Size Matters – How Consumers' Energy Drink Consumption Is Affected by Package Size Changes

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September 16, 2018

Abstract

Our paper examines the demand expansion process of energy drinks for regular users via an important test case: the introduction of large package size energy drink by Red Bull. We build a demand model on consumers' choices on energy drinks. In particular, we are interested in how consumers responded to Red Bull's new product and what are the short term and long term effects on consumers' energy drink consumptions. The goal of this paper is to examine the impact of new product introduction on consumers' demand on energy drinks. We focus on two possible complementary mechanisms that may have played a role in the energy drink market. First, comparing the existing products, a new package with larger volume provides quantity discounts for the same product with smaller sizes. Lower unit price encourages consumers to switch to the new product and switch from other brands. Second, consumption habits could be playing an important role in the market of energy drink. If this is the case, the introduction of large size Red Bull could have long term consequences in increasing consumers' energy drinks consumption. We find that without the introduction of 12 oz and 16 oz Red Bull drinks, the regular users would decrease their consumption by 15%. The effect is even stronger for young consumers, that would decrease energy drink consumption by 17% on average.

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1 Introduction

Today, packaging is more than just the conainer that holds products. The increasing amount of new package design enables firms to better communicate the benefits for their products, to differentiate from their competitors, and even to adapt to the consumers' changing consumption patterns. For example, in response to the persistent decline of soda consumption, Coca Cola introduced smaller packages to sell less of its product at a higher price. Comparing with a regular 12-ounce can of coke on average sell for 31 cents, a 7.5 - ounce can of coke on average sell for 40 cents. This tactic works for Coca Cola since it is beneficial for today's consumers who is more likely to be health-concious than in the past. "Mini-cans" let consumers indulge without consuming as many calories as they would from a regular can of soda. While many firms are using package - downsizing strategies, including examples from yogurt, icecream, tuna and peanut butter etc, another soft drink company – Red Bull, adopted the opposite strategy by introducing larger package size of its product – energy drinks. Energy drinks are beverages that contain high caffeine in combination with other ingredients such as taurine, guarana, and B vitamins, and that claims to provide its consumers with extra energy. It began being marketed as a separate beverage category in the United States with the introduction of the Austrian import Red Bull in 1997 (MartinReport). Energy drink consumption and sales have increased dramatically since then. Energy drinks have become a multibillion-dollar business, with steadily increasing sales that rose 16% in 2012 alone, amounting to a US sales market worth more than $12.5 billion.[1]Teenagers and young adults are target consumer group for energy drinks. Consumption of energy drinks by children and teens has been a growing trend; a 2012 study of U.S. high school students revealed that energy drinks represented 8.8 % of the sugar-sweetened beverages they consumed. [2]Another U.S. study found that 31% of 12-17 year olds regularly drink energy drinks, in comparison to 22 percent of 25-35 year-olds.[3]

The energy drink manufacturers create youth themes and marketing strategies to target the energy drinks' young consumer base. They create their brand image by using dramatic product names (e.g., Cocaine, DareDevil, Bawls, Pimp Juice, Rip It, and Monster Assault), edgy graphics on containers, and sponsorships of extreme sporting events and lifestyles, such as wakeboarding, skateboarding, motocross, and surfing.10

[1]Energy Drinks and Shots: U.S. Market Trends, Packaged Facts, Feb. 11, 2013

[2]Park, S., Blanck, H.M., Sherry, B., Brener, N. and O'Toole, T. (2012) Factors associated with sugar-sweetened beverage intake among united states high school students. Journal of Nutrition 142(2): 306–312

[3]Simon, M. and Mosher, J. (2007) Alcohol, Energy Drinks, and Youth: A Dangerous Mix. California: Marin Institute.

They associate the energy drink with rebelion, risk taking and adventure seeking. The manufacturers keep introducing new products. (some example from Annual Report). For instance, the leading brands Monster and Rockstar releasing new products to the market. They introduce products with new flavors and higher concentrations of caffeine. On the other hand, instead of introducing new flavors, Redbull increase the product size from 8.2 oz to 12oz and 16oz to encourage consumers to buy higher volume of the energy drink.[4]

Our paper examines this demand expansion process of energy drinks for regular users via an important test case: the introduction of large package size energy drink by red bull. We build a demand model on consumers' choices on energy drinks. In particular, we are interested in how consumers responded to red bull's new product and what are the short term and long term effects on consumers' energy drink consumptions. The goal of this paper is to examine the impact of new product introduction on consumers' demand on energy drinks. We focus on two possible complementary mechanisms that may have played a role in the energy drink market. First, comparing the existing products, a new package with larger volume provides quantity discounts for the same product with smaller sizes. Lower unit price encourages consumers switch to the new product and switch from other brands. Second, consumption habits could be playing an important role in the market of energy drink. If this is the case, the introduction of large size red bull could have long term consequences in increasing consumers' energy drinks' consumption. We use household purchase data and store level data from A.C. Nielsen from 2006 to 2009. Our results show that with the introduction of large size package from red Bull, consumers' purchase on energy drinks has significant increases, especially for the younger families in long term. We find that without the introduction of 12 oz and 16 oz Red Bull drinks, the regular users would decrease their consumption by 15%. The effect is even stronger for young consumers, that would decrease energy drink consumption by 17% on average.

2 Beverage caffeine intakes in the U.S

Recently the media has reported on the significant concern raised by both health care professionals and government officials surrounding the quantity of caffeine incorpo-

[4]Upsizing is not a unique phenomena for Red Bull. By 1990, U.S. fountain drink sizes had grown more than 50 percent. In 1994, Coke introduced the 20-ounce plastic bottle, a serving size that was more than three times bigger than its original 6-ounce glass one. Source:http://www.bloomberg.com/bw/articles/2014-07-31/coca-cola-sales-decline-health-concerns-spur-relaunch

rated into energy drinks[5]. Increasing amounts of caffeine are being introduced into the U.S. diet and the Food and Drug Administration (FDA) has commented that it will be investigating the addition of caffeine to food products. In 2010 the FDA commissioned an in-depth analysis of caffeine consumption in the U.S. population. The report estimated the average caffeine intake of adults to be 300.7 mg/day. Regular coffee drinkers, accounting for 54% of the adult U.S. population at the time of the report in 2010, are estimated to consume an average of 374.7 mg/day of caffeine from coffee alone. This represents 93.7% of the FDA cited maximum safe daily allowance. This does not take into consideration other sources of caffeine such as tea, carbonated soft drinks and energy drinks which together account for approximately 30% of total daily caffeine intake.[6] Carbonated soft drinks and tea provided a greater percentage of caffeine in the younger age groups. However, The percentage of energy drink consumers across all age groups was lower than 10%.

Energy drinks have been the subject of a lot of controversy recently. From claims of false advertising to disturbing news about deaths that followed energy drink consumption. Although there is debate regarding the overall risks and benefits of energy drink and moderate caffeine consumption, health researchers agree that caffeine consumption can have adverse health consequences, particularly at high doses. Among the most common negative effects are increased anxiety, panic attacks, increased blood pressure, increased gastric acid, bowel irritability, and insomnia. With the rising popularity of energy drinks and with more young people ingesting high levels of caffeine, more serious health problems are now being reported in the nation's poison centers, while reports from other countries suggest potentially serious consequences from caffeine overdose. To response public health concerns, the Federal Government calls for input on regulation of caffeinated energy drinks.[7]

3 Literature

Although package innovation is an important aspect of product innovations, there is limited empirical research on this topic. Experimental ressearch on the effects of package size on consumption generally predicts that larger package size leads to higher food consumption (Wansink (1996), Chandon (2013)). Wansink & Kim (2005) show

[5]Durbin R, Blumenthal R. Letter to The Food and Drug Administration Commissioner Margaret A. Hamburg: The health concerns around energy drinks. Washington, D.C; 2012.

[6]Caffeine Consumption and Implication, 2013, by Nicholas A. Williams

[7]see from http://www.abc.net.au/news/2013-09-03/government-to-examine-caffienated-energy-drink-regulation/4929964.

that people eat more when whey are served with larger portion sizes in their experimental study. Young & Nestle (2002) also shows that the expanding portion size in food has long term consequences and leads to obesity epidemic. Our paper is able to provide the linkage between the short term and long term effects in energy drink consumption with increasing portion size provided by the energy drink manufacturers. We incorporate habit formation (Erdem (1996)) by which past purchases affect current choice via habit persistence.

In recent years, there has been increasing interests in studying the perceived benefits and risks associated with energy drink consumption in public health. For instance, Attila & Çakir (2011) find that the college students who regularly consume energy drinks are more engaged in sports. About 40% of energy drinks users mixed energy drinks with alcoholic beverages. Alsunni & Badar (2011) finds that the commonest reasons for use were company of friends, to keep awake, for more energy and for better performance in driving, sports or exams. Amongst many the commonest benefit reported was ability to stay awake longer. The students reported a number of adverse effects including urination and insomnia for males and females respectively. In most studies, the survey data were collected by the researchers. The results are based on consumers' self-reported purchase and consumption patterns. In contrast, our research is based on household scanner panel data that records consumers' purchase behavior accurately. Our model builds on literature using household scanner panels estimate expected demand with discrete choice models Guadagni & Little (1983), Chintagunta (1993), , Dube (2004)). We use a structural approach that allows for consumers' choices on brands, package size and purchase quantities. Comparing with Dube (2004), our specification of the model allows the probability of purchasing a product to depend on the observable characteristics of other product: for example, for the same red bull regular energy drinks, if the price of 16 oz 1 can drink decreases, the probability of household purchasing 8 oz 1 can drink will be affected. This specification advantage is crucial for our paper since the interplay of different packaging of products is our main focus.

4 Data

Our main data source for consumers' purchases of energy drinks is individual-level homescan and store-level data from Kilts-Nielsen Consumer Panel Dataset. The homescan consumer-level data are from a panel dataset that tracks the shopping behavior of approximately 60,000 households from 2006 through 2009. The households are from

54 Scantrack markets. Their demographic information is recorded annually, including age, education, household size, income, marital status, employment, type of residence and race. The panel data provide information about each shopping trip by the panelists. We observe the time of purchase, store code, UPC code, price, promotion and purchase quantity of each item.

We use each unique brand-can size-multi-pack pair to define a product. We keep the six major umbrella brands in the individual dataset, resulting in 96 products in the estimation sample. Table 3 shows the market share and average price of major products from 2006 through 2009.

We use store-level data to construct the price matrix of the choice set that each household faces every week. We construct a different price matrix for each of four different regions: East, Central, South and West. Figure 1 shows prices for one 16 oz can of Monster in the four regions, indicating a significant variation in prices across regions. The price index for each product in each week of a particular channel type in a region is computed by dividing its total revenue by its total sales. We merge store-level data with individual-level data using region-channel type-week-product to construct the estimation sample. For item purchased, the correlation between the price index constructed from the store- level data and the actual price paid from individual-level data is 0.9894. This high correlation indicates that our price index is reasonable.

In this paper, we focus on consumers' purchase decision on energy drinks. From 2006 to 2009, 12,626 households bought energy drinks at least once. Among these households, 5,774 of them (around 46%) bought energy drink only once during this time period, and 2001 of them (around 16%) bought energy drinks twice during this time period. 1,617 of them (around 12%) are heavy users who bought energy drinks at least 10 times during this period. We keep households that have bought at least three weeks of energy drinks a year and, in total, have at least ten purchases of energy drinks, resulting in 590 households in the estimation sample.

The introduction of the large size red bull potentially could impact both the non-users of the energey drinks and the regular users. Figure 2 shows the number of adopters of energy drinks over time. We observe strong seasonal patterns, in which the number of first time energy users is higher during summer. However, there is no significant change of pattern in terms of adoption around the time larger size red bull is introduced. Therefore we focus on the purchase decision of the regular energy drinks users and do not model the adoption decision in our paper.

5 Model-free Evidence

To look at model-free evidence, we examine loyal Red Bull households (that bought only the one brand, that bought at least three weeks during the sample period and that bought Red Bull in 2006). We use the first week of 2007 as the week when larger-sized Red Bull was introduced. We take whether household h decides to buy energy drinks in month t as exogenously given.The sample consists of 169 households. Table 4 shows the purchase pattern of these loyal households after the larger-sized Red Bull was introduced. In the first column of Table 4, we conduct a fixed-effect regression of the logarithm of the weekly purchase amount of the Red Bull on larger-sized dummy, controlling for time trend (adding year dummies in the fixed-effect regression). We could see that households' monthly volume increase by 13% after the introduction of the larger-sized Red Bull. To decompose the effect of this volume increase into the effect of the can size increase and the effect of the number of can changes, we conduct fixed- effect regressions of the logarithm of the average can size and of the logarithm of the number of cans of energy drinks on the size-increase dummy (households that had already bought larger-sized Red Bull), controlling for time trend (adding year dummies in the fixed-effect regression) in the second and third columns of Table 4. Results show that households, on average, switched to the larger-sized cans of Red Bull, but they did not significantly change the number of cans that they bought. This result demonstrates that the larger size is the main reason for the increase in the purchase volume of energy drinks and that there is no substitution effect between can size and the number of cans purchased.

Figure 6 provides model-free evidence of the impact of the introduction of larger-sized energy drinks on sales using store-level data. The top figure in Figure 6 plots the weekly volume sales (defined as product of sales, number of cans per pack and size) of Red Bull and Monster in New York and in Los Angeles in 2006 and 2007. The larger- sized Red Bull (12 oz) was introduced in New York near the end of 2006. Compared with New York, very few stores in Los Angeles carried 12 oz Red Bull drinks (According to the bottom figure in Figure 6, less than 20% of stores in Los Angeles carried the 12 oz Red Bull drinks, while more than half of New York stores carried them). The top figure of Figure 6 shows a sharp increase in the weekly volume sales of Red Bull in New York, while the trend of the weekly volume of sales of Red Bull in Los Angeles and that of Monster in both New York and Los Angeles are relatively flat.

Figure 7 presents the weekly total energy drink consumption of the top ten percent heavy drinkers. There is a significant increase after the introduction of larger-sized

Red Bull at the beginning of 2007.

To look at whether the increase in Red Bull purchases are by existing Red Bull drinkers, we regress the total weekly purchase volume of heavy users of energy drink (whose total purchase volume is among the top tenth percentile of all consumers) on the introduction dummy (first week of 2007 and afterwards). Table 5 shows the regression result: the total weekly purchase volume of Red Bull significantly increased after the introduction of larger- sized Red Bull, even after controlling for the time trend.

6 Model

6.1 Model Setup

We use a utility framework that considers households's product and quantity choices. Similar to Lambrecht et al. (2007), we assume that the consumers chooses a product among the set offered by the store she visits. The product choices is a discrete choice that reflects the expected utility given the optimal quantity choices. A consumer's continous decision on purchase quantity is conditional on her product choice. The model is set up as follows: household h decides at week t whether to purchase a product j and how much to purchase at each week. We define product j as a combination of brand, bottle size and package size. For example, a choice alternative could be one 4-can 8oz Red bull energy drink.

We assume that household h in week t chooses a purchasing quantity for energy drinks of product j ,q_{hjt}, and the outside good q_{h0t} to maximise its utility subject to budget constraints. We assume that the utility on product j is represented by the following quadratic utility function:

$$u(q_{hjt}) = \frac{1}{\alpha_h}(d_{hjt}q_{hjt} - \frac{q_{hjt}^2}{2}) + q_{h0t} + \epsilon_{hjt} \tag{1}$$

with the following constraints: budget constraint:

$$y_{ht} = q_{h0t} + p_{jt} * q_{hjt} \tag{2}$$

and

$$q \geq 0 \tag{3}$$

where d_{hjt} is specified as follows:

$$d_{hjt} = \vec{\beta}'_{1hj}\vec{S} + \vec{\beta}'_{2hj}\vec{M} + \vec{\beta}'_{3hj}\vec{B} + \vec{\beta}'_{4t}\vec{Qtr} + \gamma_{1hj}S_p + \gamma_{2hj}M_p + \gamma_{3hj}B_p + \omega_{hjt} \quad (4)$$

Where $\vec{S}$ are can size dummies of product j; $\vec{M}$ are can multi- pack dummies of product j; and $\vec{B}$ are brand dummies of product j. p indicates the week when the last non-zero purchase of energy drinks occurred. S_p,M_p and B_p are dummies indicating whether the product purchased in week p belongs to the same can size, pack size and brand of product j.

ω_{hjt} is the unobservable quantity demand shocks of household h for product j in week t, which is assumed to follow a normal distribution with mean 0 and standard deviation σ. ϵ_{hjt}, on the other hand, is unobservable preference demand shocks of household h for product j in week t, which is assumed to follow a type 1 extreme value distribution.[8]

Conditional on choosing product j, household h's optimal purchase quantity q^*_{hjt} is given as follows,

$$q^*_{hjt} = \max[0, d_{hjt} - \alpha_h P_{jt}] \quad (5)$$

Hence

$$E_\omega(u(q^*_{hjt})) = E_\omega[(\frac{(d_{hjt} - \alpha_h P_{jt})^2}{2\alpha})|d_{hjt} - \alpha_h P_{jt} > 0] * prob(d_{hjt} - \alpha_h P_{jt} > 0) \quad (6)$$

6.2 Heterogeneity

We incorporate heterogeneity for the probability of household h buying in week t in the following way:

$$\vec{\beta_{1,2h}} = \vec{\eta_0} + \vec{D}'\eta_1, \quad (7)$$

where $\vec{D}$ are demographic variables of the household.

For the brand preference parameters, we incorporate the heterogeneity in the following way:

$$\vec{\beta_{3hj}} = \rho I^P_{hj1} + \nu_{jh}, \quad (8)$$

I^P_{hjt} denotes an indicator variable that is one if household h purchases product j in week t. ν_{jh} denotes the unobservable heterogeneity. We assume that ν_{jh} follows the normal distribution $N(0, \sigma^2_\nu)$, where the standard deviation σ_ν is to be estimated.

[8]Conditional on purchase, 89% of household weekly purchase consists of one unique product.

We specify the price coefficient as follows:

$$\alpha_h = \delta_0 + \delta_1 Income, \tag{9}$$

where Income specifies the income level of the household.

6.3 Model Estimation: The Likelihood Function

Estimation is based on two observed decisions: the household's actual product choice and the purchase quantity. We estimate the model parameters by maximizing the joint likelihood of these two observed outcomes. We denote the household's observed product choice by an indicator, $\hat{I}_{hjt}$, that is one if household h chooses product j, and zero otherwise, and its observed purchase quantity choice by $\hat{q}_{hjt}$. Estimation of the model proceeds via simulated maximum likelihood. The likelihood of the observed behavior of a household is the joint probability of its product choice in week t and its purchase quantity.

I^P_{hjt} denotes indicator variables that are one if household h purchases chooses product j in week t, and let $g(q_{hjt})$ denote the probability density of observing purchase quantity q_{hjt}.

Household h's contribution to the likelihood,l_{ht}, then equals

$$l_{ht} = \begin{cases} \prod_{j \in J} Pr(I^P_{hjt} = 1) g(\hat{q}_{hjt} | I^P_{hjt} = 1, q_{hjt} > 0))^{\hat{I}_{hjt}} & \text{if purchase in week } t \\ \sum_{j \in J} Pr(I^P_{hjt} = 1) prob(q_{hjt} = 0) & \text{if not purchase in week } t \end{cases} \tag{10}$$

Since ϵ_{hjt}, the unobservable preference demand shock of household h for product j in week t is assumed to follow a type 1 extreme value distribution, we have

$$Pr(I^P_{hjt} = 1) = \frac{exp(E_\omega(u(q^*_{hjt})))}{\sum_{j \in J} exp(E_\omega(u(q^*_{hjt})))}. \tag{11}$$

The assumption of normal distribution of unobservable quantity demand shocks leads to a probability density of observing the actual purchase quantity of

$$g(\hat{q}_{hjt} | I^P_{hjt} = 1, q_{hjt} > 0) = \frac{\frac{1}{\sigma_\omega} \phi(\frac{\hat{q}_{hjt} - (E(d_{hjt}) - \alpha_h P_j)}{\sigma_\omega}))}{prob(d_{hjt} - \alpha_h P_{jt} > 0)}. \tag{12}$$

6.4 Discussion of model specification

Compared with Dube (2004), our specification of the model allows the probability of purchasing a product to depend on the observable characteristics of other products:

for example, for the same Red Bull regular energy drinks, if the price of one 16 oz can decreases, the probability of the household purchasing an 8 oz can will be affected. This specification advantage is crucial for our paper since the interplay of different packaging of products is our main focus.

7 Results

7.1 Estimation Results

The purpose of this study is to quantify consumers'preferences for different package sizes of energy drinks and how the preferences can be reinforced by past consumptions. In our estimation, we select the households that have bought energy drinks for at least three weeks in each year and in total have at least 10 purchases from 2006 to 2009[9]. In total, we have 590 households in our estimation sample. Table 7 presents the parameter estimates of the proposed model. We first present consumers' preferences for price, different package sizes, brands,and loyalty for different product attributes. We then summarize how the preference vary across different demographic groups.

The identification of consumers' preferences for different package sizes relies on the variations of product attributes in consumers' choice sets. For example, We observe consumers'choice probabilities for single bottle Red Bull 8oz, 12oz and 16 oz drinks. After controlling for the price differences, we are able to attribute the differences in choice probabilities among the three alternatives to consumers' preferences for different bottle sizes. According to table 7, based on our parameter estimate for the price coefficient for the consumers at the average income level, (-0.509 = -0.613 + 61669 * 1.72E-06, p¡0.001, where $61669 is the average income among the estimation sample), we are able to quanity the consumers' higher preference for larger size drinks and multi pack drinks. Consumers are willing to pay $0.93, $1.26 and $1.96 more for 12 oz, 16 oz and 24 oz drinks relative to 8 oz drinks respectively. The results are consistent with the product prices we observed in the market. For example, according to Table 3,the average price for a single package 8oz Red Bull is $1.94 and the average price for a 12oz Red Bull is $2.76 in 2007. The price difference is about $0.82. Next, we estimate the consumers' preferences for different packages. For example, consumers are willing to pay $2.85, $5.42 and $9.675 more for 4 cans, 12 cans and 24 cans energy drinks relative to 1 can 8oz energy drink. The observed price differences are $3.62 between 4-can-8oz Red Bull and 1-can-8oz Red Bull in 2007. However, the

[9]There are some missing values for some households in certain years from the data.

price differences are much larger between 12-can Red Bull and 1-can Red Bull than the estimates from the demand model. The discrepancy can be explained by higher market share for 1-can Red Bull than the 12-can and 24-can packages.[10] In our model, we allow for the interactions of different demographic variables with different bottle and package sizes. We find that young consumers have higher preference for larger size drinks. They prefer 12 oz, 16 oz and 24 oz energy drinks compared with 8 oz energy drinks by willing to pay \$0.36, \$1.08 and \$1.50 more than the general population. Families with teenagers have higher preference with multi pack drinks. They prefer 4 cans, 12 cans and 24 cans energy drinks compared with 1 can energy drink by willing to pay \$1.50, \$2.28 and \$2.95 more than the general population. The results are consistent with our data that younger consumers are more likely to purchase large size energy drinks and family with teenagers are more likely to purchase multi pack drinks.

The estimates for the brand intercepts indicate consumers' relative preferences for different brands. We find that the preferences are significantly stronger for the leading brands, including Red Bull and Monster. Among the rest brands, consumers on average prefer Rockstar over AMP, Full Throttle and NOS. The estimates show strong regional effects for the two leading brands – Red Bull and Monster. Monster, produced by Monster Corporation based in California, is more preferred by consumers in the west coast than in other regions. In contrast, consumers in the east have higher preference for Red Bull, that is imported rom Austria. We find that while consumers in the west region value Monster \$0.79 more than the consumers in other region, consumers in the east region value Red Bull \$1.60 more than the consumers in other regions. Our estimates also show strong seasonal effects for energey drink. The demand is higher in the second and third quarters than in the first and fourth quarters of the year. We also find there is significant unobserved heterogeneity on consumers' preference for Red Bull and Monster. The standard deviation of the unobserved heterogeneity for Red Bull is higher than that for Monster.

The significant positive parameter estimates of Size loyalty, multi pack pack loyalty and brand loyalty confirm that consumers have inertia towards size, multi pack and brand. The estimate for Size loyalty suggests that consumers are willing to pay \$0.79 premium to stay with the same size of energy drink as that in their previous purchases; the estimate for multi pack loyalty suggests that consumers are willing to pay \$0.77 premium to stay with the same multi pack package and the estimate for

[10] An alternative explanation for the discrepancy is that the big package product (12-can and 24-can) are not widely available as the 1-can product. However, since we aggregate our choice sets at the time-region-channel level, we are not able to disentangle consumers' preference and product availability.

brand loyalty suggests that consumers are willing to pay $0.66 premium to stay with the same brand. It is interesting that among the three loyalty estimates, consumers show strongest persistence in size inertia.

7.2 Counterfactual Analysis – Impact of Size Regulation

In this section, we analyze the impact of bottle size changes of energy drinks on consumers' energy drink consumptions. We highlight the total volume consumption changes in short term and longer times for different consumer segments, especially for young consumers and the families with teenagers. We consider several scenarios. In the first scenario, we assume if there was no introduction of 12oz and 16oz Red Bull, how much energy drinks consumers would have purchased. As we discussed earlier,there are two possible complementary mechanisms that may have played a role to affect consumers' energy drink consumption after the introduction of large size Red Bull. First, a new package with larger volume provides quantity discounts for the same product with smaller sizes. Lower unit price encourages consumers to switch to the new product from other products. Second, consumption habits could be playing an important role in energy drink consumption. To quantify the relative importance of the two mechanism, we run a simulation in the second scenario when there was no introduction of large size Red Bull, but there was a price cut for 8oz Red Bull. In the third scenario, we study what the consumption would be if there was a regulation on the energy drink package size. In particular, we assume that all energy drink can only be offered in a 8oz can pakcate. We are interested in how much consumer will change their total consumption on energy drinks with the pakcage size regulation.

7.2.1 No Introduction of 12oz and 16oz Red Bull

In this scenario, we dropped the 12oz and 16oz Red Bull as the choice alternatives from the the consumers' choice sets from 2007, but keep everything else the same as what we observed in the data. We are interested in both short term and long term effect. We define the short term effect as the impact of sales in the first quarter of 2007, whereas the long term effect is defined as the last period of our data, i.e., the fourth quarter of 2009. Compared with the case where there was no introduction of 12 oz and 16 oz Red Bull, the introduction of 12 oz and 16 oz Red Bull would increase consumers' Red Bull consumption by 15% from 2007 to 2009. The short term increase (the first quarter of 2007) is only 7% while the long term increase (the fourth quarter

of 2009) is 20%. The larger effect in the long term increase than the short term increase is driven by consumers' brand loyalty and size loyalty. According to our estimation results, the introduction of large size Red Bull is effective in increasing Red Bull's market share. However, we should be aware of that the increase of the market share is at the expense of the lower margins Red Bull could gain from 12oz and 16oz drinks. Compared with the case where there was no introduction of 12 oz and 16 oz Red Bull drinks, with the introduction of 12 oz and 16 oz Red Bull, young household head would have increased consumption (17% in total) more than the whole sample (15% in total) suggesting that bigger size energy drinks have bigger impact on households with young household head.

7.2.2 No Introduction of 12oz and 16oz Red Bull, but price cut for 8oz Red Bull

In the second scenario, we compare with the case where there was no introduction of 12 oz and 16 oz Red Bull, but there is price cut for 8 oz Red Bull. In our data, 1can 16 oz Red Bull costs about $ 3.3 and 1 can 8 oz Red Bull costs $2. We assume a price cut for the 8oz Red Bull such that the unit price is the same as the unit price ($/oz) for the 16oz Red Bull introduced to market. Specifically, the Red Bull would cut all price of 8 oz Red Bull to 3.3/2 of their original prices, resulting in $1.65 per can. In other words, the unit price was 17.5% lower than its original price. We find that consumers' consumption of Red Bull would increase by 12% on average. This gives an upper bound of the estimates of the impact from price decrease caused by the introduction of larger size.

7.2.3 All energy drink were offered 8oz can only

When all energy drinks were offered 8 oz (1 can 16 oz Red Bull costs $ 3.3; 1 can 8 oz Red Bull costs $2; the price of all 16 oz energy drinks were adjusted to 2/3.3 of its original price.): all consumers would decrease their consumption of energy drinks. In total, consumers would decrease their consumption by 25%.

8 Discussions

In this paper, we study the impact of introduction of larger size energy drink on consumption patterns for the regular users. We find sizable effects on the total consumptions on the regular users. However, we don't model the energy drink adoption de-

cisions for new users. Potentially, the availability of large size and lower unit price product may induce more consumers to adopt the product. In our current analysis, we do not capture this effect.

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9 Tables and Figures

Table 1: Market share of major umbrella brands

	2006	2007	2008	2009
Red Bull	0.56	0.51	0.41	0.43
Monster	0.25	0.26	0.31	0.32
Rockstar	0.11	0.15	0.16	0.13

Table 2: Per oz price of major umbrella brands

$/oz	2006	2007	2008	2009
Red Bull	0.176	0.182	0.188	0.183
Monster	0.073	0.076	0.079	0.078
Rockstar	0.084	0.079	0.074	0.080

Figure 1: Prices for 1 can 16 oz Monster in Four Regions

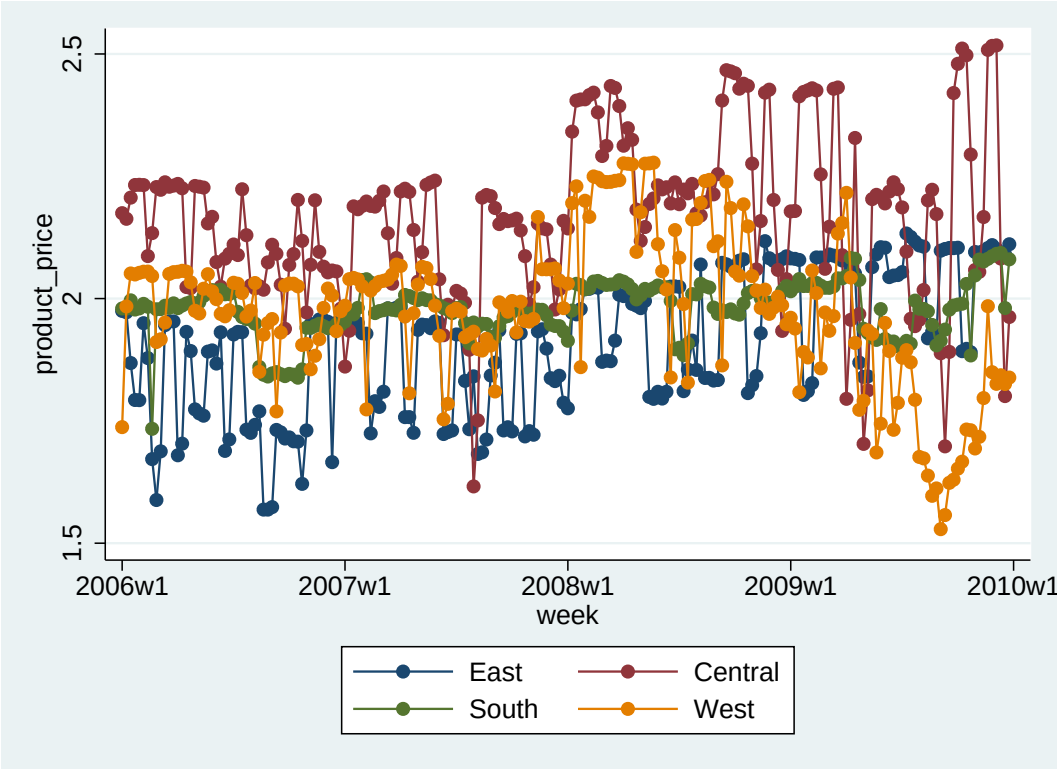

Table 3: Market share and average price of major products

brand	multi	size	market share	average price $
year 2006				
RED BULL R	24	8	0.19	31.89
RED BULL R	1	8	0.18	1.93
RED BULL DT	4	8	0.15	6.68
MONSTER R	24	16	0.15	27.37
ROCKSTAR R	1	16	0.06	1.89
MONSTER R	1	16	0.05	1.91
MONSTER R	4	16	0.04	6.60
RED BULL R	12	8	0.04	19.55
ROCKSTAR R	4	16	0.03	6.48
FULL THROTTL	4	16	0.03	6.20
year 2007				
RED BULL R	24	8	0.13	32.45
RED BULL R	1	8	0.12	1.94
MONSTER R	24	16	0.12	27.83
RED BULL DT	4	8	0.12	6.56
MONSTER R	4	16	0.09	6.59
RED BULL R	1	12	0.08	2.76
RED BULL DT	12	8	0.06	19.81
ROCKSTAR JUI	4	16	0.06	6.38
ROCKSTAR R	1	16	0.05	1.87
MONSTER ASS	1	16	0.04	1.88
year 2008				
MONSTER R	24	16	0.14	29.06
MONSTER R	4	16	0.11	6.50
RED BULL R	1	8	0.10	1.99
RED BULL R	4	8	0.09	6.53
RED BULL DT	24	8	0.09	33.36
RED BULL DT	1	12	0.08	2.72
ROCKSTAR R	4	16	0.06	6.33
MONSTER R	1	16	0.05	1.92
RED BULL R	12	8	0.05	20.40
ROCKSTAR R	24	16	0.05	25.49
year 2009				
MONSTER R	24	16	0.15	28.70
RED BULL DT	24	8	0.12	33.25
MONSTER R	4	16	0.09	6.38
RED BULL DT	1	8	0.09	1.90
RED BULL R	1	12	0.09	2.63
RED BULL R	4	8	0.07	6.41
MONSTER R	1	16	0.07	1.92
AMP R	1	16	0.05	1.89
RED BULL DT	12	8	0.04	19.59
ROCKSTAR DT	4	16	0.04	6.43

Figure 2: The number of adopters of energy drinks over time

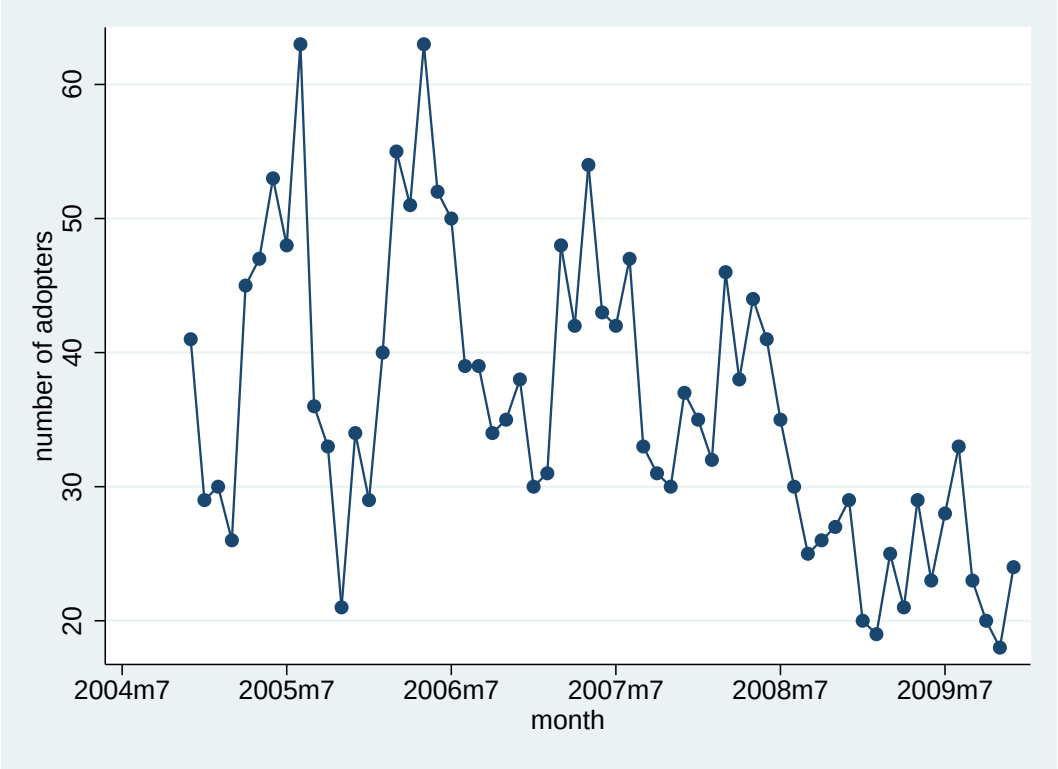

Table 4: Monthly Consumption Increase of Heavy Red Bull Drinkers after buying Larger Size Red Bull

	log week volume	log average size	log ncan
introduction of larger size Red Bull	0.13*	0.09***	0.03
	(0.08)	(0.01)	(0.07)

Figure 3: Histogram of number of weeks with purchase of energy drinks in the estimation sample

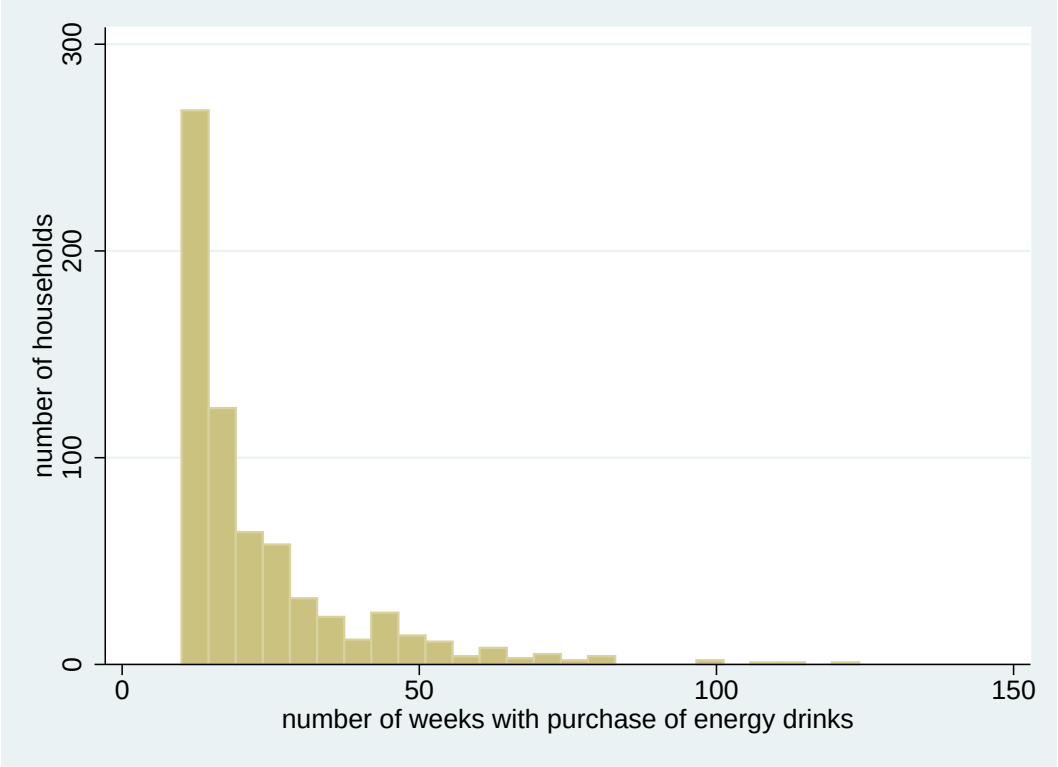

Table 5: Total weekly purchase volume of heavy users after the introduction of larger size Red Bull

	total week volume
introduction of larger size Red Bull	5430.71***
	(517.35)
time trend week	1.44
	(4.59)
constant	-247.07
	(111098.2)

Figure 4: Histogram of coefficient of variation of number of weeks between two purchases in the estimation sample

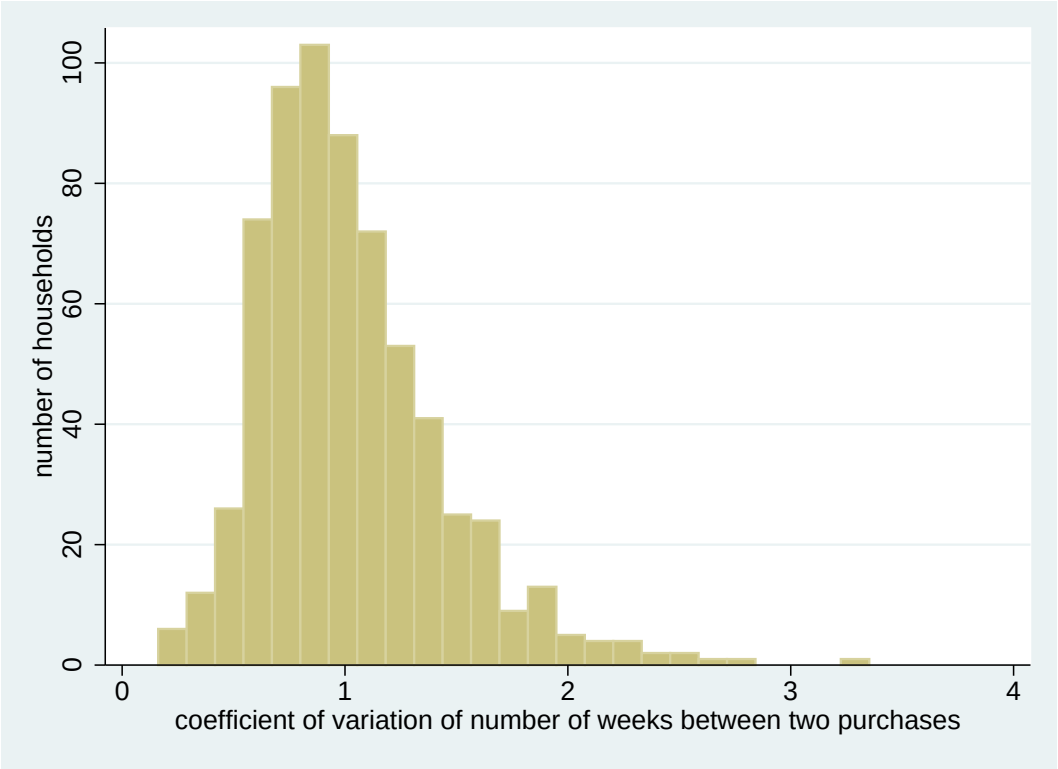

Table 6: Total weekly purchase volume of Red Bull for heavy users after the introduction of larger size Red Bull

	total week volume
introduction of larger size Red Bull	1329.56***
	(119.44)
time trend week	-4.15***
	(0.89)
constant	11101.14***
	(2148.68)

Figure 5: Purchase pattern of a household whose coefficient of variation of number of weeks between two purchases equals to 1

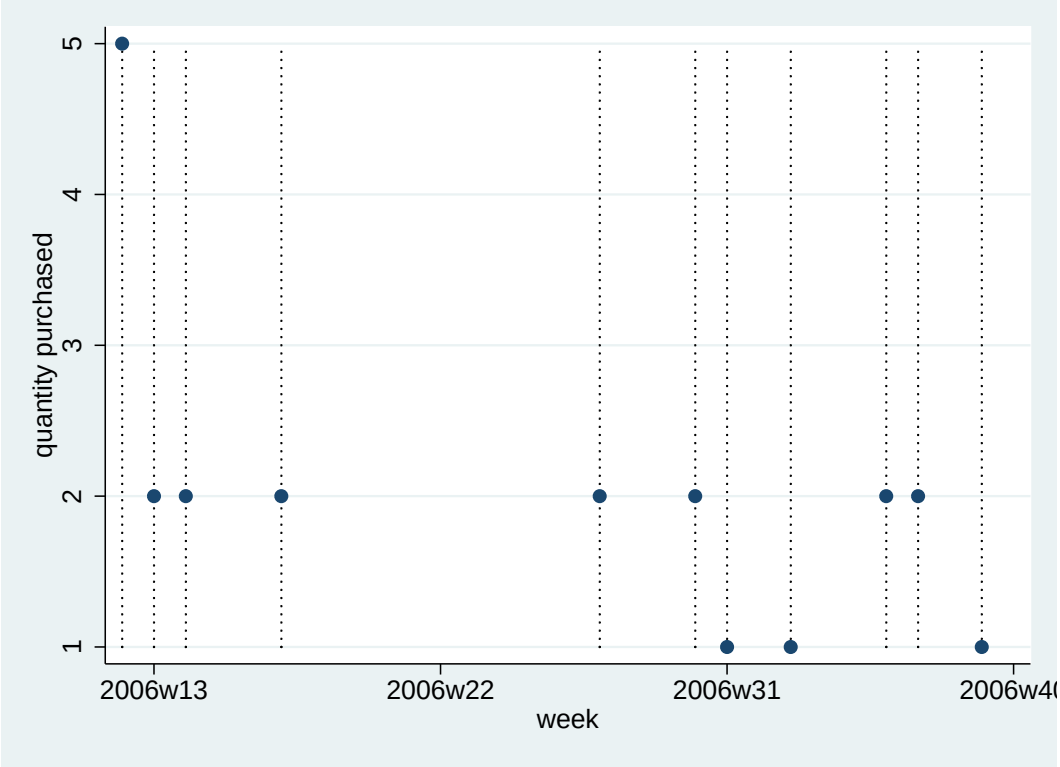

Figure 6: Weekly Volume Sales of Red Bull before and after Introduction of Larger Size Red Bull Drinks

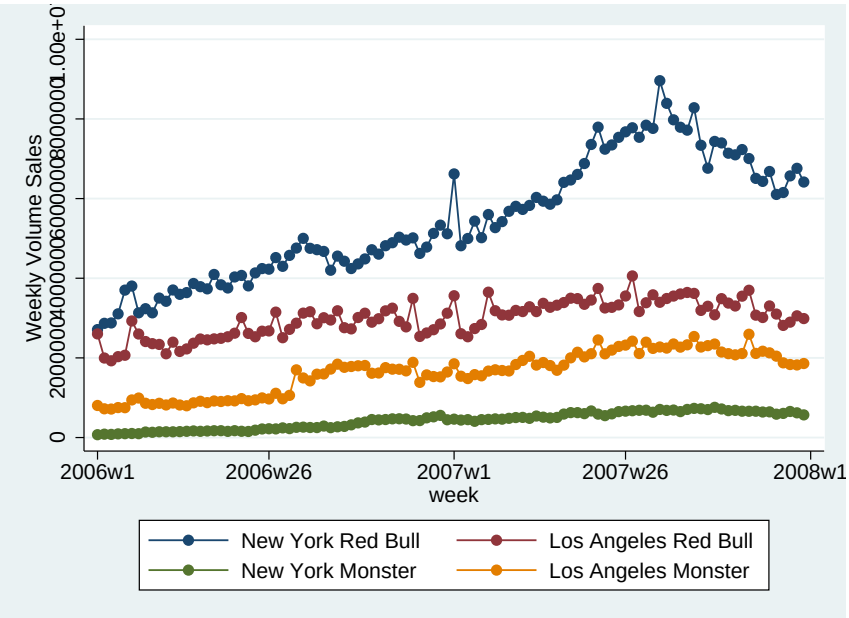

Figure 7: Weekly total consumption of energy drinks for top 10 percent heavy drinkers

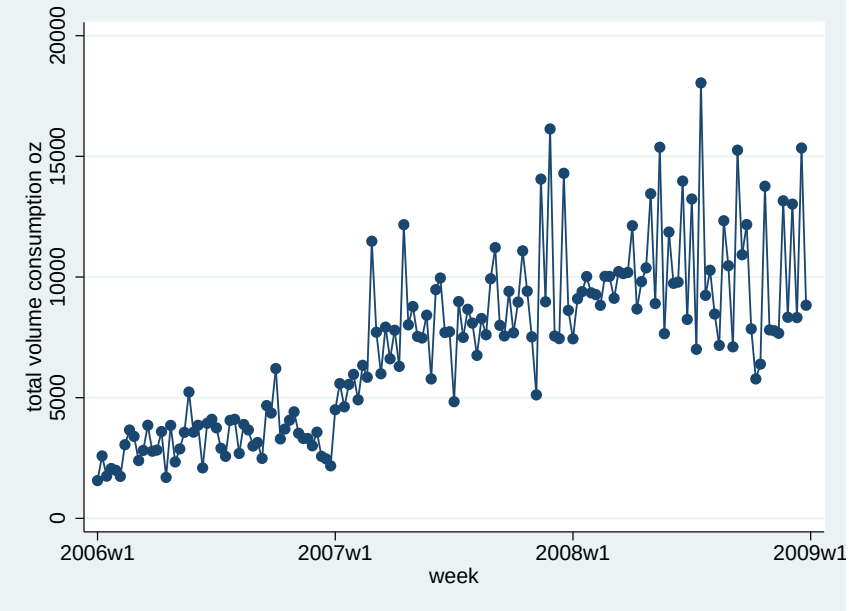

Figure 8: Weekly total consumption of Red Bull for top 10 percent heavy drinkers

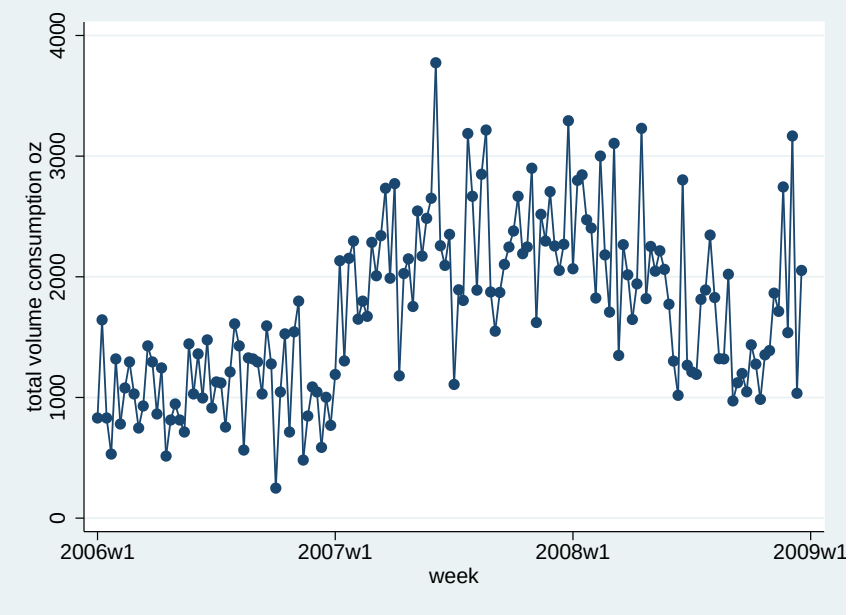

Table 7: Parameter Estimates

	Parameter Estimates	Std
12 oz dummy	0.472	0.0094
16 oz dummy	0.641	0.0063
24 oz dummy	0.994	0.0074
4 cans dummy	1.444	0.0039
12 cans dummy	2.749	0.0398
24 cans dummy	4.904	0.0546
AMP dummy	0.252	0.0092
Full Throttle dummy	0.500	0.0096
Monster dummy	0.868	0.0092
NOS dummy	0.066	0.0137
Red Bull dummy	1.143	0.0079
Rockstar dummy	0.700	0.0089
Size Loyalty	0.398	0.0046
multi pack loyalty	0.390	0.0036
brand loyalty	0.336	0.0032
second quarter dummy	0.678	0.0068
third quarter dummy	0.928	0.0057
fourth quarter dummy	0.002	0.0069
price coefficient	-0.613	1.1185E-03
standard deviation of omega	1.389	0.0003
young dummy interacting with size 12 oz	0.182	0.0131
young dummy interacting with size 16 oz	0.546	0.0012
young dummy interacting with size 24 oz	0.864	0.0054
teenager dummy interacting with 4 can	0.761	0.0034
teenager dummy interacting with 12 can	1.155	0.0454
teenager dummy interacting with 24 can	1.498	0.1111
brand first time purchase boost	0.690	0.0021
Monster unobservable heterogeneity std	1.743	0.0020
Red Bull unobservable heterogeneity std	0.953	0.0028
income effect	1.720E-06	2.5944E-09
Monster West Region Dummy	0.482	0.0014
Red Bull East Region Dummy	0.980	0.0031