# GAS PRICES, CLIMATE AND THE POWERBALL JACKPOT: IMPACTS ON U.S. CONVENIENCE STORE NON-ALCOHOLIC BEVERAGE SALES

by

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# ABSTRACT

MATTHEW A MCNEILL. Gas prices, climate and the Powerball™ jackpot: Impacts on U.S. convenience store non-alcoholic beverage sales
(under the direction of DR. CRAIG A. DEPKEN. II)

This paper examines the effects that gasoline prices, climatic conditions, and the Powerball jackpot size have on weekly scanned-data results of NA beverage sales (unit and dollar sales) at U.S. convenience stores from 2010-2016:Q1. The results indicate that the Powerball lottery jackpot has no statistically significant effect on the total number of NA beverages sold at convenience stores – no matter how large the weekly jackpot becomes. Similarly, regardless of how inexpensive gasoline becomes, it too has no definitive effect on the total number of NA beverages sold at convenience stores. My research supports the conclusion that the average NA beverage price, the climatic condition (in terms of Cooling Degree Day), and the payday-week effect have the greatest impact on weekly NA beverage consumption at U.S. convenience stores. An examination of NA beverage subcategories finds that the Powerball jackpot has a significant impact on 'still beverage' sales when the previous weeks' jackpot exceeds $150 million. Similarly, the previous weeks' jackpot must exceed $700 million to significantly impact sales of 'sugar-sweetened beverages' (SSB). For every one-cent increase in the national average NA beverage price there results in roughly a 5.5 million unit decrease in the total number of beverages sold. Likewise, a national average weekly increase of only ten cooling degree days (CDD) increases the number of NA beverage units sold weekly by approximately 2.6 million.

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# DEDICATION

This Graduate Thesis is dedicated with love to my

MOTHER & FATHER

who gave me life and whose selfless sacrifice has allowed me the opportunity to pursue higher education, and to my wife - the one woman in my life whose unconditional love and encouragement sustains me.

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INTRODUCTION

The purpose of this study is to determine the effects that the average retail price of gasoline (per gallon), the Powerball lottery jackpot size, and the average climatic condition (in Cooling Degree Days) have on NA beverage sales at U.S. convenience stores from January 16, 2010 to April 2, 2016. I also examine if the biweekly payday schedule has any effect on beverage sales and in doing so provide insight into current NA beverage pricing and trends. I develop a model that estimates the relationships between NA beverage sales (at U.S. convenience stores), and a variety of variables thought to have an effect on NA beverage sales. This model is then used as a basis to test a variety of dummy variables that serve to uncover the significance of various gas price points (at-the-pump) and Powerball lottery jackpot sizes.

Recent evidence suggests that since 2014 in the United States, declining gasoline prices correspond with an increase in the total number of vehicle miles traveled (see Appendix: Figure 1). Despite conventional gasoline having a relatively inelastic demand there could be an increase in customer traffic at U.S. gas stations when gas prices fall and demand for driving rises, which in turn might increase impulse purchases of food and NA beverage products at any attached convenience store. Also, a large and growing Powerball lottery jackpot can induce people to purchase tickets at convenience stores and thereby potentially increase beverage purchases. In January 2016, the Powerball lottery jackpot reached a record high of $1.586 billion dollars and convenience store lottery retailers commented that it was good for business because people would buy other things while in the store to purchase lottery tickets.[1] Using weekly time series data from the

[1] "Powerball Sales a Windfall for Retailers" by: Ed Donga, The Enterprise (Quote: Andy Patel, Manager)

Multi-State Lottery Association, I investigate whether the concurrent Powerball lottery has a significant relationship with weekly NA beverage sales. By introducing a series of Powerball dummy variables and Powerball lagged dummy variables I inspect whether a particular jackpot size, in the current week or previous week, has any significant impact on weekly NA beverage units purchased at U.S. convenience stores.

My analysis also considers the likely effects that temperature related conditions, in terms of the Cooling Degree Day (CDD) statistic, have on total NA beverage sales in U.S. convenience stores. Generally speaking, I expect seasonal trends and consider the positive effects that extended summer daylight hours, warmer temperatures, and vacation travel may have on U.S. convenience store NA beverage sales. The average price for NA beverages also falls during the summer months, in large part because of increased discounting and promotional activity.

Weekly national average climatic data from the American Gas Association shows a significant relationship between NA beverage sales and two temperature variables used to proxy for average U.S. weekly temperature. The first climatic variable used is a cooling degree day (CDD), which accounts for the U.S. average weekly number of degrees that a days' average temperature exceeds 65 degrees Fahrenheit. The Cooling degree day (CDD) is a measure used to indicate when people might start to use their air conditioning systems and is used in the pricing and trading of weather derivatives.[2] The second weather variable included in the model is a dichotomous cooling degree day dummy variable which acts as a seasonal proxy to control for the variation between the warmer summer months and the cooler winter months. The CDD dummy variable is

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[2] See *Pricing Weather Derivatives* by Timothy J. Richards, Mark R. Manfredo and Dwight R. Sanders.
Link: repository.asu.edu/attachments/75807/content/0402.pdf

different from the CDD variable in that it only captures the two opposing summer and winter seasons (CDD and non-CDD) that have the potential to affect NA beverage sales in different ways. The aim is to test for significant differences in NA sales between summer months (cooling degree days) and winter months (heating degree days).

Finally, I consider the effects that both the biweekly payday frequency and the average NA beverage price has on weekly NA beverage sales at U.S. convenience stores. I examine how much the biweekly payday schedule (paychecks issued every two weeks starting on Wednesday, January 13, 2010) influences the level of NA beverage sales while also analyzing just how much the average per-unit beverage price at U.S. convenience stores affects NA beverage. I find that both of these explanatory variables have a significant relationship with total NA beverage sales at U.S. convenience stores and these relationships differ with respect to beverage subcategories ('sugar-sweetened beverages' and 'still beverages').

Overall, the average weekly NA beverage price, the biweekly payday schedule, and the temperature (in terms of cooling degree days) each has a significant impact on weekly NA beverage sales at U.S. convenience stores. These findings provide insight into elements impacting NA beverage sales in U.S. convenience stores today. The findings also help beverage industry stakeholders and U.S. convenience store retailers who seek to better understand their customers and the dynamic relationships that impact NA beverage sales.

Despite its distinctiveness and purpose, this report most aligns (or parallels) with the previous research of Gicheva, Hastings, and Villas-Boas (2007), who present evidence to suggest that gas price increases affect food-consumption categories and that, within the grocery category, consumers actually substitute away from regular shelf-price products and towards promotional items to save money. This same notion likely has application to U.S. convenience stores and therefore gasoline prices may have a similar effect on the purchasing behavior of convenience store shoppers. Similarly, a higher Powerball lottery jackpot may induce shoppers to substitute away from NA beverage products and into additional lottery tickets.

Oster (2004) shows that large-stake lottery games, such as the multi-state Powerball lottery, are significantly less regressive at higher jackpot sizes. Oster's research reveals that seemingly greater benefits are discovered at larger-stake, higher-priced jackpot games, and similarly, I present evidence that the size of the jackpot must be considerably higher than it currently is today (on a consistent basis) to have any significantly beneficial effect on NA beverage sales at U.S. convenience stores.

Moreover, the public health research of French (2003) has also assisted in providing historical context of the effects that pricing can have on food choices in the U.S. Her work underscores the importance of food/beverage pricing and marketing activities on the eating environment by demonstrating that price reductions are effective in increasing purchases of more healthful foods in settings such as work sites and schools. Similarly, I find that beverage price is the most significant explanatory variable, with the greatest ability to affect unit volume consumption of NA beverages at U.S. convenience stores.

## DEVELOPING FOUNDATIONS: U.S. CONVENIENCE STORE DYNAMICS

The vast majority of convenience stores in the U.S. sell products such as gasoline, lottery tickets, cold/hot beverages, and ready-to-eat meals, with the aim of inducing customers to shop more often. Convenience store shoppers appreciate convenience stores for the one-stop shopping atmosphere, extended hours of operation, diverse product selection, and fast transactions. Convenience retailers are developing customer-centric approaches by continuing to increase store count, redesigning store layouts, adding multiple points-of-sale (POS), and diversifying their product selection. According to The Association for Convenience & Fuel Retailing, in 2016 there are 154,195 convenience stores in the United States that account for over $575 billion in total annual sales.

Of the 154,195 convenience stores in the U.S., 124,374 of them sell gasoline, accounting for approximately 80 percent of all U.S. fuel sales. Additionally, more than 50 percent of all lottery tickets are sold at these 124,374 convenience stores; in 2015 convenience stores with gas stations generated over $36.5 billion dollars in lottery sales. Since U.S. convenience stores sell the majority of gasoline and Powerball lottery tickets, it seems reasonable to question whether convenience store retailers experience a change in sales (especially NA beverage sales) after a significant increase in the demand for fuel and/or lottery tickets.

In 2014, Steve Loehr, Kwik Trip's vice president of operations and NACS vice chairman of government relations stated, "the profit for the lottery business is a *low* for us… However, we are willing to endure the smaller profits since lottery sales generate more store traffic."[3] This statement suggests that increased store traffic results in more

[3] Source: National Association of Convenience Store Retailers (NACS) Online Magazine, Issue: April 2014.

‘impulse’ purchases.  Their survey suggests that lottery customers purchased at least one other product in 95 percent of store visits and that lottery shoppers spent an average of $10.35 on purchases while non-lottery shoppers spent an average of $6.29 on purchases. According to the 2016 NACS Industry Update, tobacco products accounted for 37 percent of in-store sales, foodservice for 16 percent, and packaged (non-alcoholic) beverages accounted for 15 percent of total convenience store sales.  Thus, if 95 percent of lottery shoppers purchase at least one additional item, then there appears to be approximately a 50 percent likelihood that this one additional item is a beverage/refreshment product.[4]

Ultimately, convenience store retailers seek to maximize profits by maximizing the number of trips shoppers take inside the store and doing everything possible to make it easier and quicker for customers to buy more products while there.  Newly built convenience stores, both urban and rural, are getting bigger, averaging 4,766 total square feet[5], and have additional space for in-store destinations such as coffee islands, food service areas with seating, and telecom service kiosks.  Convenience stores are also diversifying their offerings to become part supermarket, restaurant, gas station, and even bank or drugstores, therefore further complicating how data are to be classified within the food and beverage retail sector.

The constitution and bylaws of the NACS, confirms that the definition of a convenience store is "...a retail business with primary emphasis placed on providing the public a convenient location to quickly purchase from a wide array of consumable products (predominantly food/beverage, and gasoline) and services."  Although this

[4] See the NACS Industry Update, Lexington, Kentucky; March 31, 2016, Copyright NACS 2016.; here a refreshment can also be considered a tobacco product.
[5] According to the 2016 Convenience Retailer Fact Sheet, National Association of Convenience Stores (NACS)

definition broadly defines a large segment of retailers, the NACS specifically excludes supermarkets/supercenters, drugstores, and dollar-stores from this classification to be able to target and track this retail channel exclusively. Similarly, in order to accurately track this channel Nielsen reports data on a census/sample integrated methodology representing 149,100 stores across chain, franchise, and independent formats.[6] Using a stratified sampling methodology Nielsen projects the sample set up to the total retailer account based on 860 unique retailers and 1,000 independents that represent a balanced mix of chain, franchise and independent stores.

Within the U.S. channel count comparison (see Appendix: Figure 2), convenience stores control the majority of the sector by having 56% of the total store count, while supermarket/supercenters account for 19%, drugstores account for 15%, and dollar-stores for only 10%. Our report focuses exclusively on the dynamics within the U.S. convenience store channel and analyzes the primary effects that influence total (non-alcoholic) beverage unit volume sales within this channel.

As of December 31, 2015, there were a record number of convenience stores in the U.S. according to the Nielsen Convenience Industry Store Count, which represented a 0.9% year-over-year increase or an additional 1,401 stores added. Graphical representations of U.S. convenience store growth for the last thirty years can be seen in Figure 3, and highlight the abnormal amount of store growth from 1995 to 2005. Since 1985, there's been a 68% increase in the total number of U.S. convenience stores, with the majority of growth occurring during the 1995-2005 decade when approximately

[6] The Nielsen Convenience Retail Channel definition and the NACS store count statistics vary slightly due to the various quality controls deployed and collection methods used.

39,565 stores were added, compared to only 10,200 stores from 1985 to 1995, and 12,129 stores from 2005 to 2015.

It's conceivable that an increase in U.S. demand for retail gasoline during this same period (1995-2005) helped spur much of the growth in the number of convenience stores. According to the U.S. Energy Information Administration (EIA), there was a steady increase in the total number of miles traveled in the U.S. over this period (see Figure 4). From 2000 to 2016, the 12-month moving total of U.S. vehicle miles traveled increased over 17 percent, and since 2014, the year-over-year (YoY) increase in total vehicle miles traveled in the United States has been consistently 2-3%. In addition, the EIA reports that the average spot price-per-barrel of crude oil – West Texas Intermediate (WTI) was $17.99 in January 1995 and had risen to an average of $45.96 per barrel by January 2005.[7] The significant increase and stabilization in the average price of crude oil, likely had an impact on the growth in the number of convenience stores during this particular decade.

Furthermore, in a recent survey conducted by the NACS, 67% of retailers said sales in the first quarter of 2016 were better because of lower gasoline prices, and 59% of them claimed that gasoline sales were higher from a year before (only 11% said in-store sales were down from a year before).[8] Also, a recent Wells Fargo Securities survey, titled "Beverage Buzz", found that for the fourth quarter of 2015, good weather and decreasing fuel prices appear to have helped grow sales of convenience store NA beverages.[9]

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[7] Source: U.S. Energy Information Administration; Independent Statistics and Analysis, Petroleum and Other Liquids, Spot Prices: WTI – Cushing, Oklahoma. Link: eia.gov/dnav/pet/pet_pri_spt_s1_d.htm

[8] The Association for Convenience & Fuel Retailing; "Low Gas Prices Are Fueling Convenience Store Sales in 2016", April 4, 2016. Convenience retailer survey results.

[9] See, "How Weather and Fuel Prices Are Affecting the Beverage Industry", Convenience Store Decisions, February 1, 2016. Industry Report

I report findings that suggest otherwise, and propose that, on a national level, changes in NA beverage sales are much more affected by warmer weather than by any decrease in gasoline prices. The July, 2015 NACS podcast ‘Convenience Matters’ by host Jeff Lenard and John Eichberger discusses how warmer weather heats up sales and that there’s no dismissing the increase in demand during summer months for fuel and almost everything else at convenience stores. In a recent retail survey, they concluded that during the summer months, 49% of shoppers ‘think of drinks’ while shopping inside a store.

In April 1992, the very first Powerball lottery drawing was held and operated by the Multi-State Lottery Association (MUSL). Powerball replaced ‘Lotto America’ and quickly grew in popularity and became what is known today as the country’s largest and most popular lottery game. The game is played every Wednesday and Saturday in 44 U.S. states, District of Columbia, the U.S. Virgin Islands, and Puerto Rico (it excludes: Alaska, Hawaii, Nevada, Utah, Mississippi and Alabama). On January 13, 2016, the Powerball lottery produced the largest jackpot in world history. It took 70 days to generate the $1.586 billion jackpot that was split three ways to tickets that sold at both convenience store and grocery locations in Florida, Tennessee, and California.[10] In the days leading up to this, lottery retailers claimed to have experienced a surge in both customer traffic and lottery ticket sales which also helped spur ‘impulse’ purchases of food and beverages.[11]

In this study, the focus is on what drives U.S. convenience store NA beverage sales and aims to provide further evidence of a categorical shift in the NA beverage

[10] Winning tickets sold at 7-Eleven in Chino Hills, California, Publix in Melbourne Beach, Florida, and Naifeh’s in Munford, Tennessee; evidence that convenience retailers play an important role in the selling of Powerball lottery tickets in the U.S.
[11] The Enterprise, “Powerball Sales a Windfall for Retailers” by: Ed Donga, January 7, 2016.

market at U.S. convenience stores (see Figure 5). In 2010, slightly more than half of consumers preferred the 'still beverage' type to 'SSB', compared to 2016 when roughly two out of every 3 consumers prefer 'still beverages'. Figure 5, illustrates the evolving market-share shift between 'SSB' and 'still beverage' products from 2010 to 2016, and confirms that consumers increasingly prefer 'still beverages' over 'sugar-sweetened beverages' (SSB) despite the latter having a higher average price. In 2010, the SSB category represented a 44.3% share of total NA beverages sold in U.S. convenience stores. In the first quarter of 2016, the 'SSB' category represented only 35.3% of total NA beverages sold in U.S. convenience stores. From 2010 to 2016 there was a roughly eight percent decline in the total number of SSB's sold at U.S. convenience stores. Furthermore, 'still beverages' are responsible for a larger share of total dollar volume, suggesting that the bulk of beverage performance for the past six years should be credited to the 'still' category.

To help offset the noticeable decline in SSB consumption, and bolster overall NA beverage sales, consumer packaged goods (CPG) firms are changing product designs, introducing or acquiring new brands, and constantly adjusting sales & marketing techniques.[12] The increasing negative sentiment towards SSB products and the risks they pose, has likely changed the purchasing behavior of consumers towards healthier beverage options such as juices, teas, flavored waters, coffee, and sport/energy drinks (i.e. 'non-SSB', or 'still beverages').

[12] Mckinsey & Company, "Tough Choices for Consumer-Goods Companies" By Jim Brennan, Greg Kelly, and Anne Martinez, December 2013 Link: mckinsey.com/industries/consumer-packaged-goods/our-insights/tough-choices-for-consumer-goods-companies; and refer to the 253ml bottle campaign by UTÖKA, 2016. Link: utoka.co/work/253mlbottle

## IDENTIFICATION STRATEGY

Using the statistical software package Stata along with the data and model designs described herein, the effects are identified by ordinary least squares (OLS) and the coefficients, standard errors, p-values, and confidence intervals on the set of explanatory variables are estimated. Using a stepwise regression approach, I effectively test, at each step, whether or not variables should be included based the selection criteria of adjusted R-squared and root mean square error (RMSE). Due to the seasonality and non-stationarity of much of the plotted data, transformations were performed on several variables to either first-difference form or the natural-logarithm of the original data in order to ensure stationary series.[13]

The application and first regression model excludes the Powerball variables and focuses on the changing significance levels of the payday variable when the first lag is removed, comparing Model 1 - with lags(1-4) to Model 2 - with lags(2-4).

Model 2 – Total NA Beverage Unit Volume Growth and Dep. Lags 2-4
(See Appendix: Table 2 & Table 3)

$$\boldsymbol{DEP_t = \beta_0 + \beta_1 GP_t + \beta_2 DEPP_t + \beta_3 CD_t + \beta_4 CDum_t + \beta_5 PDum_t + \beta_6 DEP_{t-2} + \beta_7 DEP_{t-3} + \beta_8 DEP_{t-4} + \varepsilon_t}$$

Where, $\boldsymbol{DEP_t}$ = Beverage Unit Volume Sales (‘total beverage’, ‘SSB’, or ‘Still’ respectively); $\boldsymbol{GP_t}$ = Gas Price Per Gallon (first-difference); $\boldsymbol{DEPP_t}$ = Dependent Variable Beverage Price Per Unit; $\boldsymbol{CD_t}$ = Cooling Degree Day (first-difference); $\boldsymbol{CDum_t}$ = Cooling Degree Day dummy variable (seasonal growth determinate); $\boldsymbol{PDum_t}$ = Biweekly Payday

[13] ADF unit-root testing; transformed variables include Total Beverage Unit Volume, Retail Gas Price, Non-Alcoholic Beverage Unit Price, Cooling Degree Day and U.S. Powerball™ lottery jackpot size.

dummy variable; $\boldsymbol{DEP_{t-2}}$ = Total Beverage Volume lag(2); $\boldsymbol{DEP_{t-3}}$ = Total Beverage Volume lag(3); $\boldsymbol{DEP_{t-4}}$ = Total Beverage Volume lag(4).

The fact that the payday dummy variable became significant when the lag(1) of total beverage unit volume was removed suggests that this lagged dependent variable was actually suppressing the significance of the biweekly payday effect. For this reason I effectively remove the dependent lag(1) variable and focus on limiting the dependent lagged variables to lags(2-4) only. The payday cycle is shown to have an impact on beverage consumption patterns and after identifying the statistical significance of the biweekly payday variable when lag(1) of the dependent variable is removed, Table 2 reports the full regression output, including variable coefficients, significant p-values, confidence intervals, and adjusted $R^2$ results.

Using Model 2 as the foundation moving forward, I create Models 3 and 4, by respectively replacing the dependent variable and lag dependent variables (lags 2 – 4 only) for either SSB unit volume or 'still beverage' unit volume. I also replace the total price per unit variable with the respective SSB price per unit and the 'still beverage' price per unit. Table 4, presents a comparison showing statistically significant OLS coefficient estimations (with standard errors) and how each explanatory variable relates, to the three different dependent variables.

The histogram in Figure 11, displays a positive right skew distribution of the weekly maximum Powerball jackpot size. Since the odds of winning a Powerball lottery game can exceed 1 in 292 million, and since each week the size of the jackpot could potentially vary by large amounts, the likelihood of this variable having a perfectly normal distribution should be considered relatively low. The record Powerball jackpot in early 2016, could easily be considered a 'black swan' event since the amount deviated so much from what is normally observed. It's safe to hypothesize that since this amount deviated so much from its mean, that many people considered it an extremely rare event and therefore allowed the jackpot size to impact their behavior irregularly. Since the weekly mean Powerball size is $126 million dollars, it's conceivable that people could become 'numb' to Powerball jackpots in excess of $100 million dollars (Hudja 2014).

The distribution of the Powerball jackpot experiences such a high degree of positive skewness, that logarithmic transformations were necessary to avoid violating assumptions of ordinary least squares (OLS). The histogram in Figure 12 shows the distribution after the lottery variable is log-transformed. Despite it not being perfectly normally distributed, this newly transformed variable is closer to normal.

The Powerball variable is included in the model in three distinct ways. The log-transformed weekly maximum Powerball lottery jackpot, the Powerball dummy variable and its lag (which measure jackpots above a specific amount). These model variations are designed to estimate any potential added causal effect that the weekly maximum Powerball jackpot may have on the dependent variable. The theory is that the weekly Powerball jackpot size would have a significant effect on the number of NA beverage units sold at convenience stores because as the jackpot size grows, ticket demand and store traffic intensifies leading to an overall increase in the number of beverage units purchased.

A Powerball jackpot that reaches a specific threshold level may have a substantially different effect on the number of NA beverage units sold at convenience stores, when compared to the effect of other jackpot levels. For example, a jackpot that exceeds $900 million dollars during a given week may have an unusual effect on convenience store demand for lottery tickets as well as the subsequent 'impulse' beverage purchase (that week or for the following week). Models 5 – 7, aim at discovering any effect that the weekly maximum Powerball lottery jackpot (or the various Powerball dummy variables at specific thresholds levels) has on NA beverage sales at U.S. convenience stores.

Model 5 – Powerball Lottery Weekly Jackpot Maximum Size
(See Appendix: Table 5)

$$\boldsymbol{DEP_t = \beta_0 + \beta_1 PB_t + \beta_2 GP_t + \beta_3 DEPP_t + \beta_4 CD_t + \beta_5 CDum_t + \beta_6 PDum_t + \beta_7 DEP_{t-2} + \beta_8 DEP_{t-3} + \beta_9 DEP_{t-4} + \varepsilon_t}$$

Note to Model 5: $\boldsymbol{DEP_t}$ = Total Beverage Unit Volume (first-difference); $\boldsymbol{PB_t}$ = Powerball lottery jackpot weekly maximum (natural logarithm transformed); $\boldsymbol{GP_t}$ = Gas Price Per Gallon (first-difference); $\boldsymbol{DEPP_t}$ = Dependent Variable Beverage Price Per Unit; $\boldsymbol{CD_t}$= Cooling Degree Day (first-difference); $\boldsymbol{CDum_t}$= Cooling Degree Day dummy variable (seasonal growth determinate); $\boldsymbol{PDum_t}$= Biweekly Payday dummy variable; $\boldsymbol{DEP_{t-2}}$ = Total Beverage Volume lag(2); $\boldsymbol{DEP_{t-3}}$ = Total Beverage Volume lag(3); $\boldsymbol{DEP_{t-4}}$ = Total Beverage Volume lag(4).

Next, Model 6 removes the original weekly maximum Powerball lottery jackpot variable and replaces it with the Powerball Lottery Dummy Variable (weekly maximum jackpot amount in USD>$150 million). This added variable shows any potential causal effect that the weekly maximum Powerball jackpot in excess of $150 million dollars, has on NA beverage sales. Model 7 estimates the effect of the previous week's jackpot that was in excess of $150 million dollars on the total number of NA beverage sales in the current week at U.S. convenience stores. The idea being that people may be more inclined to purchase lottery tickets this week if they take into account last week's jackpot size. There's a chance that the previous week's jackpot size is taken into consideration when deciding whether or not to purchase a lottery ticket in the current week. As a result, I'm testing whether or not a particular jackpot threshold level in the previous week will influence a shoppers' behavior for buying NA beverage units in the current week. It's much more likely that last week's Powerball lottery size would have a potential to impact this week's sales, than it would for the week-before-last or any week prior to that, to have a substantial effect on current week sales.

Finally, in Model 8, all Powerball variables are included together with the possibility of introducing the chance that there's a discontinuity in the complementary/substitutability between beverage demand and Powerball lottery ticket sales. Even when all three variables (at each jackpot level) are simultaneously added into the model there is no significant change in the outcome and the impact that the Powerball jackpot has on total NA beverage sales at convenience stores. When the same process is followed with the two beverage subcategories (SSB and 'still') the relationships that the Powerball jackpot variables have with each beverage category vary. Table 6 and Table 7 show the Powerball jackpot levels have a significant effect on the sales of the respective beverage category. When the Powerball jackpot is greater than $150 million it begins to have a significant effect on the total number of 'still beverages' sold at convenience stores, although this is not the case for SSB's. Likewise, when the Powerball jackpot reaches $700 million or more it begins to have a significant effect on SSB sales. This would suggest that for Powerball jackpots to have any substantial effect on the sales of NA beverages at convenience stores, the jackpot sizes need to exceed the current Powerball weekly average by at least $24 million and/or reach jackpot sizes at or above $700 million.

Importantly, the model variations allow for specific identification of the most relevant explanatory variables. Utilizing a stepwise regression methodology, I present the following 'preferred model', which only includes NA beverage unit price, Cooling Degree Days with seasonality, and the biweekly payday schedule. This model also includes lags(2-4) of the dependent variable to control for the monthly budgetary cycle.

Preferred Model
(Excluding insignificant variables; see Appendix)

$$\boldsymbol{DEP_t = \beta_0 + \beta_1 DEPP_t + \beta_2 CD_t + \beta_3 CDum_t + \beta_4 PDum_t + \beta_5 DEP_{t-2} + \beta_6 DEP_{t-3} + \beta_7 DEP_{t-4} + \varepsilon_t}$$

## DATA COLLECTION AND DESCRIPTIVE STATISTICS

According to Nielsen's definition (and data collection process), a convenience store retailer must operate in a minimum 800 square foot building, offer for sale at least 500 SKU's, must sell beer, and operate for at least 13 hours a day. Additionally, the store must carry a limited selection of grocery items and may or may not sell gas or offer fast food services. Nielsen determines its convenience store count using the store definition that requires stores to include a broad merchandise mix, extended hours of operation and a minimum of 500 stock-keeping units (SKUs), among other factors.

This analysis focuses solely on Nielson's scanned beverage data for the total U.S. convenience store retail channel (2010 - 2016:Q1) and does not include channel reclassifications performed after December 31, 2015 nor does it include data from drugstores, superettes, supermarkets, or dollar stores.

U.S. Convenience Store Total NA Beverage Unit Volume Sales (Dependent Variable)

Source: The Nielsen Company, 2016 – This variable is the weekly total number of NA beverage units sold at U.S. convenience stores from January 16, 2010 to April 2, 2016, including both SSB's and 'still beverages'.[14] According to Nielsen, a beverage unit consists of any NA beverage product UPC that is scanned electronically at a convenience store. Therefore, with this particular dataset, a beverage unit could vary in quantity/size. For example, a 'beverage unit' could be a 20-ounce bottle, a 2-liter bottle or even a 12-pack of cans because each product UPC is counted as a NA beverage unit no matter what quantity/type/brand of beverage it is. Due to the cyclical and seasonal nature of this

[14] Nielsen uses a combination of both census and sample integration methodologies to measure convenience retailers and channels. Therefore, some retailers provide census data (which includes data from every store) and others provide sample portions of their data. Nielsen then projects the sample set up to the total retailer account based on the stratified sampling methodology. Nielsen's census/sample integration combines these two pieces of information to create a full view of the marketplace.

dataset, the non-stationarity original displayed was eliminated by a first-difference transformation. The Augmented Dickey-Fuller (ADF) test statistic was -3.034 with a p-value of 0.1128, and therefore I was unable to reject the null hypothesis of non-stationarity. This newly transformed variable is also identified as stationary because the growth from one particular season to the next, and from one year to the next remains fairly consistent; meaning that the level of growth rising and falling throughout the course of a given year is fairly the same. This suggests that regardless of whether or not it's a warmer summer season or a cooler winter season, the overall growth of total NA beverage unit volume at U.S. convenience stores is fairly the same in both seasons (see Figure 6).

This analysis ultimately maintains a broad perspective in seeking to understand the general relation that convenience store beverage units have with the set of explanatory variables selected. I'm more interested in whether or not people buy more or less (net) beverage units rather than the actual quantity, size, or brand of the unit they buy. I am however interested in examining the shift from the SSB category to the 'still beverage' category.

Data Collection: U.S. convenience store scanning data is the electronic capture of UPC level transactions for each sample and census store(s) via scanners. According to Nielsen, retail tapes provide UPC, number of units sold, and selling price. Most facts are calculated by Nielsen from these three pieces of information and retailers send these tapes to Nielsen every week. This dataset is measured through the process of census/sample integration (CSI) and Nielsen works proactively with manufacturers and retailers to enhance data quality, yet there still remains the opportunity for errors in the data to occur. For example, missing edits of 'new stores', 'price range', 'missing data' or ‘outlier’ edits. There is also a chance of random quality control errors occurring, things that could include issues such as UPC glitches, manufacturing mistakes, checker/auditor errors, or even retailer tape problems. For the purpose of this analysis, I assume that the sample is representative of the total U.S. convenient store NA beverage sales.

U.S. Convenience Store Total NA ‘Sugar-Sweetened Beverage’ Unit Volume Sales

Source: The Nielsen Company, 2016 – It captures the weekly total amount of non-alcoholic SSB units purchased at U.S. convenience stores from January 16, 2010 to April 2016. This variable is included as a part of the main dependent variable: total beverage unit volume sales statistic and it’s only used when comparing the estimations of the three dependent variable categories; ‘total beverage’, ‘sugar-sweetened beverage’, and ‘still beverage’ (see Table 4) to each other and analyzing their individual relation with the set of explanatory variables. The variable defines the beverage subcategory of ‘sugar-sweetened beverages’ otherwise known as ‘carbonated soft drinks’ or ‘sparkling soda drinks’. This category is defined as any NA beverage that includes some form of ‘carbonation’ or ‘sparkling’ element. Unlike the non-stationarity displayed in the total beverage variable, the ADF test statistic for SSB is -5.515 with a significant p-value and thus I reject the null of non-stationarity and keep this dependent variable (subcategory) in its original level form. This variable provides the ability to generate the ‘still beverage’ subcategory which allows for market-share and trend analysis. Similarly, a beverage unit, consists of any SSB product UPC that is scanned electronically. Nielsen utilizes both a census/sample integrated (CSI) methodology in reporting this time-series data set.

U.S. Convenience Store Total NA ‘Still Beverage Unit Volume’ Sales

Source: The Nielsen Company, 2016 – This variable captures the weekly total amount of non-alcoholic ‘still beverage’ units sold at all participating U.S. convenience stores and is also included in the main dependent variable: total beverage unit volume sales metric. This beverage subcategory defines a variety of beverage types that are otherwise ‘non-carbonated’ and includes items such as juices, teas, water, and sports drinks. The ‘still beverage’ unit volume sales statistic is only used in the model when comparing the three dependent variable (coefficient estimations of ‘total beverage’, ‘sugar-sweetened beverage’, and ‘still beverage’) categories to each other and their individual relation with the explanatory variables. This variable is generated, by subtracting SSB unit volume sales from total NA unit volume sales. Similarly, a beverage unit (in this case) consists of any ‘still beverage’ product UPC that is scanned electronically. The first-difference transformation of this variable was necessary because the results of the ADF test showed a -2.624 test statistic with a p-value of 0.2688.

U.S. Average Retail Price of Conventional Gasoline (per gallon in USD)

*Source*: U.S. Energy Information Administration: Weekly Retail Gasoline and Diesel Prices (Dollars per Gallon, Including Taxes); Subcategory: Petroleum and Other Liquids – Weekly Data. Conventional (all formulations) retail price of a gallon of gasoline (in USD). This variable captures the weekly U.S. average conventional gasoline retail price per gallon. Due to the non-stationary characteristics, and the inability to reject the null hypothesis of non-stationarity through the ADF test, the retail gas price data was transformed into the first-difference form to remove the effects of trend and seasonality and to conform to OLS assumptions. [15] The transformed series drastically reduces the trend that was displayed in the original plot, and appears to exhibit a stochastic process (see Figure 7). Additionally, the time-series plot of gasoline prices in its original form

[15] ADF test statistic equals -0.978 and the p-value equals 0.9471; therefore, unable to reject the null hypothesis of non-stationarity.

(see Figure 14) shows that since the beginning of 2014 there's been a decline in the price (per gallon) of conventional gasoline, which is likely due to the corresponding 2014 decline in the WTI crude oil index. Prior to 2014 the average weekly U.S. price was regularly above $3.50 per gallon, but in the first quarter of 2016 the average price per gallon was consistently below $2 dollars.

<u>Powerball Lottery Variable (weekly maximum jackpot amount in USD)</u>

Source: Multi-State Lottery Association (MUSL). This variable reflects the weekly maximum jackpot size of the Powerball lottery from January 2010 to April 2016. The Powerball lottery holds jackpot drawings on Wednesday and Saturday night. The randomness of the Powerball jackpot size (see Figure 10) and the lack of a developed pattern make it more difficult to forecast a jackpot size and the length of time it will take to generate it.

During the initial data analysis, several interesting things stood out in the data that warranted further investigation. First, the data begins with somewhat smaller jackpot prizes and ends with several larger jackpots, but that this is largely due to rules changes aimed at generating larger jackpots. In January 2012, the MUSL made an amendment to game rules which worsened the odds of winning while simultaneously increasing the odds of generating record Powerball jackpots. The policy manipulations by the MUSL help to explain why jackpot amounts in the dataset begin small and end much larger.

Next, from 2014 to 2016, there are noticeable periods in which the Powerball jackpot grows and becomes the largest jackpot of that calendar year. These periods conveniently correspond to the Christmas and New Year holidays where Americans are more inclined to give and receive holiday gifts, and more inclined to travel or spend money at retailers. The start of a new year can also bring with it the feeling of a 'fresh start’ which can potentially impact the level of lottery player optimism towards winning jackpots and possibly could affect the level of interest the Powerball lottery game experiences in the month of January.

Interestingly, the period of the year in which we’ve recently seen the largest Powerball jackpots are during the same period when U.S. convenience store beverages experience the lowest levels of NA beverage sales. Due to the high degree of seasonality that effects total NA beverage sales, specifically during the winter months, it’s conceivable that the random and unpredictable behavior of the Powerball jackpot size could actually have less of an effect (or a negligible effect) on the level of total NA beverage units sold at convenience stores. This would go against the original prediction, suggesting instead that the effects of the seasonal trend could indeed have a greater effect on total beverage unit volume sales despite a potential record Powerball jackpot size.

Data Collection*:* Due to the nature of the data and the fact that a week begins on Sunday and ends on Saturday, I made sure that the Powerball variable maintained a weekly frequency by using the Saturday jackpot drawing amount and creating a new Powerball lottery dataset that instead only consisted of the one maximum jackpot amount during any given week (regardless of whether it was on the Wednesday drawing or the Saturday drawing).

<u>Powerball Lottery Dummy Variable (weekly maximum jackpot in USD>$150 million)</u>

Source: The Powerball dummy variable takes a value of one if the Powerball jackpot is in excess of $150 million dollars. The general purpose of this variable is to capture any impact that a particularly large Powerball jackpot has on total NA beverage sales. This process starts with testing Powerball sizes greater than $150 million because it’s just above the average weekly Powerball jackpot maximum amount.

Powerball Lottery Lagged Dummy Variable (weekly maximum jackpot in USD>$150 million)

Source*:* The lagged Powerball dummy variable takes a value of one if the once-lagged Powerball lottery jackpot prize amount is in excess of $150 million dollars.[16] This variable captures any impact that last week's Powerball jackpot size (at certain jackpot levels) has on the current weeks NA beverage sales. Additional lagged Powerball dummy variables were generated utilizing the historical lottery jackpot drawings and prizes from the Multi-State Lottery Association, Powerball website.

U.S. Average Climatic Condition – Cooling Degree Day (CDD)

Source: The American Gas Association – Cooling Degree Day Data. Origin: U.S. Department of Commerce, National Oceanic and Atmospheric Administration. According to the American Gas Association, Cooling Degree Days are a measure of the need for air conditioning (cooling) based on the extent to which the daily mean temperature rises above a reference temperature of 65 degrees Fahrenheit. Therefore, a daily mean temperature represents the sum of the high and the low daily readings and dividing them by two. The average weekly Cooling Degree Day measurement is recorded across nine different geographic regions in the U.S.[17] Here, it's clear to see how the dual season effects the data, where the static months can indeed be considered periods of Heating Degree Days (or winter). The variable was also transformed to create a stationary series since the ADF test statistic equaled -2.777 and the p-value was 0.2056 (see Figure 10).

[16] Dummy variables were created for Powerball sizes from $150 million to $1.5 billion. The $900 million dollar threshold happens to be slightly below the January 9,2016 Powerball jackpot ($949 million), the drawing directly preceding the record $1.5 billion dollar jackpot on January 13, 2016, therefore the lagged dummy variables were created from $150 million to $900 million (in various increments).

[17] Nine U.S. Regions: New England, Middle Atlantic, E N Central, W N Central, South Atlantic, E S Central, W S Central, Mountain, and Pacific

Cooling Degree Day Dummy Variable

Source: The American Gas Association – Cooling Degree Day Data. Origin: U.S. Department of Commerce, National Oceanic and Atmospheric Administration. This variable also uses the Cooling Degree Day variable, but to generate a binary variable that seeks to control for the dual-seasonality effect discovered in the data of total beverage unit volume. The variable is set equal to zero if the Cooling Degree Day variable is also zero, and it equals one when the CDD is a positive integer. The purpose behind this variable is to estimate whether or not total NA beverage sales is statistically significantly different in the warmer summer months versus the cooler winter months.

Biweekly Payday Schedule Dummy Variable

Source: U.S. General Services Administration – Payroll Calendar 2010. According to the U.S. Department of Labor - Bureau of Labor Statistics, the majority of U.S. employees are paid on a biweekly basis. Accordingly, I seek to estimate the effect of the biweekly payday on the level of NA beverage sales at U.S. convenience stores. The first payday of the 2010 payroll calendar was Wednesday, January 13, 2010 and therefore the week ending Saturday, January 16, 2010 is classified as a payday week. Due to the nature of biweekly pay, every other week in the dataset (starting with January 16, 2010) is set equal to 1. Conversely, an additional biweekly 'off-payday' variable was created and programmed to equal zero if the week experienced a payday and if the week was an 'off week' or 'non-payday', (i.e. the week following a payday), then the dummy variable was set equal to 1.

Both variables capture the effects of the biweekly payday schedule, but in different ways and are not included together in the model. For example, since the week ends on Saturday and the biweekly payday schedule is on Wednesdays, the payday dummy variable is capturing the effect on total beverage unit volume when employees are paid half-way through the week. This is capturing the effects that the work week, in which employees are furthest from their last paycheck and closest to their next paycheck, has on the sales of total NA beverages at U.S. convenient stores. Theoretically, for those biweekly employees that have limited budgets or live paycheck-to-paycheck, these particular weeks would be the weeks in which they have the least amount of money to spend. On the other hand, in the week after the biweekly Wednesday paycheck, employees would theoretically have the most amount of money to potentially spend on convenience store items and therefore it’s also highly conceivable that during this week, employee consumption behavior would be able to have the most significant impact on U.S. convenience store total NA beverage sales.

U.S. Average Price Per Total Non-Alcoholic Beverage Unit (in USD/unit)

Source: The Nielsen Company, 2016 – Generated from time-series data of total dollar volume and total unit volume NA beverage sales, this variable captures the weekly average price per NA beverage unit at U.S. convenience stores. The variable, in its original form, displays a seasonal trend in which most summer periods show price decreasing and during the winter months the price is increasing. Additionally, the results from an ADF test were insufficient to reject the null hypothesis of non-stationarity.[18] To eliminate this trend, the variable is first-difference. The transformation greatly improves the stationarity of the series despite the periodic ‘spikes’ displayed in the first-difference growth plot of the beverage unit price starting around 2013 and continuing annually at a

[18] The Augmented Dickey-Fuller (ADF) test statistic equals -2.678 and the corresponding p-value equals 0.2452.

diminishing rate.  This random set of 'spikes' at year-end is likely attributable to the U.S. holiday season in which retail shopping demand increases.

U.S. Average Price Per Non-Alcoholic 'Sugar-Sweetened Beverage' Unit (in USD/unit)

Source: The Nielsen Company, 2016 – Utilizing 'SSB' dollar volume and unit volume data, this variable captures the weekly average price per non-alcoholic SSB unit at U.S. convenience stores. This variable is used as a proxy for 'sparkling/soda' beverage price, and represents the overall average price of a single SSB (unit) at U.S. convenience stores.

U.S. Average Price Per Non-Alcoholic 'Still Beverage' Unit (in USD/unit)

Source: The Nielsen Company, 2016 – Using 'still beverage' dollar and unit volume scanning data; originally from weekly retail tapes that provide UPC, number of units sold, and selling price for census stores. This variable captures the weekly average price per 'still beverage' unit sold at U.S. convenience stores.  Similarly, this variable is used as a proxy for 'still beverage' price, and represents the average price of a single 'still beverage' unit at U.S. convenience stores.

U.S. Convenience Store Total Non-Alcoholic Beverage Unit Volume Sales (Lags 1-4)

Source: The Nielsen Company, 2016 – Based on total NA beverage unit volume sales, the lag dependent variables, lags 1 through 4, included in the model are used to control for the monthly (4-week) budgetary cycle effect on the original dependent variable.  The notion being that most people tend to follow monthly budgeting patterns that can dictate how their money is spent on a four to five-week basis.  Therefore, I assume purchases of beverage products in each of the previous four weeks impact the current weeks' total beverage unit volume sales.

Table 1, provides a detailed summary of descriptive statistics on the most relevant variables.  The sample was made up of 325 observations from January 2010 to April

2016. The total sales of NA beverages at U.S. convenience stores exceeded $500 million dollars per week on average, implying revenues surpass $26 billion dollars annually. Also, note that the 'still beverage' category, on average, sells approximately 72 million more beverage units per week than the SSB category at U.S. convenience stores. This results in a relatively large discrepancy in the total revenue in each category with 'still beverages' averaging more than double the weekly revenue than that of the 'sugar-sweetened beverage' category. There is a large range in the Powerball lottery weekly maximum variable, the minimum is $25 million and the maximum is $1.59 billion with a weekly average maximum jackpot of $126 million.

## RESULTS AND DISCUSSION

The primary comparison displayed in Table 4 shows that each dependent variable is effected in rather different ways by the same set of explanatory variables and these variables explain different amounts of the variability in their respective dependent variables. For example, in the SSB category, the independent variables explain 67.2% of the variation in the dependent variable, while the same comparison for ‘still beverages’ results in an explanation of roughly 61.9% of the movement of beverage sales. No matter which category, the retail price of gasoline has no effect on the total number of NA beverage units sold. Since the price of gasoline (at-the-pump) doesn’t have a strong relationship with NA beverage sales, using it as an indicator to predict future NA beverage sales at U.S. convenience stores would likely yield unreliable results. This finding goes against my original assumption that the average gas price would help determine or forecast total weekly NA beverage sales at U.S. convenience stores.[19]

The average price of a SSB unit and ‘still beverage’ unit both have significant effects on the number of respective beverage units sold. This comparison and the results from subcategory testing indicate which variables have the most impact ‘total beverage’ sales. The estimates show that a one-cent increase in the average price of a NA ‘still beverage’ unit results in roughly a 3.8 million unit decrease (+/- 1/4 million) in the number of weekly ‘still beverage’ units sold. Likewise, a one-cent increase in the average weekly price of a ‘total beverage’ unit (which includes both ‘SSB’ and ‘still

[19] See the related proposal by the U.S. Energy Information Administration, December 15, 2014 report titled “*Gasoline prices tend to have little effect on demand for car travel*”, Source: eia.gov/todayinenergy/detail.php?id=19191

beverages') results in roughly a 5.6 million unit decrease (+/- 1/2 million) in the number of total NA beverages sold at U.S. convenience stores.

All three dependent variables do not display the same statistically significant relationship with respect to the Cooling Degree Day measurement, in which an average increase in the temperature (keeping all other variables constant) corresponds to an increase in the dependent variable. The OLS estimation results suggest that a 10 degree increase in the U.S. average weekly Cooling Degree Day statistic will result in an increase of over one-quarter of a million NA beverage units. For the 'still beverage' subcategory, the same 10 degree increase results in roughly a 120 thousand unit increase, respectively. The Cooling Degree Day variable is shown not to have a significant relationship with SSB sales.

The Cooling Degree Day dummy variable, which controls for the dual-seasonality effects on beverage unit sales is significant for SSB sales but not statistically relevant for the other two categories. The results indicate that during the summer season, SSB sales increase and emphasize the importance that summer has on total SSB consumption. It also indicates that there's no statistical difference (in the rate of total beverage sales, or 'still' sales) between the warmer summer months and the cooler winter months. Suggesting that the rate of beverage sales throughout the calendar year is consistent and doesn't vary drastically from season to season. The lack of a defined patterned in the plotted data of the first-difference of the dependent variable further confirms that the rate of growth (or the number of 'ups and downs') stays fairly steady throughout the entire data series.

The findings also show the fluctuating effect that the biweekly 'off-payday' variable has on the two dependent variable subcategories ('SSB' and 'still' unit sales) versus its effect on total NA beverage sales.[20] The regression results suggest that the biweekly 'off-payday' has a statistically significant relationship with the unit sales of 'total beverage' but does have the same effect on the sales of SSB or 'still beverage' units. Another unique finding is that the biweekly payday ('off-week') provides the positive response to the dependent variable (compared to the payday week). This was earlier explained by the discrepancy in the alignment of midweek paydays and end-of-week total beverage data, and the idea that during the actual payday week employees may experience budgetary shortcomings in the beginning of the week that restrict their ability to significantly impact convenience store total NA beverage unit growth during the same week. Conversely, the payday 'off-week' dummy variable shows that whenever it's the week after a payday, when employees likely have the greatest ability to spend the bulk of their income, there results in roughly a 1.6 million unit increase in total NA beverage units sold at convenience stores.

The relationship that the biweekly payday schedule has with total beverage unit sales is important for U.S. convenience retailers. This finding provides implications for the timing of promotional pricing initiatives because it's conceivable that people could be more willing to pay a higher price during an 'off-payday' week because they have the bulk of their income, and possibly more attentive to price changes during payday weeks, therefore individual product responses to changes in price may vary during different types of payday weeks.

The OLS estimates when the Powerball jackpot variables are included are shown in Table 5. The focus here remains on estimating the Powerball lottery's jackpot effect

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[20] 'Off-payday' weeks are the weeks situated in-between payday weeks (i.e. non-payday weeks), assumed during these weeks biweekly employees have the ability to spend the bulk proportion of their biweekly income. Begins each week on the Sunday after a Wednesday payday and ends on the following Saturday.

on the total number of NA beverages sold at U.S. convenience stores and thus the dependent variable is total beverage unit sales for each of the four models and what changes is the type of Powerball variable(s) included. The first column (Model 5) shows that including the maximum weekly Powerball jackpot (unlike the Powerball jackpot variables that represent amounts in excess of $150 million) eliminates the significance of any biweekly off-payday effect, and it also does not significantly impact the number of total beverage units sold during a corresponding week. This finding goes against the initial theory that the Powerball jackpot size would have a significant effect on the unit sales of NA beverages.

The second column (Model 6) in Table 5, includes the generated Powerball dummy variable jackpot size in excess of a $150 million prize/payout. The regression process begins at $150 million and continues by generating and testing each jackpot threshold dummy variable, in increments of $50 million or $100 million, all the way up to $1.5 billion dollars. The OLS estimates show that at no point are the estimated coefficients of the various Powerball jackpots statistically significantly different from zero. This finding is also contrary to the original prediction that jackpot lottery size has a significant effect on total beverage sales as the jackpot sizes increase. It's less surprising that the smaller jackpot thresholds (i.e. the $100 million and $200 million jackpots) did not have statistically significant effects because on average, the weekly jackpot size is $126 million dollars and therefore these smaller threshold amounts would likely have less of an impact on beverage sales than would the much larger jackpot threshold amounts. At the same time, it's interesting to see that for the 'still beverages' subcategory, the Powerball lagged dummy variable (greater than $150 million) has a significant effect on the current level of 'still beverage' sales.

The third and fourth columns (Model 7 and 8) in Table 5, show how the inclusion of the lagged Powerball jackpot dummy variable and the inclusion of all Powerball variables simultaneously also does not have the significant effect on total NA beverage sales. Even when all Powerball variables are included together, there is no significant effect on the sales of total NA beverages.

Further analysis shows that in Tables 6 and 7, the beverage subcategories react differently than the 'total beverage' category to changes in Powerball jackpot size. Each beverage subcategory is shown to have significant relations with the lagged Powerball variable when they are at least above the average weekly jackpot size of $126 million. When the Powerball jackpot is greater than $150 million, 'still beverage' sales are significantly impacted. Likewise, when the jackpot exceeds $700 million, there's a significant effect on the sales of SSB's at convenience stores.

The process for the lagged variables begins at $150 million (lagged 1 period) and continues until $900 million (lagged 1 period), which was the highest lagged jackpot amount that immediately preceded the $1.5 billion jackpot recorded in January 2016. I find that the threshold level or magnitude of the previous weeks' Powerball jackpot size also has no significant impact on total NA beverage units in the current week (unless it's at the $150 million or $700 million jackpot levels). This further confirms the notion that the various Powerball jackpot sizes (whether in the current or previous week) do not all hold significant relations with U.S. convenience store NA beverage sales (both 'still beverage' and SSB) in the same uniform way. Unless the previous week's Powerball jackpot is above $150 million (for 'still') or above $700 million (for SSB), the Powerball lottery has no substantial effect on the sales of NA beverages at convenience stores. Yet again, the variables that consistently remain statistically significant throughout this analysis are the average total NA beverage price per unit, Cooling Degree Days, and the biweekly payday effect.

The consistency of these significant relationships underscores the importance of the three particular explanatory variables chosen to remain in the Preferred Model (see Table 8). Their effect on U.S. convenience store total NA beverage sales is apparent. To avoid issues related to extraneous effects and to the potential to overfit the model, tests of robustness were performed to generate the Preferred Model, and it focuses solely on the most relevant and significant variables affecting NA beverage sales at U.S. convenience stores.

With the highest adjusted $R^2$ statistic and the lowest RMSE (amongst comparable results), this model suggests that a one-cent increase in the average unit price of NA beverages at U.S. convenience stores results in over a 5.6 million unit decrease in the total number of NA beverage units sold (holding all other variables constant). This amounts to a potential loss of over $10 million dollars for convenience retailers.[21]

These results also show that a 10-degree increase in the average Cooling Degree Day statistic results in roughly a one-quarter of a million unit increase in weekly NA beverages sold. During the warmest Cooling Degree Day weeks, convenience stores could experience upwards of 2.7 million more beverage units sold.[22] The evidence suggests that the average price per unit has the greatest effect on total beverage unit sales at U.S. convenience stores, followed by the climatic conditions represented by the Cooling Degree Day statistic and, lastly, by the biweekly 'off-payday' effect. Overall the

[21] $10,282,213.70 = $1.83/average price per total non-alcoholic beverage unit multiplied by the estimated coefficient on the beverage unit price variable; 5,618,696.

[22] Maximum Cooling Degree Day statistic divided by ten; and then this result (10.7) multiplied by the OLS estimated coefficient on Cooling Degree Days; 256,072

effect that the biweekly ‘off-payday’ has on beverage sales is statistically significantly different from zero, and thereby implies that in the week following a payday week there is a significant effect on total NA beverage sales.

## CONCLUDING REMARKS

The findings of this report, support the conclusion that the retail price of conventional gasoline and the weekly maximum Powerball jackpot size in the U.S. have no significant effect on the level of total NA beverage sales at U.S. convenience stores. For the Powerball lottery jackpot to have any significant impact on U.S. convenience store beverage sales, it needs to be consistently much larger than what it is today. Some stores may experience surges in traffic during exceptionally large or (record) jackpot sizes, but the infrequent occurrence of these jackpots limits any sustainable effect on NA beverage sales. What has the largest impact to the weekly NA beverage sales at U.S. convenience stores, is the individual unit price of the beverage. The second most important factor is the outside temperature in terms of the Cooling Degree Day statistic. Lastly, this study confirms the importance of the biweekly payday schedule and validates its effect on U.S. convenience store NA beverage sales.

It's clear that since 2010, the behavior of convenience store consumers in the U.S. has shifted largely in favor of a healthier beverage category, which, in effect, has positive health implications for studies and policy related to solving the current obesity crisis.[23] There's now a much larger share of convenience store consumers who prefer 'still beverage' products to 'SSB' products despite having a $0.39 cent higher average unit price. The findings also underscore the point that Oster (2004) makes in which the

[23] Nutrition, Physical Activity and Obesity Data, Trends and Maps web site. U.S. Department of Health and Human Services, Centers for Disease Control and Prevention (CDC), National Center for Chronic Disease Prevention and Health Promotion, Division of Nutrition, Physical Activity and Obesity, Atlanta, GA, 2015. Available at cdc.gov/nccdphp/DNPAO/index.html.

benefits of the Powerball lottery appear to have a greater effect when the size of the jackpot is significantly larger.[24]

Beverage pricing analysis at an individual product level would serve to complement this analysis by providing insight into the distinctions between various beverage types/quantities. As consumer behavior shifts, it becomes increasingly important for the beverage industry to find ways to offer 'still beverage' products at lower unit prices. It also introduces challenges for the 'sugar-sweetened beverage' industry in how to stimulate sales in SSB unit/dollar volume (especially in the winter), and may ultimately force them to take drastic new measures in how they market, design, package, and price their SSB products in U.S. convenience stores.

Convenience retailers who better understand the importance of strategic beverage unit pricing, customer payday patterns, and climatic effects will have greater success in innovating and improving the implementation and strategic timing of beverage sales promotion and pricing initiatives that seek to increase total NA beverage sales.

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[24] According to Oster (2004); the lottery becomes progressive at a jackpot around $806 million. Suggesting that concerns about regressivity might be allayed by concentrating lotto games to produce higher average jackpots.

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# APPENDIX A: TABLES

**TABLE 1: Summary Descriptive Statistics**
**Beverage Unit/Dollar Volume, Powerball Lottery Jackpot, Gas Price, Beverage Price, Cooling Degree Day Variables**
**(Dependent Variable: First-Difference of Weekly Beverage Unit Volume Sales 2010-2016:Q1)**

| Variable | Observations | Mean | Standard Deviation | Minimum | Maximum |
|---|---|---|---|---|---|
| U.S. Convenience Store Weekly Non-Alcoholic Total Beverage Unit Volume | 325 | 280,000,000 | 32,800,000 | 206,000,000 | 352,000,000 |
| U.S. Convenience Store Weekly Non-Alcoholic Total Beverage Dollar Volume | 325 | $513,000,000 | $62,600,000 | $370,000,000 | $658,000,000 |
| U.S. Convenience Store Weekly 'Sugar-Sweetened Beverage' Unit Volume | 325 | 104,000,000 | 5,514,260 | 89,200,000 | 115,000,000 |
| U.S. Convenience Store Weekly 'Sugar-Sweetened Beverage' Dollar Volume | 325 | $165,000,000 | $9,333,453 | $139,000,000 | $188,000,000 |
| U.S. Convenience Store Weekly 'Still Beverage' Unit Volume | 325 | 176,000,000 | 28,100,000 | 117,000,000 | 240,000,000 |
| U.S. Convenience Store Weekly 'Still Beverage' Dollar Volume | 325 | $348,000,000 | $54,000,000 | $231,000,000 | $474,000,000 |
| Powerball Lottery Weekly Maximum Jackpot Amount | 325 | $126,000,000 | $130,000,000 | $25,000,000 | $1,590,000,000 |
| U.S. Average Weekly Retail Gasoline Price Per Gallon of Regular (Conventional) Gasoline | 325 | $3.09 | $0.56 | $1.64 | $3.91 |
| U.S. Convenience Store Weekly Total Non-Alcoholic Beverage Price Per Unit | 325 | $1.83 | $0.06 | $1.73 | $1.97 |
| U.S. Convenience Store Weekly 'Sugar-Sweetened Beverage' Price Per Unit | 325 | $1.59 | $0.04 | $1.53 | $1.70 |
| U.S. Convenience Store Weekly Still Beverage Price Per Unit | 325 | $1.98 | $0.07 | $1.84 | $2.13 |
| U.S. Average Weekly Cooling Degree Day | 325 | 23.6 | 31.9 | 0 | 107 |

Notes: sources - Nielsen market research scanning data, Multi-State Lottery Association, U.S. Energy Information Administration, and the American Gas Association.

**TABLE 2: OLS Estimates of the Effect of Gas Price, Beverage Price, Cooling Degree Day, Payday and Dependent Lags(1-4) on U.S. Convenience Store Total Non-Alcoholic Beverage Sales (Dependent Variable: First-Difference of Weekly Beverage Unit Volume Sales 2010-2016:Q1)**

| | Total Beverage (First-Difference) (Model 1) | Total Beverage (First-Difference) (Model 2) |
|---|---|---|
| Gas Price (First-Difference) | 13971.5 | -48720.5 |
| | (75480.3) | (75548.5) |
| Beverage Price (First-Difference) | -5481092.6 *** | -5635688 *** |
| | (563863.0) | (575742.6) |
| Cooling Degree Day (First-Difference) | 267035.2 *** | 255091.6 *** |
| | (44403.8) | (45343.4) |
| Cooling Degree Dummy | 715575.1 | 330374.1 |
| | (833289.1) | (847087.5) |
| Payday Week Dummy | 1296721 | 1616662 * |
| | (804738.2) | (819523) |
| Total Beverage | | |
| Lag(1) | -0.177 *** | |
| | (0.0445) | |
| Lag(2) | -0.074 | -0.0393 |
| | (0.0449) | (0.0451) |
| Lag(3) | 0.0144 | 0.0327 |
| | (0.0462) | (0.0470) |
| Lag(4) | 0.0447 | 0.0374 |
| | (0.0463) | (0.0474) |
| Constant | -414705 | -467809.3 |
| | (667921.2) | (683485.1) |
| R-Squared | 0.449 | 0.421 |
| AIC | 10999.4 | 11013.3 |
| BIC | 11037.1 | 11047.2 |
| F | 28.11 | 28.31 |
| N | 320 | 320 |

*Standard Errors in Parentheses*

*(* p<0.05, ** p<0.01, ***p<0.001)*

**TABLE 3: OLS Estimates of the Effect of Gas Price, Beverage Price, Cooling Degree Day, Payday and Dependent Lags(2-4) on U.S. Convenience Store Total Non-Alcoholic Beverage Sales**
**(Dependent Variable: First-Difference of Weekly Beverage Unit Volume Sales 2010-2016:Q1)**

| Source | SS | df | MS | | |
|---|---|---|---|---|---|
| | | | | Number of Obs. = | 320 |
| | | | | F(8, 311) = | 28.31 |
| Model | 1.1413E+16 | 8 | 1.4266E+15 | Prob > F = | 0.0000 |
| Residual | 1.5673E+16 | 311 | 5.0394E+13 | R-squared = | 0.4214 |
| Total Beverage* | 2.7085E+16 | 319 | 8.4907E+13 | Adj. R-squared = | 0.4065 |
| | | | | Root MSE = | 7100000 |

| Total Beverage* | Coefficient | Standard Error | t | P>\|t\| | [95% Confidence Interval] | |
|---|---|---|---|---|---|---|
| Gas Price* | -48720.51 | 75548.53 | -0.64 | 0.5190 | -197371.4 | 99930.36 |
| Beverage Price* | -5635688 | 575742.6 | -9.79 | 0.0000 | -6768531 | -4502844 |
| Cooling Degree Day* | 255091.6 | 45343.39 | 5.63 | 0.0000 | 165873 | 344310.3 |
| Cooling Degree Dummy | 330374.1 | 847087.5 | 0.39 | 0.6970 | -1336373 | 1997121 |
| Payday Week Dummy | 1616662 | 819523 | -1.97 | 0.0490 | 4150.7 | 3229172 |
| Total Beverage | | | | | | |
| Lag(2) | -0.0393151 | 0.045059 | -0.87 | 0.384 | -0.1279741 | 0.049344 |
| Lag(3) | 0.0327179 | 0.0469985 | -0.70 | 0.487 | -0.0597574 | 0.1251932 |
| Lag(4) | 0.0373587 | 0.04738 | 0.79 | 0.431 | -0.0558671 | 0.1305845 |
| Constant | -467809.3 | 683485.1 | -0.68 | 0.494 | -1812649 | 877030.5 |

**(First-Difference)*

**TABLE 4: OLS Estimates of the Effect of Gas Price, Beverage Price, Cooling Degree Day, and Payday on U.S. Convenience Store Total Non-Alcoholic Beverage Sales, Sugar-Sweetened Beverage Sales and Still Beverage Sales (Dependent Variable: First-Difference of Weekly Beverage Unit Volume Sales 2010-2016:Q1)**

| | Total Beverage (First-Difference) (Model 2) | Sugar-Sweetened Beverage (Model 3) | Still Beverage (First-Difference) (Model 4) |
|---|---|---|---|
| **Gas Price** (First-Difference) | -48720.5 | 30303.1 | -8955.9 |
| | (75548.5) | (34334.5) | (43857.3) |
| **Total Beverage Price** (First-Difference) | -5635688 *** | | |
| | (575742.6) | | |
| **Sugar-Sweetened Beverage Price** (First-Difference) | | -491851.0 * | |
| | | (231664) | |
| **Still Beverage Price** (First-Difference) | | | -3854704.0 *** |
| | | | (250630.0) |
| **Cooling Degree Day** (First-Difference) | 255091.6 *** | 35661.2 | 119410.0 *** |
| | (45343.4) | (18763.2) | (28557.4) |
| **Cooling Degree Dummy** | 330374.1 | 2870361.0 *** | 431574.4 |
| | (847087.5) | (456238.1) | (498505.5) |
| **Payday Week Dummy** | 1616662.0 * | 348407.7 | 782025.0 |
| | (819523.0) | (360477) | (473301.9) |
| **Total Beverage Lag(2)** | -0.0393 | 0.0355 ** | -0.00978 |
| | (0.0451) | (0.0623) | (0.0361) |
| **Lag(3)** | 0.0327 | 0.0955 | -0.00373 |
| | (0.0470) | (0.0732) | (0.0383) |
| **Lag(4)** | 0.0374 | 0.2264 *** | 0.00699 |
| | (0.0474) | (0.0621) | (0.0386) |
| **Constant** | -467809.3 | 32000000 *** | -235236.4 |
| | (683485.1) | (4583947) | (394978.8) |
| **R-Squared** | 0.421 | 0.672 | 0.619 |
| **F** | 28.31 | 79.92 | 63.06 |
| **N** | 320 | 321 | 320 |

***Standard Errors in Parentheses***

***(* p<0.05, ** p<0.01, ***p<0.001)***

**TABLE 5: OLS Estimates of the Effect of Powerball Jackpot, Gas Price, Beverage Price, Cooling Degree Day, and Payday on U.S. Convenience Store Total Non-Alcoholic Unit Volume Beverage Sales**
**(Dependent Variable: First-Difference of Weekly Total Beverage Unit Volume 2010-2016:Q1)**

| | Total Beverage (First-Difference) (Model 5) | Total Beverage (First-Difference) (Model 6) | Total Beverage (First-Difference) (Model 7) | Total Beverage (First-Difference) (Model 8) |
|---|---|---|---|---|
| Powerball Jackpot Maximum (Natural-Logarithm) | -244827.1 | | | -599986.3 |
| | (581970.6) | | | (912577.4) |
| Powerball Jackpot > $150 Million | | 11948.6 | | -242631.1 |
| | | (912085.2) | | (1548851) |
| Powerball Jackpot > $150 Million Lag(1) | | | 1300607 | 1815282 |
| | | | (907926.3) | (1079233) |
| Gas Price (First-Difference) | -50261.9 | -48687.7 | -52971.9 | -59097.71 |
| | (75737.4) | (75711.7) | (75479.4) | (75775.1) |
| Beverage Price (First-Difference) | -5651636 *** | -5635357 *** | -5655873 *** | -5709650 *** |
| | (577751) | (577221.2) | (574943.9) | (577667.6) |
| Cooling Degree Day (First-Difference) | 253746.3 *** | 255130.9 *** | 255732.7 *** | 251892.9 *** |
| | (45516.0) | (45515.1) | (45269.1) | (45462.6) |
| Cooling Degree Dummy | 321911.0 | 330273.8 | 292417.4 | 258692.8 |
| | (848449.2) | (848487) | (846073.4) | (848113.4) |
| Payday Week Dummy | 1597792 | 1617346 * | 1540709 | 1450508 |
| | (821834.5) | (822505.5) | (819856.6) | (826462.7) |
| Total Beverage Lag(2) | -0.0401 | -0.0393 | -0.0377 | -0.039 |
| | (0.0452) | (0.0451) | (0.0449) | (0.0451) |
| Lag(3) | 0.0335 | 0.0327 | 0.0353 | 0.0385 |
| | (0.0471) | (0.0471) | (0.0469) | (0.0471) |
| Lag(4) | 0.0376 | 0.0374 | 0.0368 | 0.0372 |
| | (0.0474) | (0.0475) | (0.0473) | (0.0474) |
| Constant | 666655.9 | -471216.6 | -751797.3 | 10300000 |
| | (2782201) | (732330) | (710548) | (16500000) |
| R-Squared | 0.422 | 0.421 | 0.425 | 0.428 |
| F | 25.12 | 25.08 | 25.48 | 20.91 |
| N | 320 | 320 | 320 | 320 |

***Standard Errors in Parentheses***
***(* p<0.05, ** p<0.01, ***p<0.001)***

TABLE 5. Notes to Table 5. Time-series beverage and price data are from the Nielsen market research scanning data of U.S. Convenience Store total non-alcoholic beverage weekly unit and dollar volume sales from January 2010 to April 2016. The Multi-State Lottery Association (MUSL) Powerball lottery historical data archive and the U.S. Energy Information Administration (EIA) containing average U.S. retail price of conventional gasoline (per gallon). Climatic data is from the American Gas Association (AGA) and refers to Cooling Degree Day measures of the need for air conditioner based on the extent to which the daily mean temperature rises above a reference temperature of 65 degrees Fahrenheit. The final column, Model 8, displays the estimates when all Powerball variables are simultaneously included in the model together. This method does not introduce the notion of discontinuity between lottery sales and beverage demand since at no particular jackpot level did the various Powerball variables become statistically significant.

**TABLE 6: OLS Estimates of the Effect of Powerball, Gas Price, Beverage Price, Cooling Degree Day, Payday and Dependent Lags(2-4) on U.S. Convenience Store Non-Alcoholic Still Beverage Sales**
**(Dependent Variable: First-Difference of Weekly Still Beverage Unit Volume Sales 2010-2016:Q1)**

| Source | SS | df | MS | | |
|---|---|---|---|---|---|
| | | | | Number of Obs. = | 320 |
| | | | | F(8, 311) = | 46.8 |
| Model | 8.6413E+15 | 11 | 7.8557E+14 | Prob > F = | 0.0000 |
| Residual | 5.1703E+15 | 308 | 1.6787E+13 | R-squared = | 0.6257 |
| Still Beverage | 1.3812E+16 | 319 | 4.3296E+13 | Adj. R-squared = | 0.6123 |
| | | | | Root MSE = | 4100000 |

| Still Beverage | Coefficient | Standard Error | t | P>\|t\| | [95% Confidence | Interval] |
|---|---|---|---|---|---|---|
| Powerball Maximum | -371436.2 | 526152.9 | -0.71 | 0.481 | -1406745 | 663872.7 |
| Powerball > $150 Million | -417345.5 | 894520.7 | -0.47 | 0.641 | -2177490 | 1342799 |
| Powerball Lag(1) > $150 Million | 1422336 | 623624.4 | 2.28 | 0.023 | 195232.7 | 2649439 |
| Gas Price | -17387.3 | 43830.9 | -0.40 | 0.6920 | -103633.1 | 68858.47 |
| Beverage Price | -3889288 | 250078.9 | -15.55 | 0.0000 | -4381368 | -3397209 |
| Cooling Degree Day | 116162.1 | 28526.02 | 4.07 | 0.0000 | 60031.53 | 172292.6 |
| Cooling Degree Dummy | 379042.7 | 496959.2 | 0.76 | 0.4460 | -598822 | 1356907 |
| Payday Week Dummy | -647366.1 | 475497.5 | -1.36 | 0.1740 | -1583001 | 288268.5 |
| Still Beverage | | | | | | |
| Lag(2) | -0.0085953 | 0.0360313 | -0.24 | 0.812 | -0.0794939 | 0.0623034 |
| Lag(3) | 0.0033176 | 0.0382437 | 0.09 | 0.931 | -0.0719344 | 0.0785696 |
| Lag(4) | 0.0058378 | 0.0384947 | 0.15 | 0.88 | -0.0699081 | 0.0815837 |
| Constant | 7071605 | 9530965 | 0.74 | 0.459 | -11700000 | 25800000 |

**TABLE 7: OLS Estimates of the Effect of Powerball, Gas Price, Beverage Price, Cooling Degree Day, Payday and Dependent Lags(2-4) on U.S. Convenience Store Non-Alcoholic Sugar-Sweetened Beverage Sales (Dependent Variable: First-Difference of Weekly SSB Unit Volume Sales 2010-2016:Q1)**

| Source | SS | df | MS | | |
|---|---|---|---|---|---|
| | | | | Number of Obs. = | 321 |
| | | | | F(8, 311) = | 62.63 |
| Model | 6.5906E+15 | 11 | 5.9914E+14 | Prob > F = | 0.0000 |
| Residual | 2.9562E+15 | 309 | 9.5669E+12 | R-squared = | 0.6903 |
| SSB | 9.5468E+15 | 320 | 2.9834E+13 | Adj. R-squared = | 0.6793 |
| | | | | Root MSE = | 3100000 |

| SSB | Coefficient | Standard Error | t | P>\|t\| | [95% Confidence | Interval] |
|---|---|---|---|---|---|---|
| Powerball Maximum | 308080.9 | 262711.4 | 1.17 | 0.242 | -208848.7 | 825010.6 |
| Powerball > $700 Million | -5194247 | 2647169 | -1.96 | 0.051 | -1.04E+07 | 14511.03 |
| Powerball Lag(1) > $700 Million | -6069679 | 2595489 | -2.34 | 0.020 | -1.12E+07 | -962611.4 |
| Gas Price | 22279 | 33616.33 | 0.66 | 0.508 | -43866.88 | 88424.88 |
| Beverage Price | 489336.6 | 227421.3 | 2.15 | 0.032 | 41846.32 | 936826.8 |
| Cooling Degree Day | 36183.88 | 18351.81 | 1.97 | 0.050 | 73.5443 | 72294.21 |
| Cooling Degree Dummy | 2785693 | 446449 | 6.24 | 0.000 | 1907229 | 3664158 |
| Payday Week Dummy | -381745.8 | 352408.8 | -1.08 | 0.280 | -1075170 | 311678.7 |
| SSB | | | | | | |
| Lag(2) | 0.3277354 | 0.0620482 | 5.28 | 0.000 | 0.2056449 | 0.4498258 |
| Lag(3) | 0.1155877 | 0.0718065 | 1.61 | 0.108 | -0.0257039 | 0.2568793 |
| Lag(4) | 0.2278413 | 0.0609162 | 3.74 | 0.000 | 0.1079782 | 0.3477043 |
| Constant | 27600000 | 6594325 | 4.19 | 0.000 | 14600000 | 40600000 |

**Preferred Model: OLS Estimates of the Effects of Beverage Price, Cooling Degree Day, Payday and Dependent Lags(2-4) on U.S. Convenience Store Total Non-Alcoholic Beverage Sales**
**(Dependent Variable: First-Difference of Weekly Beverage Unit Volume Sales 2010-2016:Q1)**

| Source | SS | df | MS | | |
|---|---|---|---|---|---|
| | | | | Number of Obs. = | 320 |
| | | | | F(8, 311) = | 32.35 |
| Model | 1.1392E+16 | 7 | 1.6274E+15 | Prob > F = | 0.0000 |
| Residual | 1.5694E+16 | 312 | 5.0300E+13 | R-squared = | 0.4206 |
| Total Beverage* | 2.7085E+16 | 319 | 8.4907E+13 | Adj. R-squared = | 0.4076 |
| | | | | Root MSE = | 7100000 |

| Total Beverage* | Coefficient | Standard Error | t | P>\|t\| | [95% Confidence Interval] | |
|---|---|---|---|---|---|---|
| Beverage Price* | -5618696 | 574600.8 | -9.78 | 0.0000 | -6749279 | -4488114 |
| Cooling Degree Day* | 256072 | 45275.46 | 5.66 | 0.0000 | 166988.2 | 345155.8 |
| Cooling Degree Dummy | 421623.9 | 834404 | 0.51 | 0.6140 | -1220147 | 2063394 |
| Payday Week Dummy | 1660094 | 815986 | 2.03 | 0.0430 | 54562.95 | 3265626 |
| Total Beverage | | | | | | |
| Lag(2) | -0.0439916 | 0.04443 | -0.99 | 0.323 | -0.1314119 | 0.0434287 |
| Lag(3) | 0.0258416 | 0.0457301 | 0.57 | 0.572 | -0.0641368 | 0.1158201 |
| Lag(4) | 0.0326528 | 0.0467708 | 0.70 | 0.486 | -0.0593733 | 0.1246789 |
| Constant | -515948.1 | 683485.1 | -0.76 | 0.448 | -1851475 | 819578.5 |

**(First-Difference)*

Table 8: Notes to Preferred Model. Time-series beverage and price data are from the Nielsen market research scanning data of U.S. Convenience Store total non-alcoholic beverage weekly unit and dollar volume sales from January 2010 to April 2016.

## APPENDIX B: FIGURES

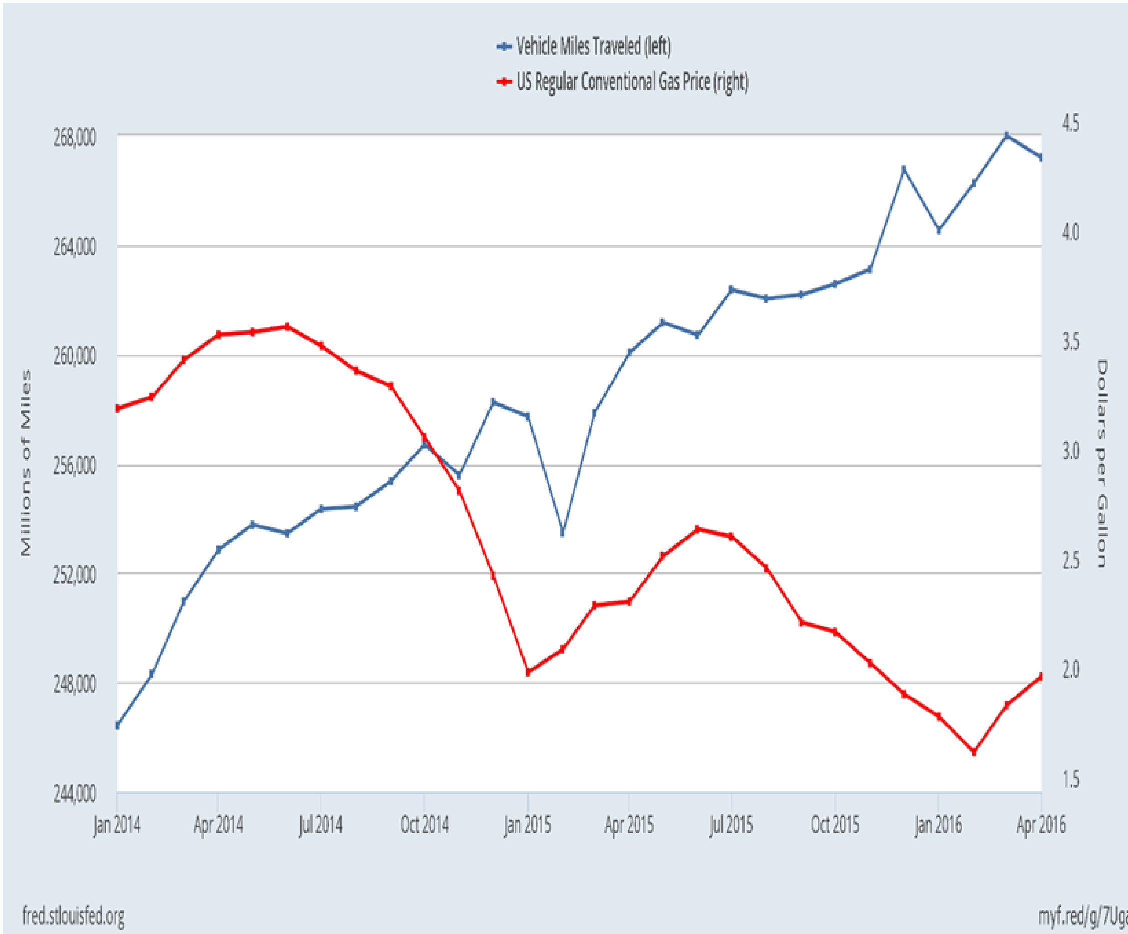
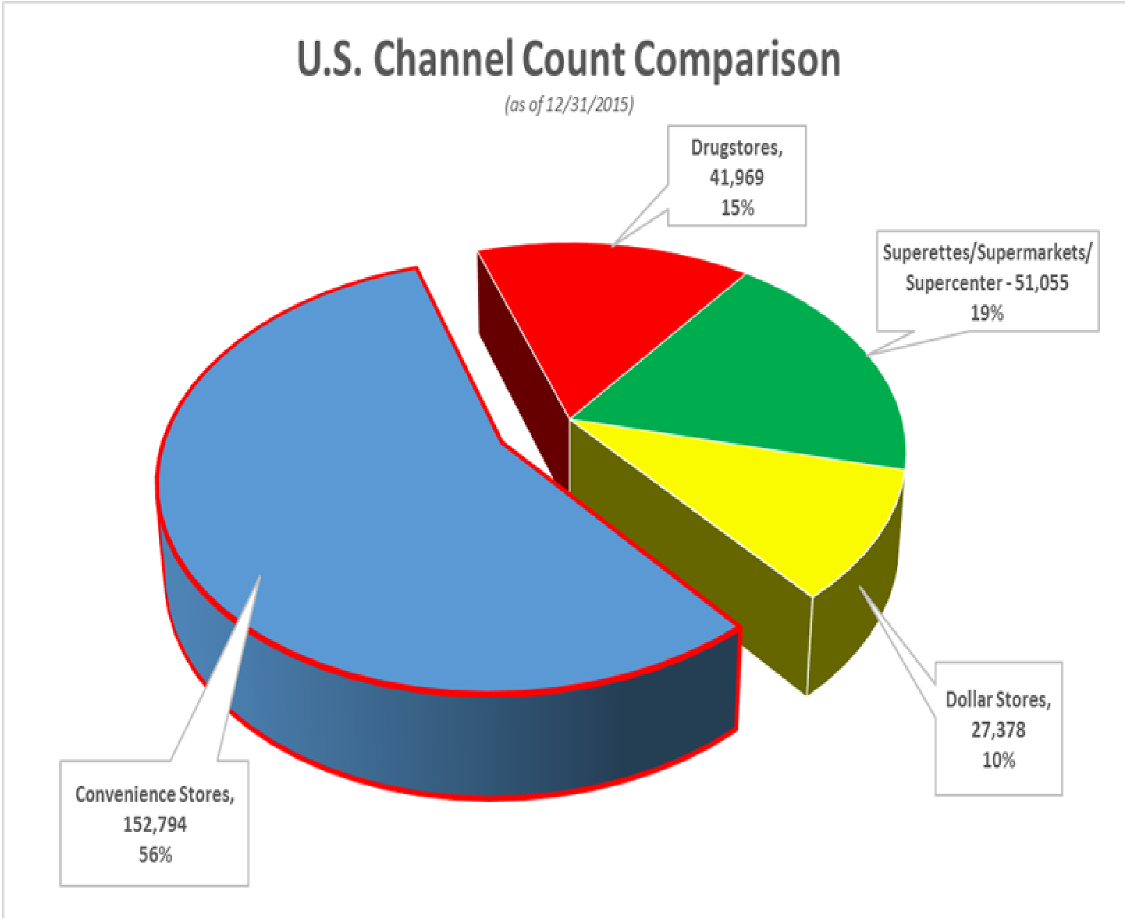



Figure 1: source - U.S. Federal Reserve Bank of St. Louis – FRED Economic Research. Dates from January 1, 2014 to April 1, 2016. Miles traveled data source: U.S. Federal Highway Administration. Gas price data source: U.S. Energy Information Administration (EIA)




Notes: Figure 2 - U.S. Channel Count Comparison of total stores per channel. Data: National Association of Convenience Store Retailers (NACS) Industry Update; Online Review. Dates as of December 31, 2015. Convenience retailers make up approximately 56% of total U.S. food and beverage retailers.

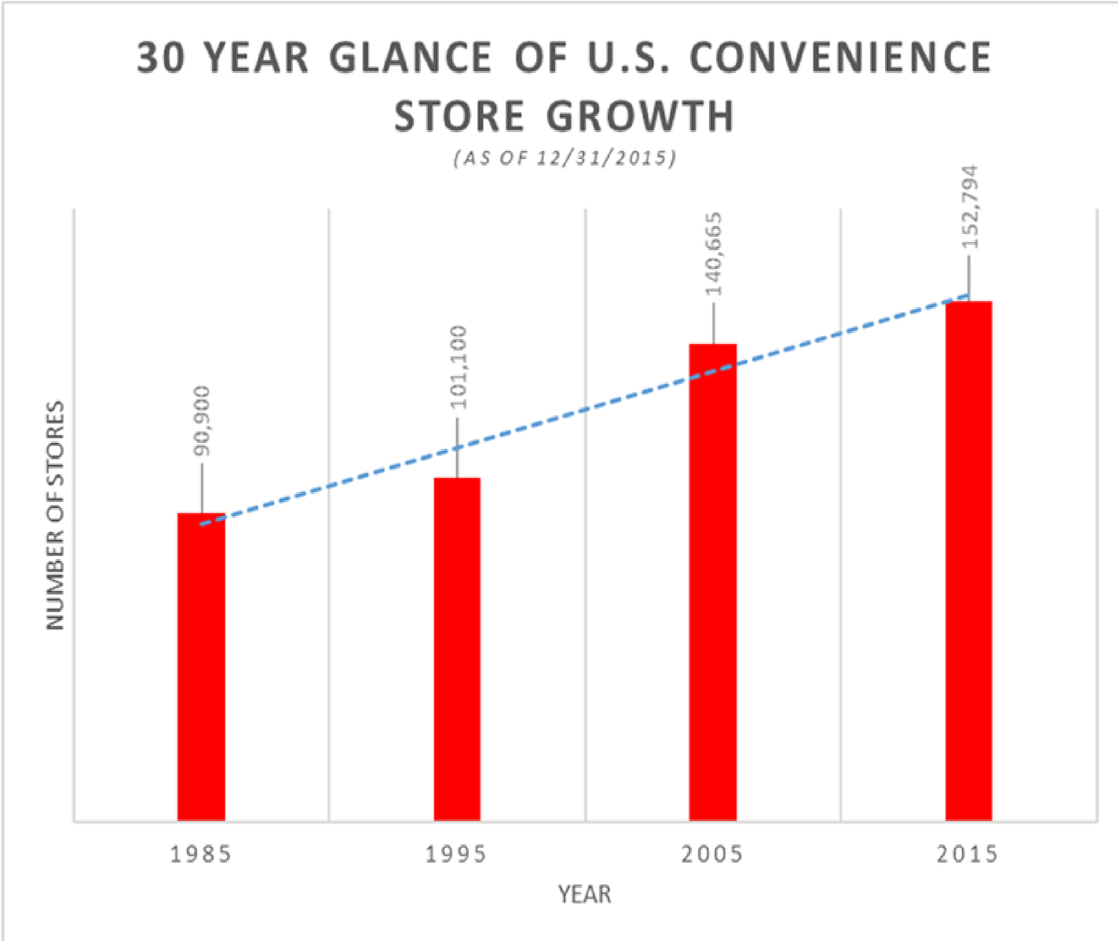
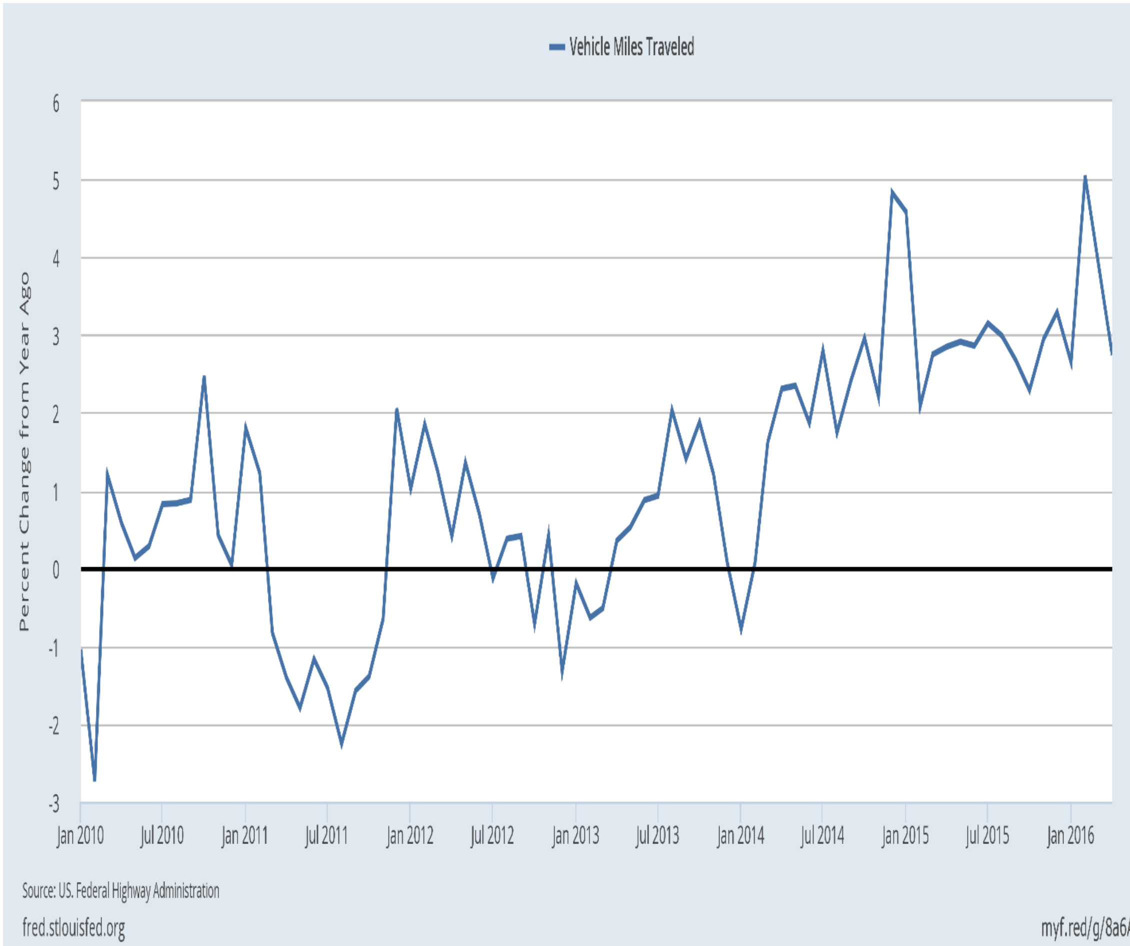
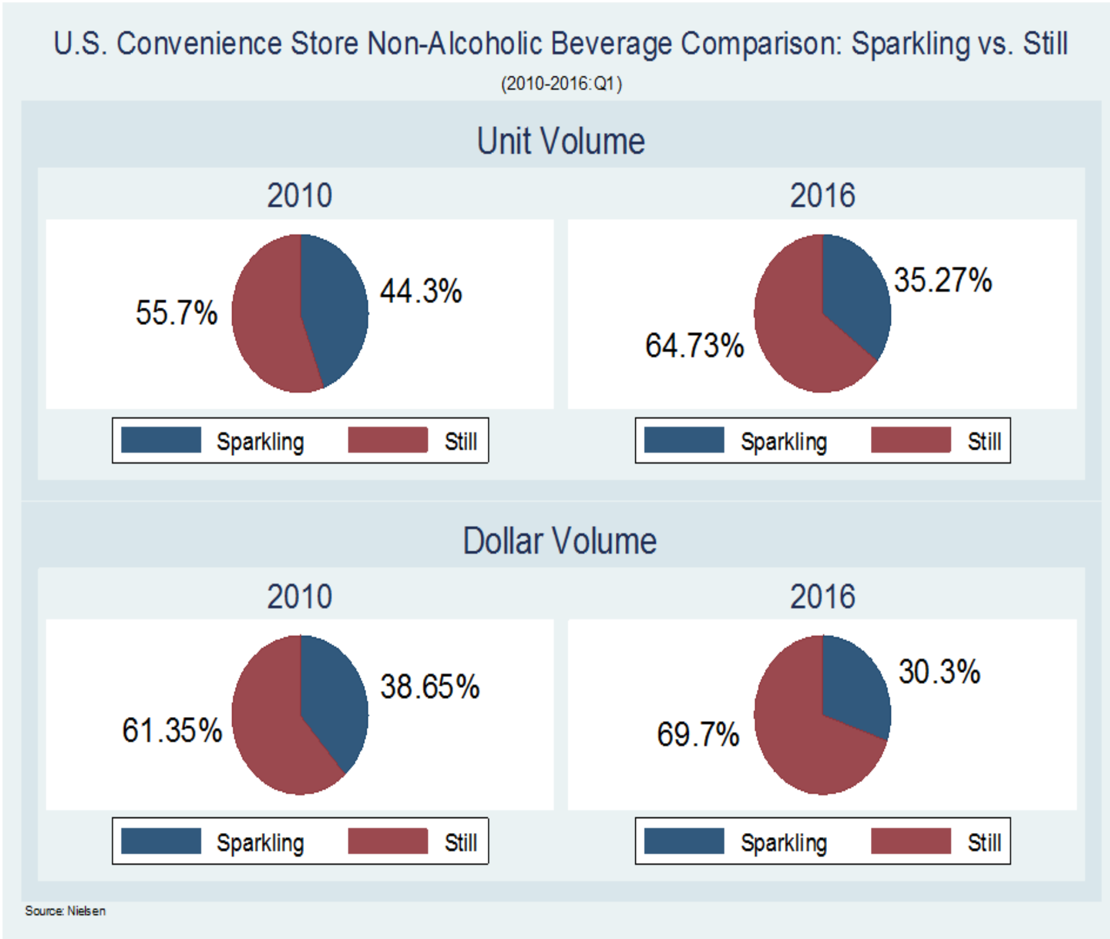


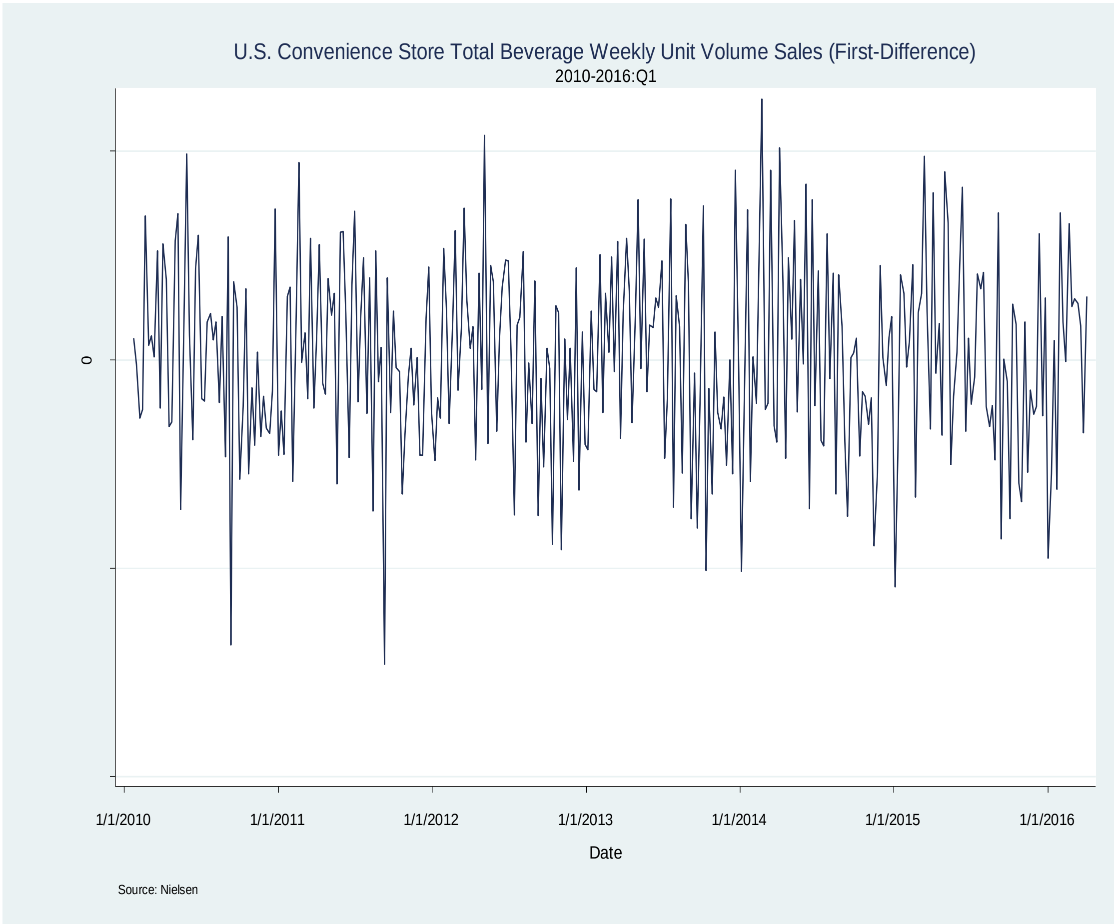

Figure 3: Notes to Figure 3. U.S. Convenience Retail Channel, store count growth since 1985. Data: National Association of Convenience Store Retailers (NACS) Industry Update: store count report; Online Review. Dates as of December 31, 2015. As of 2015, there were 152,794 convenience retail stores in the United States.



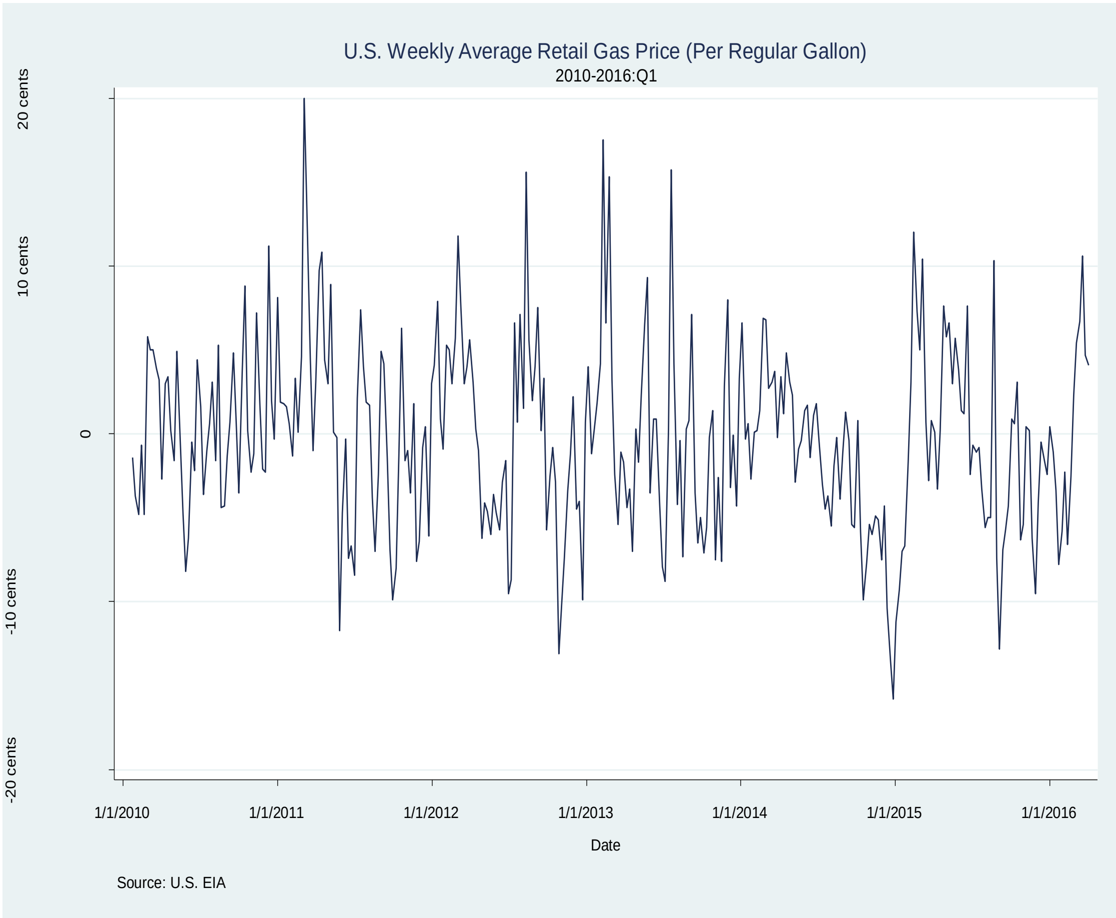

Notes: Figure 4 source - U.S. Federal Reserve Bank of St. Louis – FRED Economic Research. Dates from January 2010 to April 2016. Vehicle miles traveled data source: U.S. Federal Highway Administration. Displaying percent change from the previous year, suggesting that in the United States, since approximately 2014, total vehicle miles traveled has seen consistent 2%-3% year-over-year (YoY) growth.



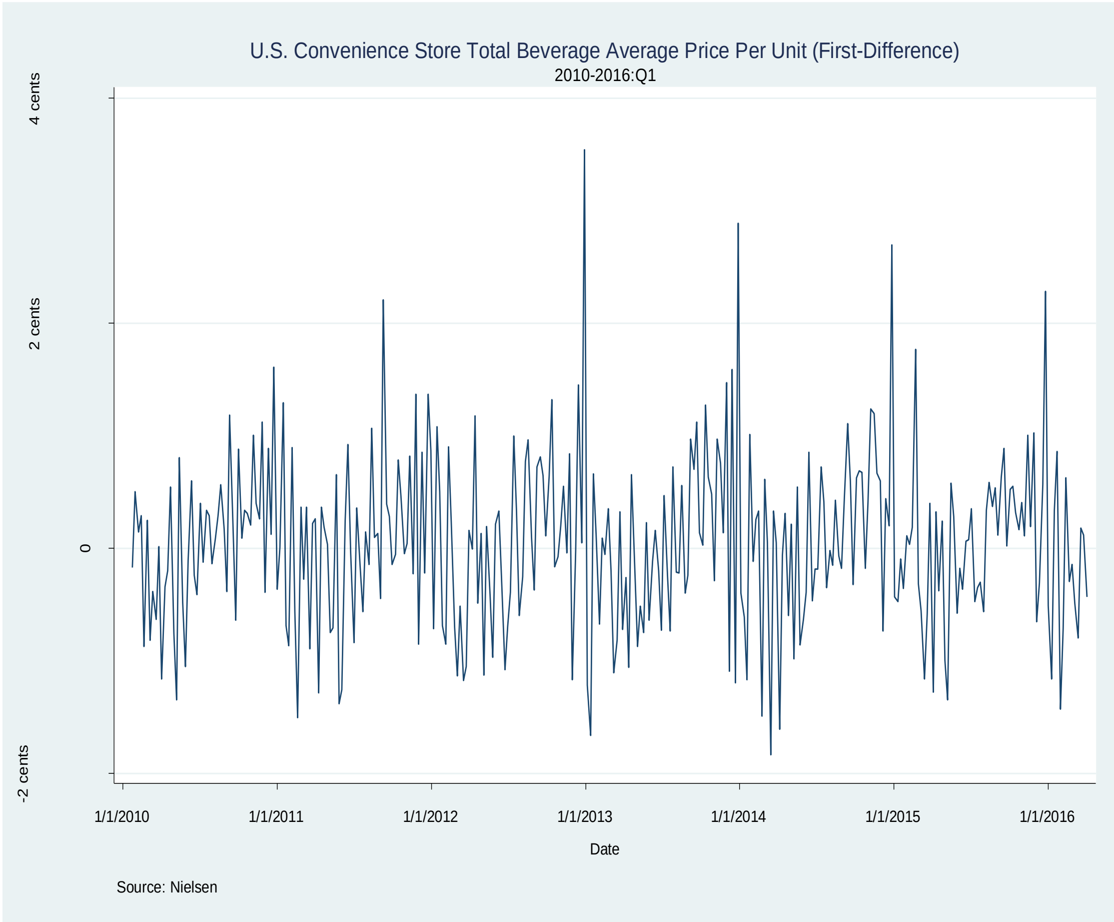

Notes: Figure 5. Source: Nielsen.



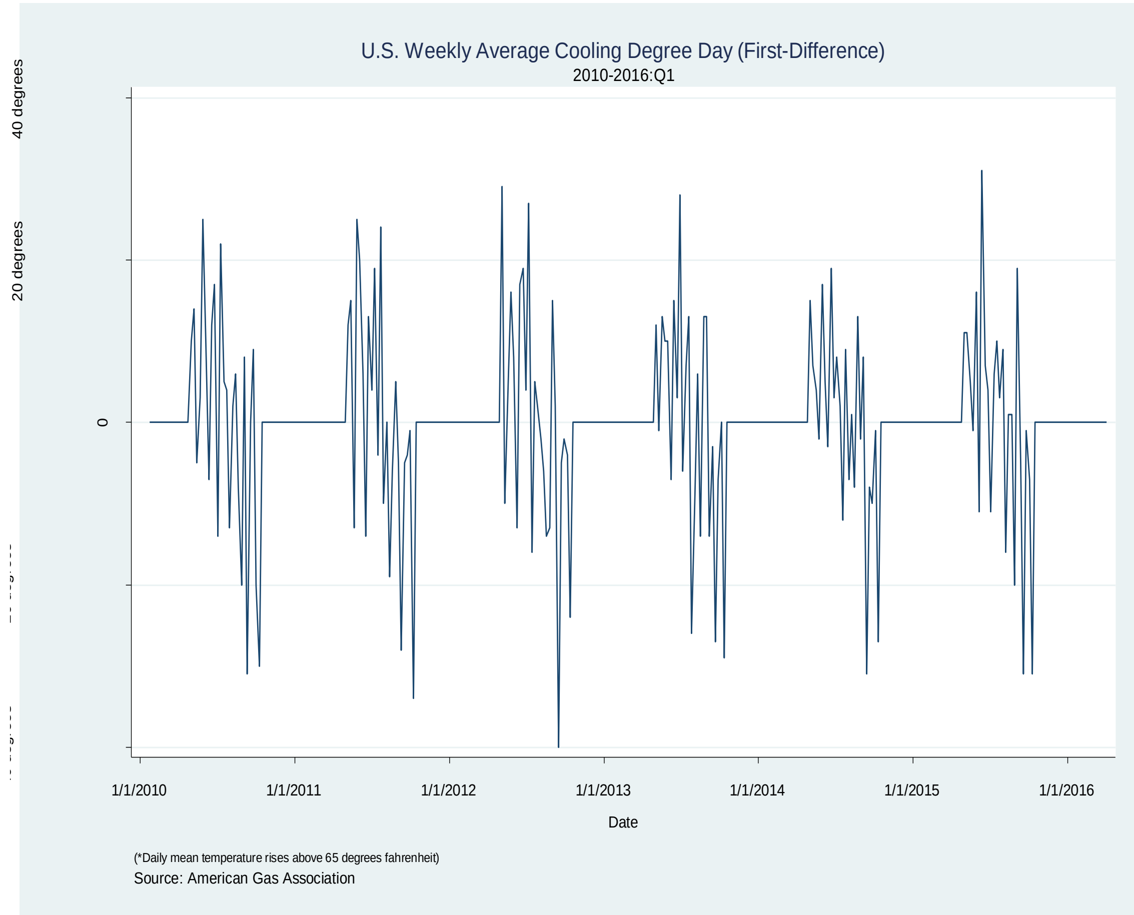

Notes: Figure 6. Source: Nielsen



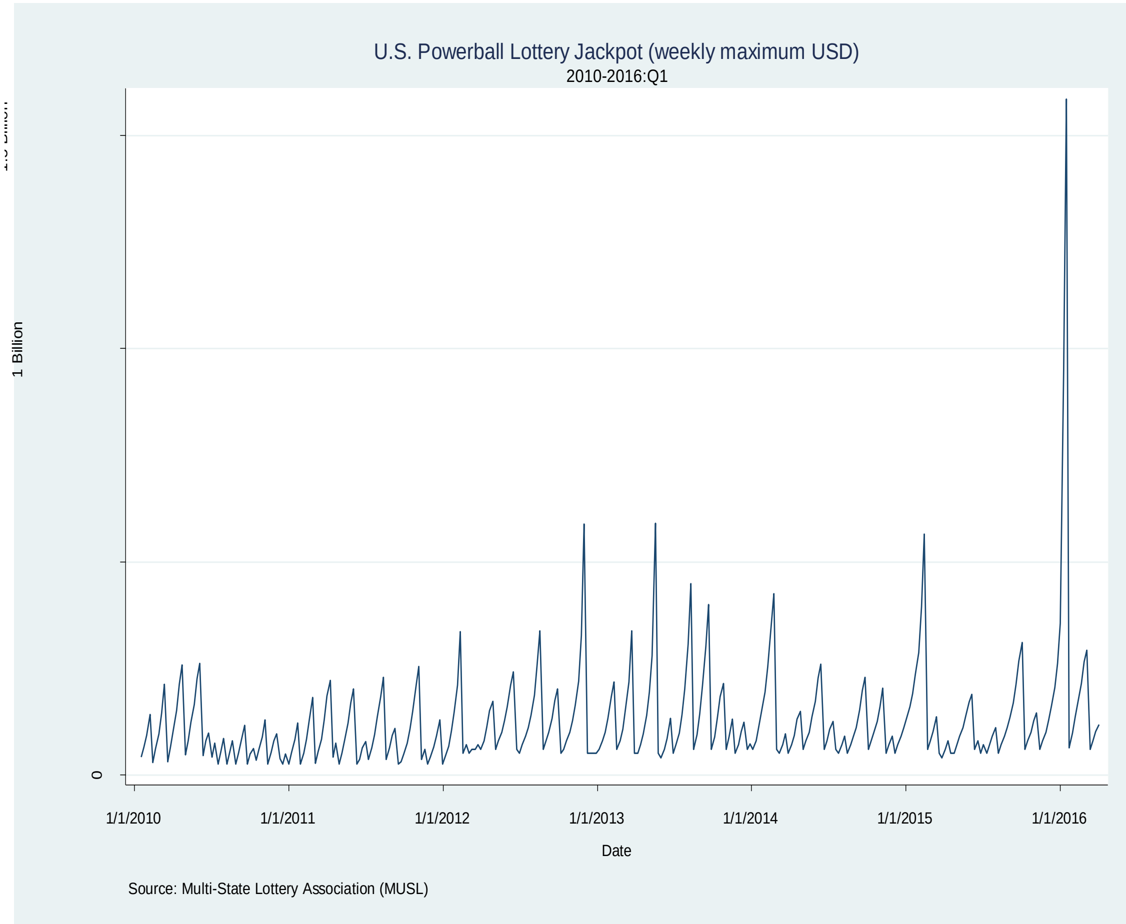

Notes: Figure 7. U.S. Weekly Average Retail Gas Price (Per Conventional Gallon) from January 16, 2010 to April 2, 2016. Source: U.S Energy Information Administration (EIA)



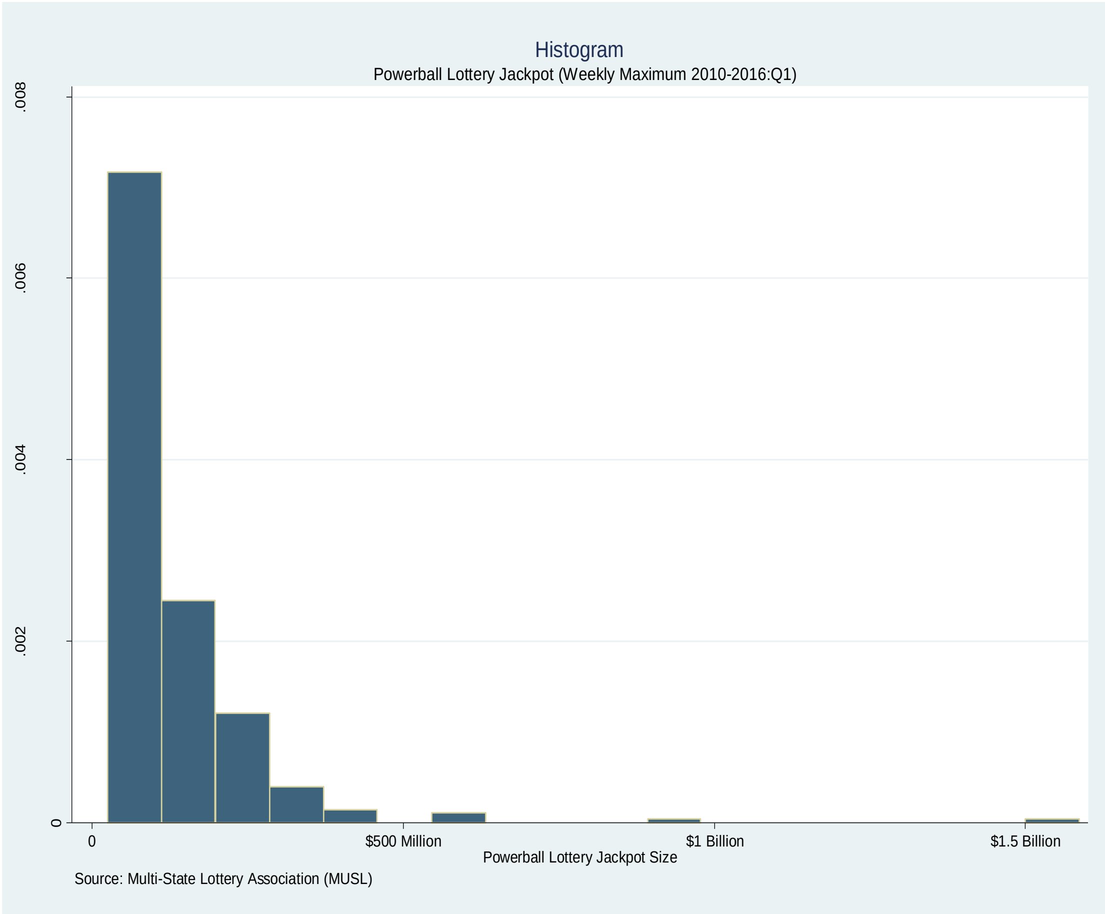

Notes: Figure 8. Source: Nielsen



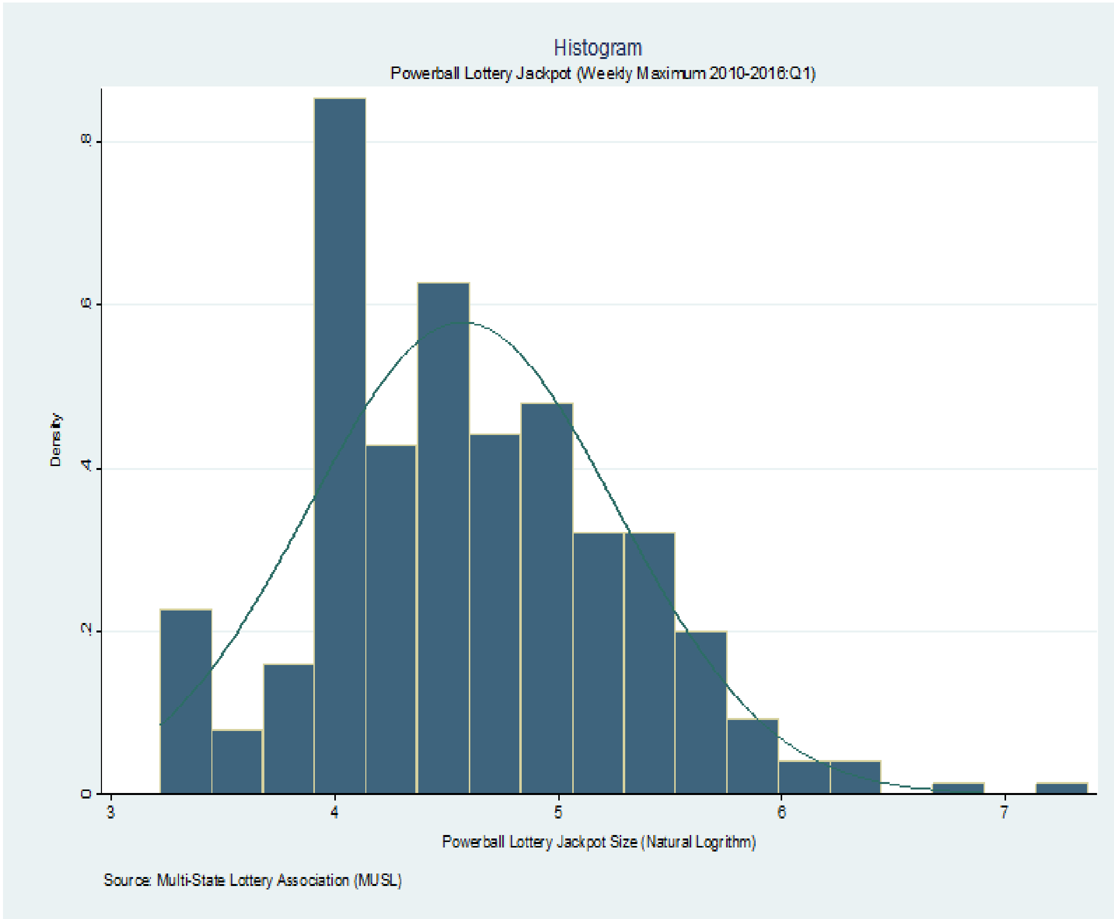

Notes: Figure 9. Source: American Gas Association (AGA)



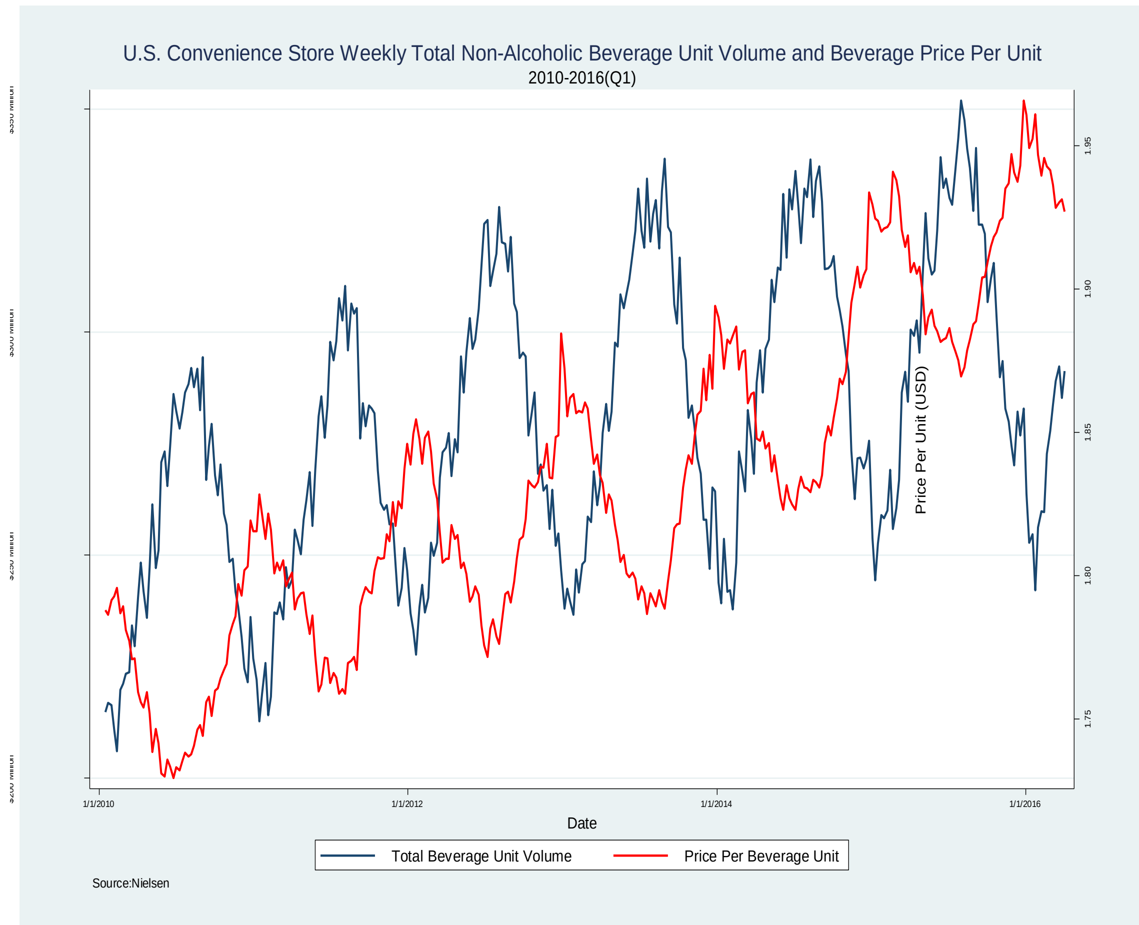

Notes: Figure 10. Source: Multi-State Lottery Association (MUSL). The Powerball variables herein consider the maximum jackpot amount during the week (and not the weekly average) due to results from tests for robustness.



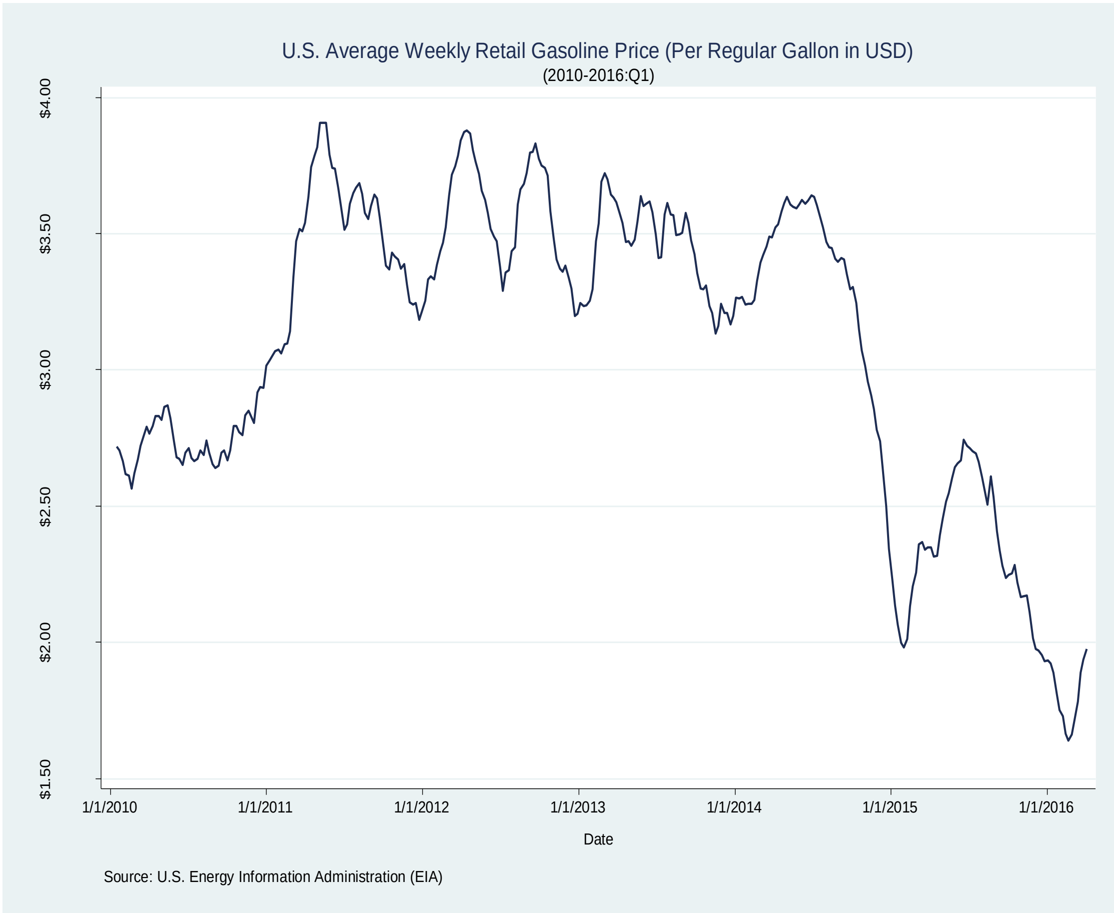

Notes: Figure 11. U.S. Powerball Lottery Jackpot Weekly Maximum (in USD) from January 16, 2010 to April 2, 2016. Source: Multi-State Lottery Association (MUSL).




Notes: Figure 12. U.S. Powerball Lottery Jackpot Weekly Maximum (in USD) from January 16, 2010 to April 2, 2016, Natural Logarithmic Transformation. Source: Multi-State Lottery Association (MUSL)




Notes: Figure 13. Source: Nielsen




Notes: Figure 14. Source: U.S Energy Information Administration (EIA)