and consist the left end of the distribution in figure 4.2. Omitting these individuals made little difference to the results.

Since we now know that the consumers' under-reaction to shrouded sales tax largely drops after the first visit and the remaining tax salience effect remains stable, it is natural to estimate the precise value of the stationary tax salience effect that is likely caused from behavioral inattention. We run the same regression as equation 4.1, but this time instead of having coefficients for each number of visits, we only have one coefficient for the second visit onwards. The first coefficient represents the tax salience effect when consumers do not realize that taxes are hidden, and the second coefficient represents the stationary tax salience effect in the environment where the tax display policy is known to consumers.

Shown in table 1 are the results of the regression. We see that the regression with date fixed effect estiamtes that hiding a 5% sales tax increases individual sales by 9.6% on the first visit, and 3.8% on second visit onwards.

Chetty et al. (2009) estimated that posting a 7.4% sales tax reduces demand by 8%, which is quite similar to the shrouded tax treatment effect we obtained in the previous section. Since their ex-

Figure 4.1: Transition of Shrouded-Tax Treatment Effect over Store Visits



Note. (i) The x-axis of each diagram is the k-th visit to a store by an individual consumer after the treatment. (ii) The y-axis represents the coefficients from 4.1. (iii) The estimations differ in what is included as the time fixed effects.

Figure 4.2: Number of Visits in January 18 - March 14, 2014

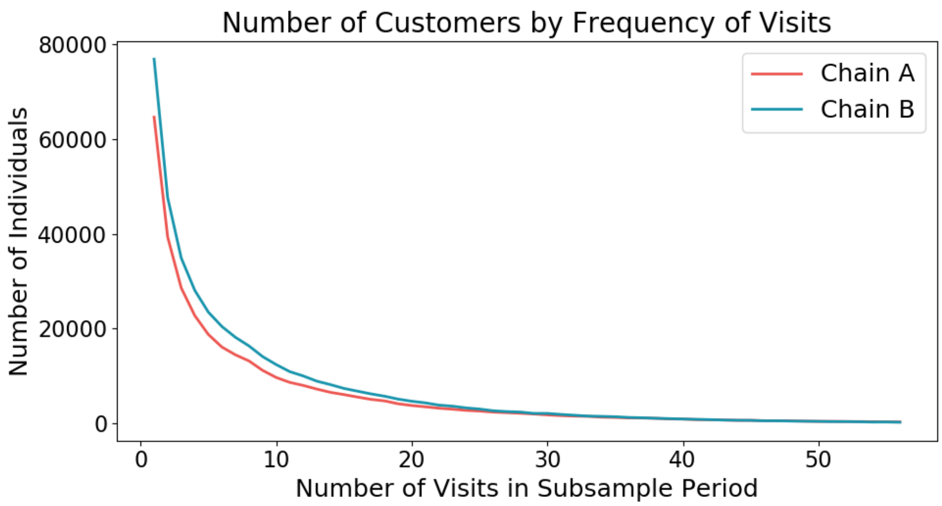


Table 1: Treatment Effect on First Visit and Second Visit Onwards

	Dependent Variable:		
	Individual Sales Per Visit (log)		
	Kanto Region (4 weeks)		
	(1)	(2)	(3)
Treatment (Shrouded, First Visit)	0.049***	0.084***	0.096***
	(0.002)	(0.002)	(0.002)
Treatment (Shrouded, Second Visit Onwards)	0.044***	0.040***	0.038***
	(0.001)	(0.001)	(0.001)
Individual FE	x	x	x
Period FE	x	x	
Weekday FE	x	x	
Week FE		x	
Date FE			x
R^2	0.55	0.55	0.55
N	6,991,493	6,991,493	6,991,493

Note. (i) Standard errors are in parentheses. $^{*}p < 0.1$, $^{**}p < 0.05$, $^{***}p < 0.01$. (ii) The sample focuses two weeks before and after the change in price tags.

periment design was a reversed version of ours and they started to post both tax-inclusive and tax-exclusive prices instead of tax-exclusive prices only, the possibility of not knowing the change in price display policy is much lower than our natural experiment. However, their experiment period was three weeks, and since the treatments were applied to product categories that consumers are not likely to purchase very frequently such as cosmetics, hair care accessories, and deodrants, most shoppers in the experiment likely saw the new price tags for the first time. It is possible that the consumers experienced some degree of confusion in a way that the estimated result was higher compared to the case that consumers are fully aware of how the taxes are included in the price tags after a few visits to the stores.

5 Prices

Store Response in Prices

This section sheds light on how the pricing of each store is affected by the new price display methods. This is a topic worth paying attention to, not only because it uncovers the business decisions on pricing in response to laws that regulate tax salience, but also because it may be a source of endogeneity when estimating consumer response to the change in price display policies. Precisely estimating the tax salience effect to the consumers requires the price levels in the sample stores to stay stable throughout the period, or at least not to fluctuate in a systematic way correlated with the changes in price tags. Especially concerning is the possibility of stores predicting the increase in demand by hiding taxes and thus raising prices simultaneously to exploit underreaction of the consumers. Some stores may even raise their prices by the exact values of sales tax to deceive consumers into thinking that there were no change in price tags at all. In such case, the estimated tax salience effect will be attenuated from its true value.

We first start by checking the price index of each chain during the focused subsample periods around the modification date of price display policies on October 1, 2013 and February 1, 2014. We define the Laspeyeres price index of each chain as

$$\text{Price Index of Chain } x = \sum_{s=S_x} \sum_{j_s=J_s} q_{j_s} p_{j_s}, \tag{5.1}$$

where

- S_x : set of stores run by chain x
- J_s : set of goods sold at least once during the period in store j
- q_{j_s} : total quantity of product j sold in store s in first week

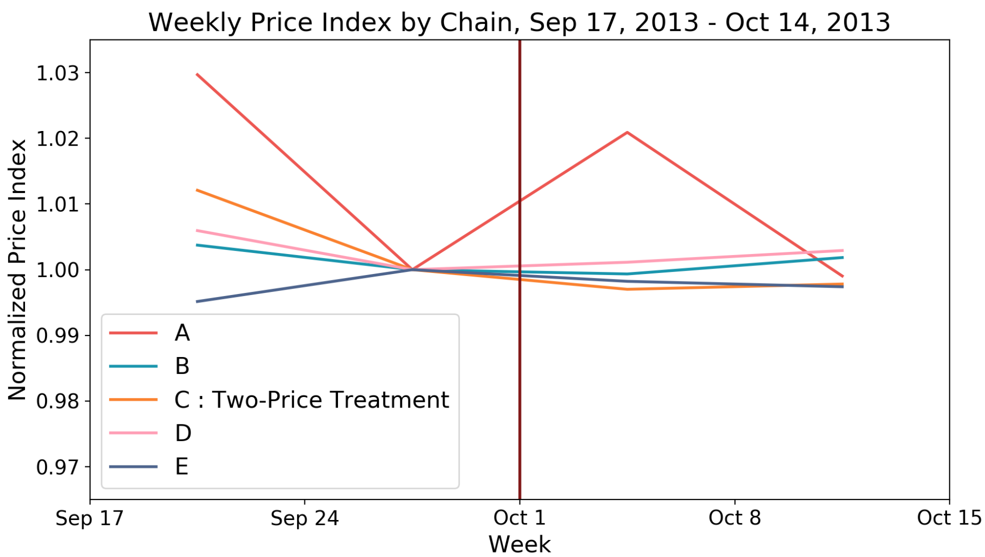
· p_{j_s}: average weekly price of product j in store s

Since prices are taken from supermarket scanner data, we do not observe prices of goods when they are not sold. In order to supplement the unobserved prices, first, we define the most frequently observed price each day as the daily price. Then the weekly price is calculated by the average of the daily prices. We drop the product from the basket consisting the price index if it was not sold even once in a week and cannot calculate the average. The reason we chose weekly price index instead of daily price index here is to include products that were sold less frequently in the interest of mitigating sample selection bias.

The price indices in the four-week sample period around October 1, 2013 are shown in figure 5.1. There is a fluctuation of the price index of Chain A within a range of about 3%, but the treatment chain does not show much shift in its price index.

The price indices in the sample period around February 1, 2014 are shown in figure 5.2. Chain

Figure 5.1: Price Indices of Chains : First Half of Sample Period

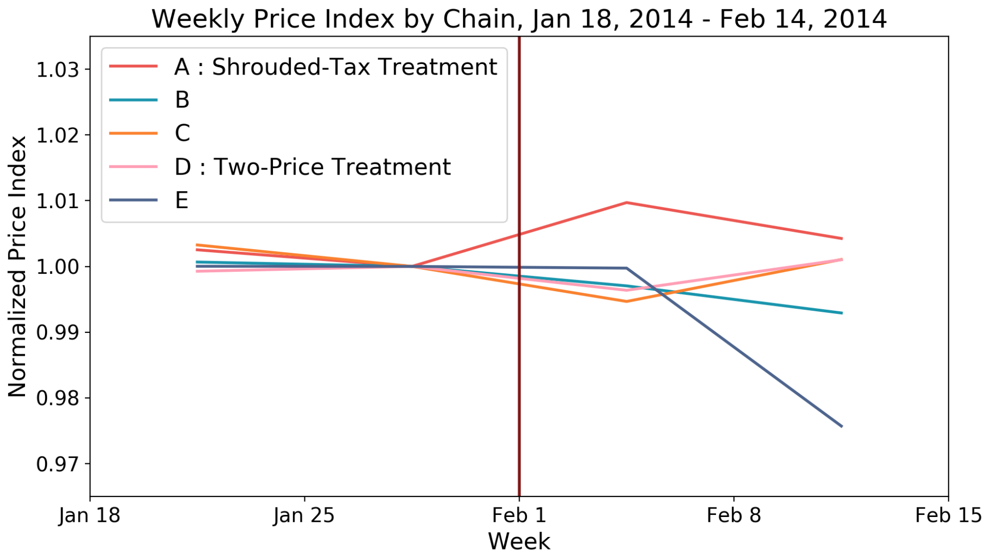


Note. (i) The vertical line on October 1st indicates when chain C started to show both tax-inclusive and tax-exclusive prices instead of tax-inclusive prices only.

A raised its price level by approxiately 1% when it changed its price tags from tax-inclusive to tax-exclusive. The shrouded-tax treatment effect estimated in the following sections should thus be interpreted as the lower bound of its true value. We also see a significant drop in price levels of chain E in the fourth week. Since chain E has no stores in the Kanto area, this is another reason we focus on this particular region when estimating the shrouded-tax treatment effect.

In order to obtain an accurate value of how much the stores shifted its prices by receiving treatments, we run a diff-in-diff regression of weekly prices of products on treatment dummy variables.

Figure 5.2: Price Indices of Chains : Second Half of Sample Period



Note. (i) The vertical line on October 1st indicates when chain A and D changed their price display methods from showing tax-inclusive prices only.

The regression equation is

$$\log\left(p_{jsw}\right) = \beta_s shroud_{jsw} + \beta_t twoprice_{jsw} + \gamma_j + \zeta_s + \eta_w + \epsilon_{jsw},$$

where

- p_{jsw} : average price of product j in store s in week w
- $shroud_{jsw}$: indicates that store s showed tax-exclusive price tags
- $twoprice_{jsw}$: indicates that store s showed both tax-exclusive and tax-inclusive prices
- γ_j : product fixed effect
- ζ_s : store fixed effect
- η_w : week fixed effect

Shown in table 2 are the results of the regression. We see that stores with shrouded tax treatment raised product prices by 1% while stores with two-price treatment did not change prices significantly. Past literature on tax salience effect has mostly focused on consumer response to the change in how taxes are shown. This result is an evidence that firms also shift their prices simultaneously with their adjustment on tax salience when a legal reform on tax display regulation takes place.

Policy makers should notice this reaction by businesses and take into account the general equilibrium effect when evaluating the potential costs of such legal reform.

Table 2: The Price Tag Treatment Effect on Prices

	Dependent Variable: Weekly Price of Product (log)
	Nationwide (4 weeks)
Treatment (Pre-tax)	0.010*** (0.001)
Treatment (Both)	-0.000 (0.001)
Product FE	x
Store FE	x
Week FE	x
R^2	0.97
N	7,894,236

Note. (i) Standard errors are in parentheses. $^{*}p < 0.1$, $^{**}p < 0.05$, $^{***}p < 0.01$. (ii) The sample focuses two weeks before and after the change in price tags.

The most plausible explanation of stores that received the shrouded-tax treatment raising prices is that they took advantage of the hidden sales tax and made shoppers perceive that the prices did not rise as much as they actually did. Our next study is to see what kind of products the stores that received shrouded-tax treatment effect raised their prices the most. We run a similar diff-in-diff regression as before but with coefficient for each category. The regression equation is now

$$\log\left(p_{jsw}\right) = \sum_{c \in C} \beta_c \cdot \mathbb{I}\left\{j \in c\right\} \cdot shroud_{jsw} + \gamma_j + \zeta_s + \eta_w + \epsilon_{jsw}, \tag{5.2}$$

where C is the set of product categories. Since the single chain that hid taxes instead of displaying two prices have stores only in the region called Kanto, we are able to compare similar group of consumers by also limiting the control stores to the ones located in the Kanto region. The tradeoff is that there is only one control chain in the sample with stores in the region, and a chain-wide shock unobservable to the econometrician may skew the estimated parameter. We report the estimation results with both stores nationwide and in the Kanto region as the control group.

Table 3 and 4 are the results of regression shown in equation 5.2. Some prices are not observed throughout the sample period, and the corresponding products are dropped from the analysis. The ratio of number of products dropped in each category is reported in the third and sixth column of the table. Product categories with higher ratio of dropped products may be prone to underestimation of the store response, since the reason we do not observe any purchase of a product may be the result of a high price. The coefficients of categories with higher ratio of dropped products and low number of observations should be evaluated with caution.

Product categories that show higher price reponses to the display change include vegetables, eggs, and commodities like kitchen utensils, toiletries, medicine, and DIY goods. One explanation why these categories have higher reponse to the treatment is that it is more difficult for customers to refer to past prices of the products in these categories. Since prices of fresh produce like vegetables and eggs fluctuate on a daily basis, consumers likely have wide ranges of what the past prices fell into. On the other hand, consumers presumably purchase non-food commodities less frequently than food in supermarkets, and may only have vague memories on what the prices were in the past. Kalyanaram and Winer (1995) states that numerous evidence in marketing literature shows that consumers rely on past prices as part of the reference price formation process. The categories with higher response rate by stores in the result reconciles to categories with products that are more difficult to form mental reference prices from past prices.

Price Elasticities

In this subsection we estimate the conventional price elasticities of consumers. There are mainly two purposes for the price elasticities. First, by calculating the ratio of the shrouded-tax treatment effect to the usual price elasticities, we obtain an indicator of what proportion of hidden sales tax the consumers take into account. Chetty et al. (2009) estimated this parameter to be 0.35. Second, we compare the price elasticities by categories in this subsection to the price reponse to the shrouded-tax treatment effect obtained in the last subsection. By doing so, we expect to figure out whether exploitative price raise concurrent with price display changes are related to the level of price elasticities.

We first estimate the price elasticity of overall sales. The regression equation is

$$\log\left(q_{jsw}\right) = elasticity \cdot \log\left(p_{jsw}\right) + \alpha_s + \gamma_j + weekFE + \epsilon_{jsw}, \tag{5.3}$$

where q_{jsw} is the total store sales quantity of product j in week w and the definition of the other variables are the same as in the previous subsection. Shown in table 5 is the result of the regression. The overall price elasticity in supermarket stores is 1.05. The estimated price elasticity, 1.05, is lower than 1.59, the value estimated by Chetty et al. (2009), and a large factor of this discrepancy is their experiment design. Their experiment was conductetd on "impulse purchase categories" – goods that exhibit high price elasticities – so that the demand response to the intervention would be detectable. On the other hand, our estimate of the price elasticity represents the purchase on all categories sold in supermarkets.

Table 3: The Shrouded Treatment Effect on Price by Product Category

	Dependent Variable: Weekly Product Price by Store (log)					
	Nationwide (4 weeks)			*Kanto Region (4 weeks)*		
	Coefficient	N	Unobserved Ratio	Coefficient	N	Unobserved Ratio
Vegetables	0.056*** (0.006)	137838	0.105	0.048*** (0.007)	40069	0.101
Fruits	0.008 (0.008)	25642	0.15	0.011 (0.01)	7053	0.139
Fish	0.008* (0.004)	97132	0.124	0.001 (0.005)	28357	0.123
Meats	-0.020** (0.008)	43718	0.106	-0.009 (0.009)	12414	0.089
Eggs	0.038*** (0.003)	12896	0.018	0.035*** (0.004)	3385	0.007
Cooked Food	0.004* (0.002)	143356	0.075	0.007** (0.003)	41511	0.069
Semi-Cooked Food	0.012*** (0.002)	45708	0.089	0.009*** (0.003)	11841	0.084
Bento Box	0.011* (0.006)	28116	0.132	0.011 (0.01)	5792	0.114
Beverages	0.000 (0.001)	900468	0.12	0.011*** (0.001)	240208	0.109
Processed Food	0.012*** (0.001)	2491148	0.1	0.015*** (0.001)	641861	0.082
Snacks	0.013*** (0.001)	1179142	0.117	0.017*** (0.001)	275526	0.094
Other Food	0.009*** (0.002)	66334	0.32	0.008*** (0.002)	17731	0.272

Table 4: Continued from Last Table

	Nationwide (4 weeks)			*Kanto Region (4 weeks)*		
	Coefficient	N	Unobserved Ratio	Coefficient	N	Unobserved Ratio
Utensils	0.028^{***} (0.002)	186444	0.39	0.030^{***} (0.002)	51760	0.380
Toiletries	0.020^{***} (0.002)	452384	0.279	0.040^{***} (0.002)	117320	0.227
Cosmetics	0.015^{***} (0.002)	158694	0.478	0.025^{***} (0.002)	38722	0.432
Medicine	0.033^{***} (0.004)	61002	0.407	0.025^{***} (0.004)	13599	0.375
Pet Supplies	-0.040^{***} (0.004)	168514	0.24	-0.048^{***} (0.004)	51365	0.205
Other Commodities	0.031 (0.028)	64	0.692	-0.004^{**} (0.002)	8	0.667
Stationery	-0.010 (0.007)	296	0.339	0.015^{*} (0.009)	71	0.343
DIY	0.050^{***} (0.005)	11034	0.333	0.058^{***} (0.007)	3393	0.310
Vehicle Supplies	0.128^{***} (0.034)	632	0.564	0.153^{**} (0.06)	58	0.561
Clothes	-0.002 (0.006)	1180	0.597	-0.002 (0.009)	240	0.562
Others	0.014 (0.013)	590	0.291	0.039 (0.053)	76	0.296
Product FE	x			x		
Store FE	x			x		
Week FE	x			x		
R^2	0.98			0.98		
N	6,158,428			1,979,534		

Note. (i) Standard errors are in parentheses. $^{*}p < 0.1$, $^{**}p < 0.05$, $^{***}p < 0.01$. (ii) The sample focuses two weeks before and after the change in price tags.

Table 5: Price Elasticity

	Dependent Variable: Weekly Sales Quantity of Product (log)
	Nationwide (4 weeks)
weekly log price	-1.049*** (0.033)
Product FE	x
Store FE	x
Week FE	x
R^2	0.63
N	7,802,552

Note. (i) Standard errors are in parentheses. $^{*}p < 0.1$, $^{**}p < 0.05$, $^{***}p < 0.01$. (ii) The sample focuses two weeks before and after the change in price tags.

Next, we estimate the price elasticity by product categories so that we can compare the values with the price response estimated in the last subsection. The regression equation is

$$\log\left(q_{jsw}\right) = \sum_{c \in C} elasticity_c \cdot \mathbb{I}\left\{j \in c\right\} \cdot \log\left(p_{jsw}\right) + \alpha_s + \gamma_j + weekFE + \epsilon_{jsw},$$

where the definition of the variables are the same as equation 5.2 and 5.3. Shown in table 6 and 7 are the results of the regression. As in the result table of the store responses in price levels, the ratio of the number of products dropped due to unobserved prices are reported in the third column of the table. Most of the price elasticities are around 1.1, but we see that ready-eat meals and some categories in consumer goods such as toiletries and medicine show a relatively higher absolute value of price elasticity.

We end this section by comparing the price elasticities and store responses in price levels to shrouded-tax treatment by product categories. Dots in figure 5.3 represent categories plotted on a plane with consumer price elasticity as the x-axis and store responses as the y-axis. Contrary to our intuition, stores raised their prices in categories where consumers have higher price elasticities when taxes are hidden. One reasoning is that price display change was one of the few chances to raise the prices of categories with higher price elasticities, since consumer would respond sharply to the usual price increases.

Table 6: Price Elasticities by Product Categories

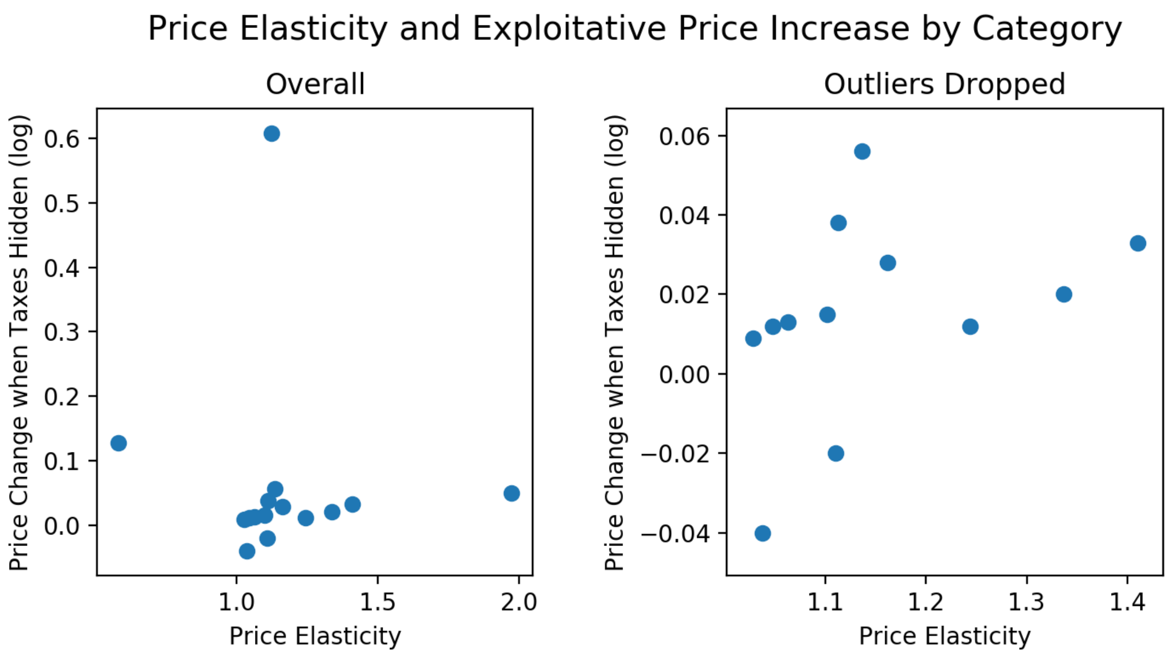
	Dependent Variable: Weekly Store-Product Sales Quantity (log)		
	Nationwide (4 weeks)		
	Price Elasticity	No. of Products	Unobserved Ratio
Vegetables	-1.136*** (0.038)	10418	0.421
Fruits	-1.070*** (0.036)	1791	0.572
Fish	-1.149*** (0.036)	7464	0.451
Meats	-1.110*** (0.033)	4118	0.347
Eggs	-1.113*** (0.040)	1447	0.162
Cooked Food	-1.160*** (0.036)	13471	0.324
Semi-Cooked Food	-1.244*** (0.034)	4067	0.347
Bento Box	-1.198*** (0.036)	2748	0.34
Beverages	-1.098*** (0.032)	67303	0.466
Processed Food	-1.047*** (0.032)	196210	0.427
Snacks	-1.063*** (0.032)	81186	0.498
Other Food	-1.027*** (0.034)	2527	0.767

Table 7: Continued from Last Table

	Price Elasticity	No. of Products	Unobserved Ratio
Utensils	-1.162*** (0.049)	5356	0.864
Toiletries	-1.337*** (0.061)	15537	0.782
Cosmetics	-1.101*** (0.042)	1663	0.952
Medicine	-1.410*** (0.231)	1079	0.889
Pet Supplies	-1.037*** (0.032)	6339	0.779
Other Commodities	-1.124*** (0.363)	5	0.857
Stationery	0.645 (0.427)	11	0.823
Diy	-1.973*** (0.222)	608	0.798
Vehicle Supplies	-0.583*** (0.190)	3	0.985
Clothes	-1.825 (1.116)	3	0.992
Others	-0.968*** (0.034)	27365	0.414
Product FE	x		
Store FE	x		
Week FE	x		
R^2	0.64		
N	7,802,552		

Note. (i) Standard errors are in parentheses. $^{*}p < 0.1$, $^{**}p < 0.05$, $^{***}p < 0.01$. (ii) The sample focuses two weeks before and after the change in price tags. (iii) The third and sixth columns show the ratio of number of products dropped in each category.

Figure 5.3: Relation between Price Elasticities and Price Responses to Shrouded-Tax Treatment

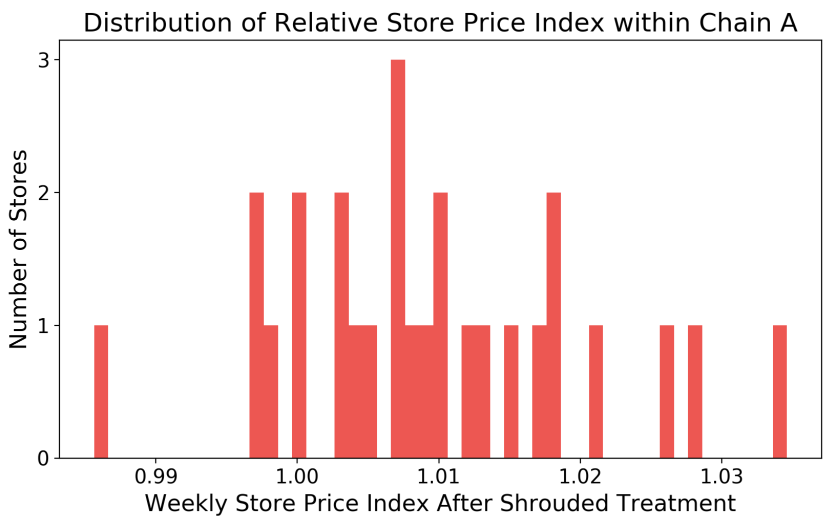


Note. (i) In both diagrams, the x-axis is the price elasticity of the product categories, and the y-axis is the coefficient estimated by equation 5.2. (ii) The diagram in the right side excludes the three outlier categories.

Endogeneity Concern

One possible concern of the estimation in section 4 is the bias caused by price endogeneity. To address this issue, we picked the stores of which the fluctuation of the price index stayed within 0.3% over the price display change. Since the pricing decisions were left to the store managers, there were variation in how much to increase their prices after the headquarter of the chain decided to hide the sales tax in all stores. As we see from figure 5.4, 5 out of 27 stores of chain A matched the criteria. The result was the same as before: consumers strongly underreacted to shrouded sales tax on their first visits and adjusted such underreaction on second visit onwards, but the response towards the treatment stayed significantly above zero.

Figure 5.4: Histogram of Price Index Fluctuation after Shrouded-Tax Treatment



Note. (i) The x-axis of the diagram is the Laspeyres store price index of the week immediately after the treatment, and the preceding week is set as the reference week. (ii) A product is dropped from the index if its price is not observed at least once every week.

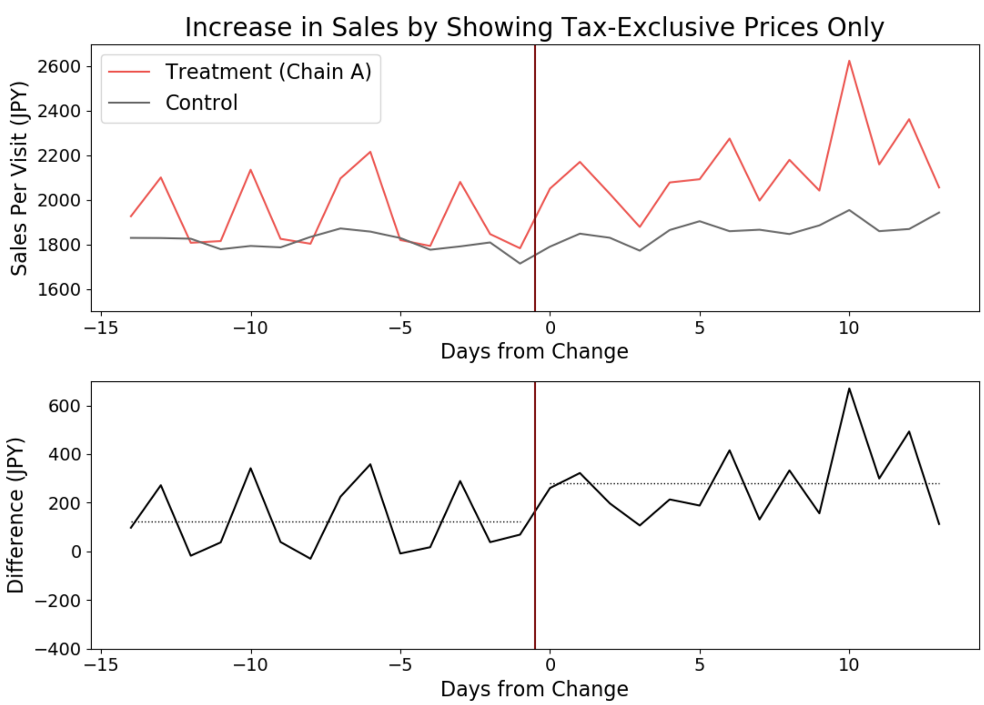
6 Shrouded-Tax Treatment and Two-Price Treatment

This section focuses on the difference of consumer reponse to the shrouded-tax treatment and the two-price treatment. The shrouded-tax treatment effect is what Chetty et al. (2009) measured in their experiment in a single store. We also estimate the two-price treatment effect, where chains switched their prices they display from tax-inclusive prices to both tax-inclusive and tax-exclusive prices. Since tax-inclusive price is included in the price tags both before and after the two-price treatment, it only adds information on what portion of the whole price is sales tax, and should not influence a rational consumer. The literature of partitioned pricing, however, suggests that writing down shipping costs for online shopping and surcharge fees for airline tickets seperately causes the demand to be higher. The analysis on two-price treatment provides evidence if the same could be said for sales tax.

Transition of Average Sales Per Visit

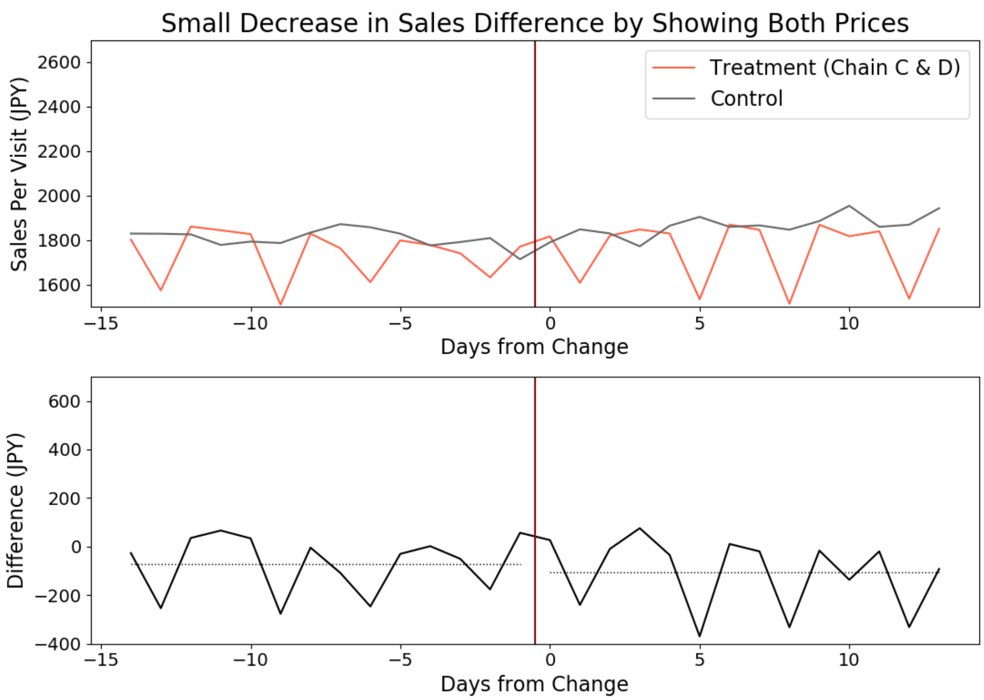
Figure 6.1 and 6.2 shows the transition of average sales per individual store visit in the national data. The vertical lines show the timing of changes in price tags by the treatment chains. Figure 6.1 indicates that the shoppers in the treatment chain started spending more per visit after it started to display tax-exclusive prices instead of tax-inclusive prices compared to the shoppers in the control group. On the other hand, we see from figure 6.2 that shoppers in chains that started showing both prices spent slightly less compared to the control group.

Figure 6.1: Transition of Average Sales Per Visit : Pre-tax Treatment



Note. (i) The y-axis represents the daily average of sales value in each individual consumer store visit. (i) The dotted lines in the bottom diagram indicates the average difference before and after the treatment. (ii) 2,000 JPY amounts to 18.30 USD as of October 2019.

Figure 6.2: Transition of Average Sales Per Visit : Two-Price Treatment



Note. (i) The y-axis represents the daily average of sales value in each individual consumer store visit. (i) The dotted lines in the bottom diagram indicates the average difference before and after the treatment. (ii) 2,000 JPY amounts to 18.30 USD as of October 2019.

Regression Equation

We take a closer look to the tax salience effect shown in previous figures by difference-in-difference estimation. The samples are taken from two four-week periods, two weeks before and after October 1, 2013 and February 1, 2014 in all five chains. The regression equation is

$$\log\left(sales_{ik}\right) = \beta_s shroud_{ik} + \beta_t twoprice_{ik} + \alpha_i + timeFE + \epsilon_{ik},$$

where

- $sales_{ik}$: total sales of individual i at store visit k
- $shroud_{ik}$: indicates that the consumer faced tax-exclusive price tags
- $twoprice_{ik}$: indicates that the consumer faced both tax-exclusive and tax-inclusive prices
- α_i : individual fixed effect.

The time fixed effects are the same as equation 4.1 in section 4.

Result

Shown in table 8 are the results of the regression. It suggests that showing tax-exclusive price tags instead of tax-inclusive ones increases expenditure on a single store visit by 4.7% on average, while showing both prices actually decreases expenditure by 1.0%.

Although the estimation on two-price treatment shows that it shrinks consumer basket size by 1%, this was likely caused by the increase in sales values by the control group. Figure 6.2 shows that there were no change in individual sales per visit to the treatment group before and after the two-price treatment took place. The majority of evidence in past research on partitioned pricing such as Morwitz et al. (1998), Xia and Monroe (2004), and Hossain and Morgan (2006), shows that consumer demand increases when certain fees are showed seperately from the base price. Our result on the other hand, suggests that displaying both the base price and the total price and thus notifying the consumers the portion of sales tax does not increase individual spending.

7 Tax Salience Effect by Consumer Characteristics and Purchase Patterns

Another topic we explore is how tax salience effect varies depending on individual's characteristics. Since our analysis is based on supermarket scanner data that does not include any individual

Table 8: The Price Tag Treatment Effect on Individual Sales

	Dependent Variable: Individual Sales Per Visit (log)					
	Nationwide (4 weeks)			*Kanto Region (4 weeks)*		
	(1)	(2)	(3)	(4)	(5)	(6)
Treatment (Pre-tax)	0.047*** (0.001)	0.047*** (0.001)	0.047*** (0.001)	0.047*** (0.002)	0.046*** (0.002)	0.046*** (0.002)
Treatment (Both)	-0.009*** (0.001)	-0.010*** (0.001)	-0.010*** (0.001)			
Store FE	x	x	x	x	x	x
Period FE	x	x		x	x	
Weekday FE	x	x		x	x	
Weekday FE		x			x	
Day FE			x			x
R^2	0.54	0.54	0.54	0.59	0.59	0.59
N	12,525,420	12,525,420	12,525,420	3,504,080	3,504,080	3,504,080

Note. (i) Standard errors are in parentheses. $^{*}p < 0.1$, $^{**}p < 0.05$, $^{***}p < 0.01$. (ii) The sample focuses two weeks before and after the change in price tags.

characteristics, we rely on city-level data and consumer purchase patterns. To analyze how tax salience effect varies according to income, we match stores with city-level data to obtain average income of the consumers. We also categorize consumers by beer purchase patterns and the time of the day they visit the stores. The first purchase pattern likely reveals how cost concious consumers differ from the others, and the latter compares those who visit during regular working hours to those who do not.

7.1 Tax Salience Effect by Average Income

In order to investigate the relation between income level and the shrouded-tax treatment effect, we match city-level average income per tax payer[4] to the cities the stores are located. We then run a diff-in-diff regression similar to the previous section, but this time with coefficients for each income level. The regression equation is

$$\log\left(sales_{ik}\right) = \sum \beta_m \cdot \mathbb{I}\left\{i \text{ visited store } s \text{ in city with average income } m\right\} \cdot shroud_{ik} + \alpha_i + dateFE + \epsilon_{ik} \tag{7.1}$$

It is difficult to say how income level affects the strength of tax salience effect by intuition. The same amount of sales tax hits consumers with lower income harder and they may be more aware of hidden taxes, but consumers with higher income may be better in calculating the total price with sales tax. The results are shown in figure 7.1. We see that consumers in cities with higher average income has lower effect to the treatment, i.e., incorporate hidden taxes more into their decision making.

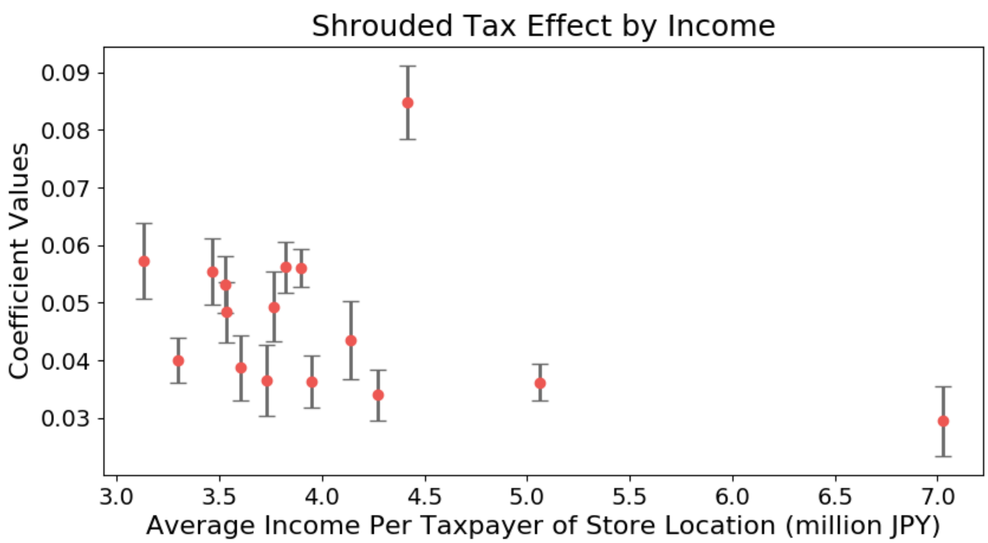
Now that we know consumers with lower-income are more prone to tax salience effect, the question that arise is by how much. We run a regression with the interaction term with the shrouded-tax treatment dummy and the income level instead of dividing up the coefficients for each income level. Shown in table 9 are the results of the regression. It shows that doubling the average income decreases the shrouded-tax treatment effect on individual sales value by 2.5 percentage points. This result is contrasting with that of Goldin and Homonoff (2013), which states that only low-income consumers respond to cigarette taxes levied afterwards at the register.

7.2 Tax Salience Effect by Purchase Patterns of Beer-Like Beverages

The previous subsection reveals how income affects the tax salience effect, but does not necessarily capture the behavior of cost-conscious consumers. We now turn to the purchase patterns observed in the data to uncover the relation between response to hidden taxes and cost consciousness.

[4] Average income per tax payer of each city is obtained from the public data by the Ministry of Internal Affairs and Communications

Figure 7.1: Shrouded-Tax Treatment Effect by City-level Average Income of Store Locations



Note. (i) The y-axis is the level of β_m in equation 7.1 (ii) The bars represent the 95% confidence intervals of the estimates.

Table 9: Treatment Effect with Interaction Term on Individual Sales

	Dependent Variable: Individual Sales Per Visit (log)		
	Kanto Region (4 weeks)		
	(1)	(2)	(3)
Treatment (shrouded)	0.366^{***}	0.403^{***}	0.423^{***}
	(0.102)	(0.102)	(0.101)
Treatment (shrouded) * log(income)	-0.021^{***}	-0.023^{***}	-0.025^{***}
	(0.007)	(0.007)	(0.007)
Individual FE	x	x	x
Period FE	x	x	
Weekday FE	x	x	
Weekday FE		x	
Date FE			x
R^2	0.59	0.59	0.59
N	3,504,080	3,504,080	3,504,080

Note. (i) Standard errors are in parentheses. $^{*}p < 0.1$, $^{**}p < 0.05$, $^{***}p < 0.01$. (ii) The sample focuses two weeks before and after the change in price tags.

Liquor Taxes on Beer-Like Beverages

In Japan, liquor tax imposed on beer is disproportionately high compared to other liquors with the same alcohol degree, and this has led beer companies to produce substitutes with similar tastes that are not legally classified as beer to avoid higher taxes. Legal categories and liquor taxes imposed on these alternatives are shown in table 10. There are clear tiers of perceived qualities and prices among beer and substitutes. Consumers who can afford relatively higher prices and particular about the bitterness of malts tend to buy "real" beer, while others make compromise and settle with lower-tier substitutes. Buyers of lower-tier substitutes can generally be regarded as cost-conscious consuemrs who are willing to sacrifice the authenticity of beer for the amount they pay.

Table 10: Characteristics of Beer-Like Beverages in Japan

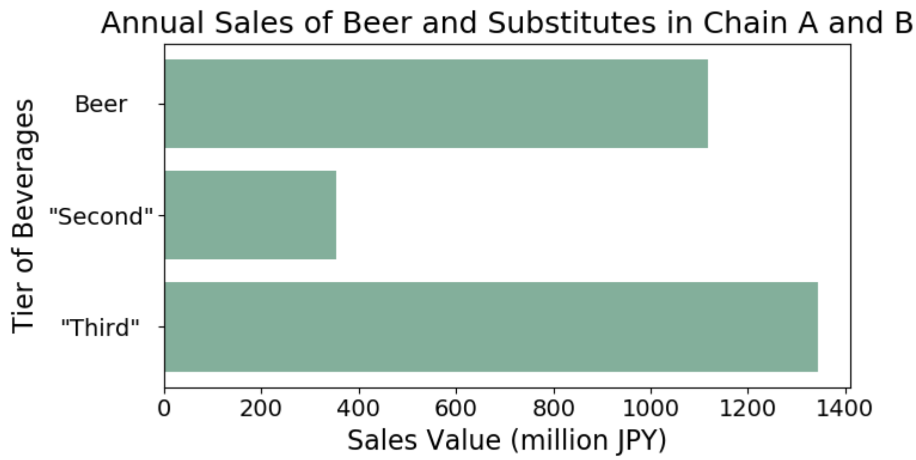
	Beer	"Second Beer"	"Third Beer"	
Liquor Tax (JPY per 500ml)	110	67	40	
Price of Best Seller (500ml can)	251	175	151	146
Legal Category	Beer	Low-Malt Beer	Others	Liqueur
Production Method	Brew	Brew	Brew	Blend
Proportion of Malts	$\geq 67\%$	$< 67\%$	0	N/A

Share of Beer Substitutes

Beer substitutes have major shares in Japan. Figure 7.2 shows sales of each alternative compared to beer. The "third beer" was first introduced in 2004 follwing the raise in liquor tax targeted towards low-malt beers, and started taking over the market share of low-malt beers since then.

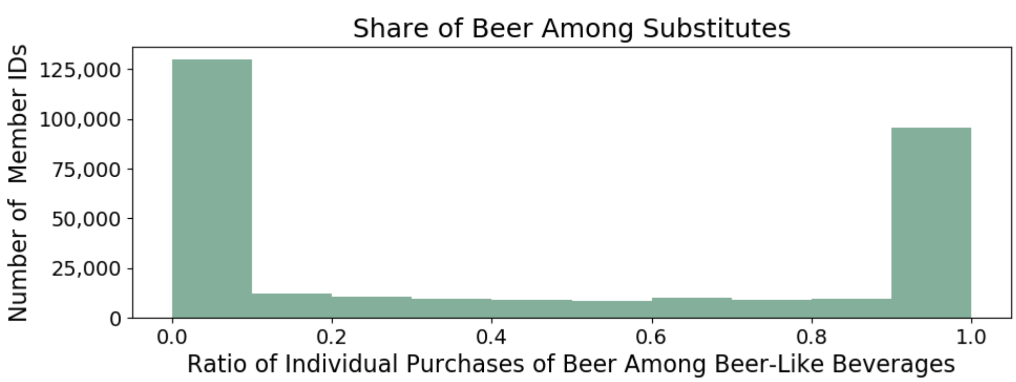
Consumers tend to stick to one type of beer-like beverages. 7.3 is a histogram showing how each consumer purchases "real beer" instead of cheaper substitutes, and we see there is a polarization in consumption pattern. In the following estimation, we seperate consumers depending on what type of beer-like beverages they purchased the most in terms of sales value from February 15, 2013 to February 14, 2014.

Figure 7.2: Sales Values of Beers and Alternatives in Chain A and B, from Feb 15, 2013 to Feb 14, 2014.



Note. (i) The definition of each tier is given in table 10.

Figure 7.3: Beer Sales Ratio of Each Consumer in Chain A and B, from Feb 15, 2013 to Feb 14, 2014.



Note. (i) The x-axis represents the sales share of “real” beer as opposed to “second” and “third” beers within each individual. (ii) A large number of consumers purchased this type of beverages only once.

Regression

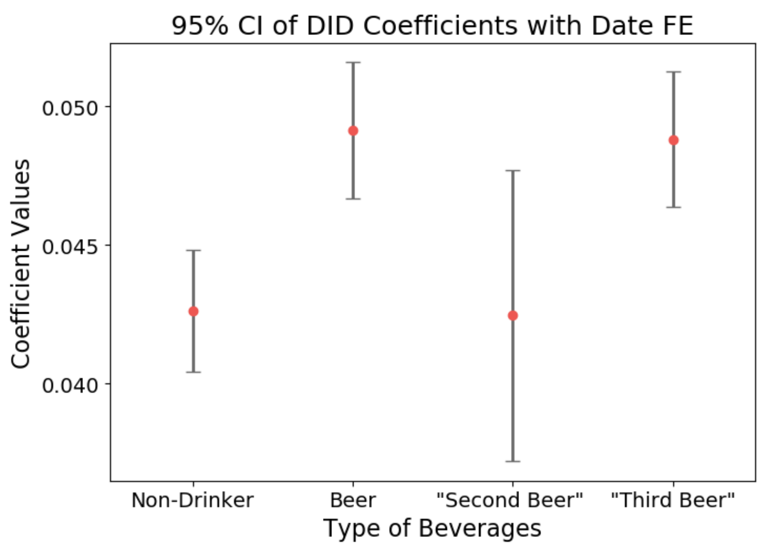
To see how cost-conscious consumers respond differently from others to shrouded-tax treatment, we again run a diff-in-diff regression with coefficient for each beer type. The sample data used is the sales record of chains A and B in Kanto Region, within a sample period of two weeks before and after February 1, 2014, when chain A changed its price display policy. This time coefficients are seperated for each type of beer-like beverages the consumers purchased the most for the previous year:

$$\log\left(sales_{ik}\right) = \sum_{l \in L} \beta_l \cdot \mathbb{I}\left\{i = l\right\} \cdot shroud_{ik} + \alpha_i + dateFE + \epsilon_{ik}, \tag{7.2}$$

where $L = \{NonDrinker, Beer, Second, Third\}$.

The results are shown in figure 7.4. There were no large differences in the result by changing the specifications of the time fixed effects. We see that there are no significant differences in tax salience effect among buyers of beer and substitutes, but the effect towards individuals who did not purchase beer-like beverages in a year is significantly lower compared to beer consumers. We do not find any evidence that cost-conscious consumers are less vulnerable to tax salience effect, but the result suggests that alcohol consumers may fail to take into account hidden taxes more due to impulsive decision making compared to non-drinkers.

Figure 7.4: Shrouded-Tax Treatment Effect by Type of Beverage Customer Purchased

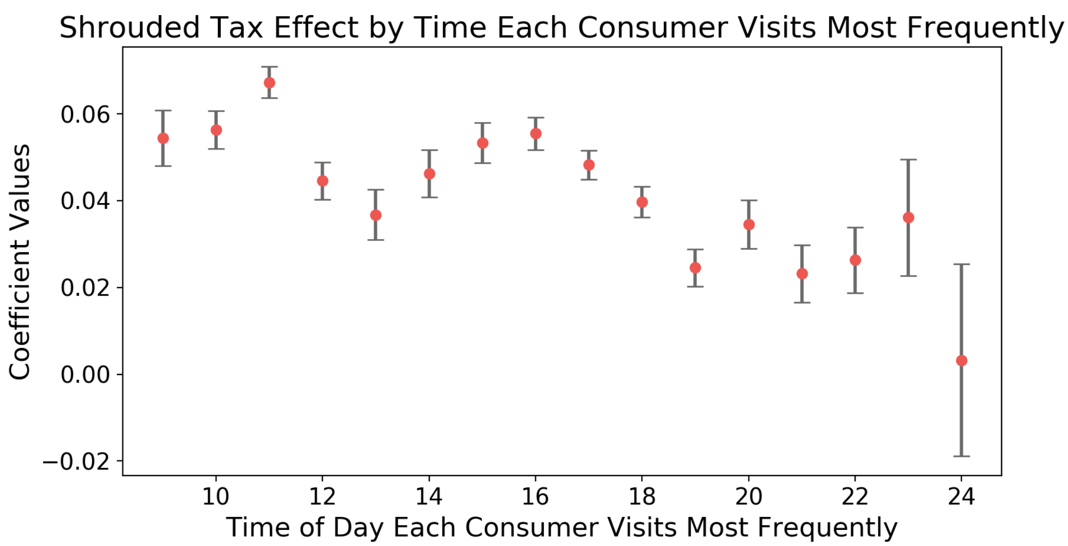


Note. (i) The y-axis is the level of β_l in equation 7.2 (ii) The bars represent the 95% confidence intervals of the estimates.

7.3 Tax Salience Effect by Time of Day

Finally, we estimate how the shrouded-tax treatment differs by the time of day consumers visit the stores. We group each consumer by the time of the day she visits the stores most frequently and allocate treatment coefficient to each group. The result is shown in figure 7.5. Consumers who visit in the morning and in late afternoon seems to have been more vulnerable to the treatment of hiding taxes, while consumers who visit the stores in early afternoon possibly for lunch and in the evening are less prone to the tax salience effect. Consumers who visit the stores in the morning and early afternoon are likely to be people who do not work on regular work hours, such as retired people and stay-at-home parents.

Figure 7.5: Shrouded-Tax Treatment Effect by the most frequent time of day consumers visit stores



8 Change in Store Visits

We have so far concentrated on the intensive margin, or how a store visitor shifts her purchase behavior. In this section, we shift our focus on the extensive margin and see how the number of store visitors is affected by different tax display policies. We implement a difference-in-difference estimation by regressing the number of weekly store visitors on both two-price treatment dummy and the shrouded-tax treatment dummy. Shown in table 11 are the results of the regression.

We see that the number of store visitors decreases by 4.9% when stores omit sales tax from price tags, while showing both prices have no impact. This is an evidence that consumers actually care

Table 11: Treatment Effect on Number of Visitors with Loyalty Cards

	Dependent Variable: Number of Store Visits (log)		
	Nationwide (4 weeks)		
	(1)	(2)	(3)
treatmentboth	0.000	0.005	0.004
	(0.010)	(0.010)	(0.011)
treatmentpretax	-0.060***	-0.052***	-0.049***
	(0.009)	(0.009)	(0.009)
Individual FE	x	x	x
Period FE	x	x	
Weekday FE	x	x	
Week FE		x	
Date FE			x
R^2	0.97	0.97	0.97
N	7,222	7,222	7,222

Note. (i) Standard errors are in parentheses. $^{*}p < 0.1$, $^{**}p < 0.05$, $^{***}p < 0.01$. (ii) The sample focuses two weeks before and after the change in price tags.

whether the total prices are shown upfront and are less likely to visit stores that hide the sales tax. One thing to notice when interpreting this result is that the treatment groups were one of the very first supermarket chains to adopt the new price tags after the legal reform. Eventually most stores adopted the price display policy that hides the sales tax. We expect that consumers do not decrease their store visits as drastically as in the result when all stores apply the same tax display policy.

9 Conclusion

Our main analysis investigated the consumer response to shrouded-tax treatment by the number of visits to supermarket stores. The estimation shows that the tax salience effect works particularly strong on the first visit and falls steeply on the second visit, but remains relatively constant above zero in the subsequent visits. This suggests that consumers learned that the price tags did not include taxes when they paid the actual amount on the first visit, but gave limited attention to sales tax afterwards.

We also examined how stores shift their prices when the affiliated supermarket chains modifies their price display policies. Our estimation shows that when the chain decides to hide taxes in their price tags the stores raise the prices by an average of 1%, while the stores that had to post both tax-inclusive and tax-exclusive prices did not change their prices. The product categories with higher price elasticity of demand experienced higher increase in prices when the chain adopted the tax-exclusive price display policy.

The third analysis examined how two types of treatments differed in the effect towards individual purchase amount. We find that the shrouded-tax treatment increases sales value of each visit to a supermarket by 4.7% on average, and two-price treatment does not increase the purchase amount of consumers.

Lastly, we analyzed how the tax salience effect differs across consumers by average income and purchase patterns of beer-like beverages, and the most frequent time of the day they visited. The regression result with the interaction term with income shows that doubling the average income decreases the effect of hiding taxes on individual sales value by 2.5 percentage points. There were no significant differences in the response towards tax salience among buyers of beer and its alternatives, but consumers who have not bought any of them over the past year were affected significantly less. We also found that the under-reaction to hidden taxes were stronger for consumers who visit the stores in the morning and early afternoon.

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