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# Who drinks soda pop? Economic status and adult consumption of sugar-sweetened beverages

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**Who Drinks Soda and Soft Drinks?**  
**The Economic Status of Adult Soda Consumers**

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# **Who Drinks Soda and Soft Drinks? The Economic Status of Adult Soda Consumers**

## **Abstract**

Drinking soda or soft-drinks is widespread in developed countries, yet the economic characteristics of consumers are only partly known. Knowing the economic status of soda drinkers is important because public health advocates are implementing soda taxes in a number of U.S. cities to reduce consumption of these beverages. This research uses a large scale random sample of young baby boomers to investigate who drinks soda. Using detailed income and wealth data the research finds a simple inverse gradient. The poorer an individual along both income and wealth dimensions, the more likely they are to drink soda and the more times they drink it. While public health advocates are implementing soda taxes to reduce future health care costs, the findings suggest soda taxes are regressive and financially impact the poor immediately.

JEL Codes: D10, I10, I12, I14

Keywords: Soda, soft drinks, income, wealth, socioeconomic status

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## 1. Introduction

Drinking soda or soft-drinks is widespread in developed countries. In the U.S. roughly half the population drinks soda or other type of sugar-sweetened beverages in a typical day (Ogden et. al., 2011). However, drinking soda is associated with poorer health and potentially is a major cause fueling the obesity epidemic (Malik et. al. 2006). Because of this association policy makers are now implementing soda taxes to reduce the consumption of these beverages. Berkley, California was the first U.S. city to implement a soda tax in 2015. Other cities are now following with a tax in place or being implemented shortly in Philadelphia, Boulder, San Francisco and Seattle (Willmsen, 2017). Table 1, shows the amount and when collection of the tax began.

Table 1: U.S. Soda and other Sugar Sweetened Beverage Taxes as of January 2018

City	Tax Per Ounce	Collection Began
Berkeley, CA	1¢	Jan. 2015
Philadelphia, PA	1.5¢	Jan. 2017
Boulder, CO	2¢	July 2017
Oakland, CA	1¢	July 2017
Chicago / Cook County, IL	1¢	Aug. 2017
Seattle, OR	1.75¢	Jan. 2018
San Francisco, CA	1¢	Jan. 2018

Notes: Chicago / Cook County tax was repealed on October 11, 2017.

These taxes clearly have an impact with Fletcher, Frisvold and Tefft (2010) finding that taxes reduce soda drinking and shift consumption to fruit juices and whole milk. Since fruit juices are also high in sugar, soda taxes might not make people healthier if they simply shift individuals from one type of taxed sugared beverage to another untaxed sugared beverage, like orange juice. Soda taxes can also reduce health if they shift people to alcoholic beverages. Beer

is federally taxed at 58 cents per gallon (128 ounces).<sup>1</sup> The median U.S. state adds an additional 20 cents per gallon tax.<sup>2</sup> This means the average U.S. state taxes an ounce of beer at slightly less than 1.2 cents, which is lower than Seattle, Philadelphia and Boulder's soda tax rate.

While the negative health impact of drinking large quantities of soda is well known, less well-known is the economic profile of drinkers. While some work has pointed out that soda drinkers have lower income (Ogden et. al. 2011), no research to date has examined the wealth of soda drinkers. Understanding the full economic profile of soda drinkers is important to identify the group of people actually paying soda taxes. If soda taxes primarily fall on the poor then the taxes are regressive. Regressive taxes can unintentionally reduce health outcomes by reducing the amount of money available for spending on food and health care.

We use a large, nationally representative sample of U.S. adults born between 1957 and 1964 to investigate the socio-economics status of soda drinkers. Our research uses the National Longitudinal Survey of Youth (NLSY79), which offers more extensive economic measures than data sets used in previous investigations. In addition, the NLSY79 enables longitudinal analysis to see how changes in wealth and income impact soda drinking.

## **Background**

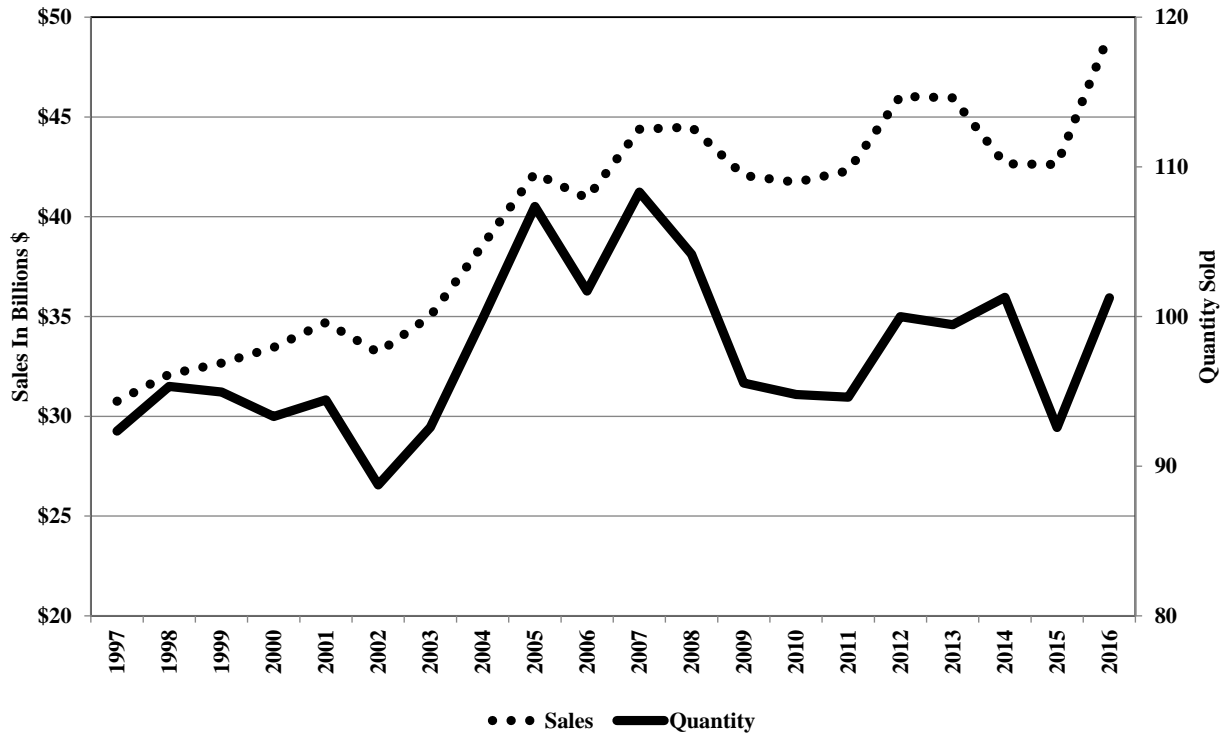
Soft drink manufacturing and sales is a major business. Figure 1 shows data from the Bureau of Economic Analysis (BEA) on the size of the U.S. industry. The dotted line in figure 1 shows after adjusting for inflation soft drink manufacturing (NAICS 31211) is currently almost a \$50 billion a year industry. Moreover, soda sales have been steadily rising and have increased by almost \$20 billion in two decades.

Figure 1: Soft Drink Manufacturing Sales in Dollars and Index of Quantity Produced

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<sup>1</sup> [https://www.ttb.gov/tax\\_audit/atftaxes.shtml](https://www.ttb.gov/tax_audit/atftaxes.shtml)

<sup>2</sup> <https://www.taxadmin.org/assets/docs/Research/Rates/beer.pdf>



Notes: Figures from the BEA’s “Gross-Domestic-Product-(GDP)-by-Industry” located at [https://www.bea.gov/industry/gdpbyind\\_data.htm](https://www.bea.gov/industry/gdpbyind_data.htm). Sales are adjusted for inflation using the CPI into 2012 dollars.

The solid line in figure 1 is an index created by the BEA that tracks the physical quantity of output compared to the amount manufactured in 2012, which is set at 100. Since carbonated beverages have a shelf life of less than one year, the amount manufactured approximates the amount consumed. The solid line shows the quantity of soda manufactured is related to the business cycle. Soda drinking falls during recessions like 2001 and 2008 and rises during expansions. Overall, the quantity of soda manufactured from 1997 to 2016 has grown almost 10%. Given the U.S. population has grown almost 20% in that time frame; this suggests soda consumption per person has been falling.

The data in figure 1 understate the size of the health problem posed by soda because sugar-sweetened beverages comprise more than just soft drinks. The *Dietary Guidelines for*

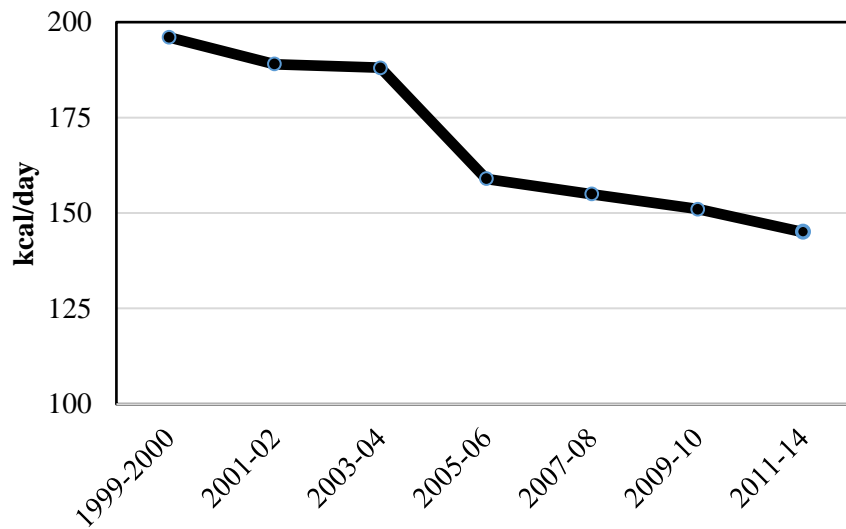
*Americans 2015-2020* (U.S. Departments of Health and Human Services and Agriculture n.d.) defines sugar-sweetened beverages as: “Liquids that are sweetened with various forms of added sugars. These beverages include, but are not limited to, soda (regular, not sugar-free), fruitades, sports drinks, energy drinks, sweetened waters, and coffee and tea beverages with added sugars.” Added sugars are sweeteners that do not occur naturally in the beverage and include corn syrups, honey, sucrose, fructose, and glucose. Many people, who do not drink soda, drink instead these other sweetened beverages, which can lead to health problems like diabetes and heart disease.

Because there are high costs for illness in terms of lost productivity and treatment many businesses and government officials are motivated to seek strategies for preventing disease (Keehan 2017; Japsen 2012; Stewart et al. 2003; Witter and Liu 2013). In developed countries, the burden of disease falls more heavily on low socioeconomic status (SES) individuals and groups, following a gradient – each step up the SES ladder exhibits lower disease prevalence (Braveman et al. 2010; Marmot 2004). One possible factor contributing to this gradient is variation in nutrition, or diet quality, by SES (Darmon and Drewnowski 2008; Kirkpatrick et al. 2012; Wang and Chen 2011; Wang et al. 2014). This paper examines one aspect of diet linked with a variety of diseases: the consumption of sugar-sweetened beverages (SSB).

About one-third of the calories from added sugars come from beverages (Ervin and Ogden 2013) and non-diet sodas are the top single source of added sugars in American diets (Welsh et al. 2011). An average 12-ounce non-diet cola contains about 9.5 teaspoons of sugar (USDA n.d.), which exceeds the American Heart Association’s recommended daily maximum of 6 teaspoons for women and 9 for men (AHA 2014). This means drinking a single soda each day provides more sugar than recommended.

Studies based on the NHANES shows adult SSB consumption increased until about 1999 (Bleich et al. 2009) and has since decreased (Kit et al. 2013; Rehm et al. 2016; Rosinger et al. 2017). Figure 2 shows the SSB decline in terms of kilocalories consumed per day. Despite the downward trend, the majority of Americans (57%) still consume more than the recommended maximum intake of SSB (Rehm et al. 2016).

Figure 2: Trend in Adult Sugar-Sweetened Beverages Consumption



Source: Kit et al. (2013) and Rosinger et al. (2017)

Concerns about the health consequences of SSB consumption initially focused on its association with weight gain and obesity (Bray and Popkin 2013; Schmidt 2014; Mozaffarin et al. 2011; Ma et al. 2014). Reviews indicate that the literature supports the hypothesis that SSB intake is associated with weight gain and obesity among both children and adults (Della Torre et al 2016; Hu 2013; Hu and Malik 2010; Malik 2006; Vartanian et al. 2007), although two papers question this conclusion (Trumbo and Rivers 2014; Weed et al. 2011). Malik, Schulze and Hu's (2006) overview of the literature finds drinking soda is associated with weight gain and obesity



in both children and adults. More recent research by Pase et. al. (In Press) suggests sugary beverages might lead to Alzheimer's disease, which means SSB might have additional negative health outcomes.

## **2. Literature and Theory**

Few studies investigate the relationship between adult consumption of sugar-sweetened beverages (SSB) and socioeconomic status (SES) in the United States. Ervin and Ogden (2013) describe patterns in the consumption of added sugars in general by three income groups in the National Health and Nutrition Examination Survey (NHANES) 2005-2010. They find an SES gradient for both men and women, with added sugar intake falling with successively higher income groups. Welsh et al. (2011) describe trends in both total added sugars and disaggregated by type. They report that SSB intake is highest in the bottom income quartile and lowest in the top income quartile. From the 1999-2000 round to the 2007-2008 round of the NHANES SSB consumption fell in all income groups, but dropped the most in the middle quartiles.

Three studies using regression analysis examine consumption of SSB by socioeconomic status. All use cross-sectional data, measure socioeconomic status using income, and control for educational attainment. Deshmukh-Taskar et al. (2007) base their analysis on data collected in the mid-1990s for the Bogalusa Heart Study (n = 1,266). Their sample includes adults ages 20 to 38 living in a semi-rural area of Louisiana. While SSB consumption fell as income increased, the differences between the four income groups (defined in absolute dollar terms) were not statistically significant. The difference in SSB consumption by respondents with twelve or fewer years of education and those with more education did not achieve statistical significance either.

In contrast, both Rehm et al. (2008) and Han and Powell (2013) report evidence that consumption of sugary beverages declines with income and education. Rehm et al. (2008) study

individuals over the age of 18 in New York City (n=9,865) and focus on sugar-sweetened (i.e. non-diet) soda consumption. They report that adults with low household income (< 200% of the poverty line) have 1.7 times higher odds of frequent soda consumption than those with high income (at least 600% of the poverty line). Middle income (200-599% of the poverty line) individuals are also more likely to consume soda than those with high income (OR 1.4).

Another important factor impacting consumption is parental influence. Youths whose parents drank soda were almost three times more likely to drink soda than youths whose parents didn't drink these beverages (Grimm et. al., 2004). Children from Belgium families whose mothers had at least a bachelor's degree consume just 42 percent of the amount of soft drinks of children whose mothers had a high school degree or less (De Coen et. al., 2012). In addition youths who are dieting drink less soda (Bere et. al., 2008).

Han and Powell (2013) provide the only analysis of the relationship between SSB and socioeconomic status using U.S. nationally representative data. They analyze consumption patterns based on 24-hour recall in five rounds of the NHANES, ranging from 1999 to 2008. They define low income as household income below 135% of the poverty line and high income as over 300% of the poverty line. Low- and middle-income young adults (ages 20 -34) are more likely to consume SSB than their high-income counterparts (OR 1.47 and 1.37 respectively). SSB consumption is also more likely among low- and middle income adults 35 years and older. With respect to education, respondents with high school or less are more likely to consume SSB than those with at least some college. The authors find similar patterns when they focus specifically on soda consumption.

Outside the U.S. Vereecken et al. (2005) investigated material wealth and soda consumption for European countries. Vereecken et al. used as a wealth proxy the family's

affluence, called FAS. They found except for France there was “no significant relationship between daily soft drink consumption and FAS was found.”

### **3. Methodology**

#### *3.1 Data*

We use the National Longitudinal Survey of Youth 1979 cohort (NLSY79), a large nationally representative sample of Americans, to estimate the model (initial  $n = 12,686$ ). The NLSY79 has questioned the same group of individuals born between 1957 and 1964, “baby boomers,” annually from 1979 to 1994 and every other year since 1994. From 1979 until the late 1990s the majority of respondents were interviewed face-to-face. Since that time the survey has shifted to phone interviewing. Survey details and the raw data are available from the Bureau of Labor Statistics ([www.bls.gov/nls](http://www.bls.gov/nls)). Observations with missing values for any variable are dropped from the analysis rather than imputed.

Because soda drinking questions were asked in only four survey waves (2008, 2010, 2012, and 2014) respondents were in their 40’s and 50’s during the period of analysis. The NLSY79 has high retention rates with approximately 80% of all living respondents participating in the 2008 to 2014 surveys respectively. Because the NLSY79 is a multi-stage random sample that over-sampled Blacks and Hispanics, all descriptive statistics are adjusted by survey weights to account for over-sampling effects and attrition. Reported regression results are not adjusted with sampling weights but instead include dummy variables for oversampled groups, as recommended by Zagorsky (1997, Chapter 3.9) to ensure coefficient estimates are not biased. While not recommended, the regressions were also run using sampling weights. The weighted regression results were slightly more significant and coefficients slightly more supportive of the findings than the results reported.

## *4.2 Soda Consumption Measures*

The NLSY79 survey asked respondents four times “In the past seven days, how many times did you have a soft drink or soda that contained sugar? (Do not include diet soft drinks or sodas, or carbonated water).” There were 8,186 respondents who provided at least one answer to this question.

One binary variable we created was if a respondent ever answered “yes” to any of these four questions. This identifies individuals ever drank soda in the combined 28-day observation period. “Frequent soda drinkers” are defined as respondents who consumed soda seven or more times in any one of the seven-day study periods. These frequent drinkers are consuming at an average rate of at least one drink per day. Because our measures of soda consumption rely on respondent recall about the past week, there could be measurement error.

## *4.3 Wealth and Income Measures*

To understand the amount of resources available to a consumer it is important to examine both income and wealth. Income is the flow of money received periodically, predominantly from employment. Wealth is the stock of financial resources stored in bank accounts, stocks, bonds, homes and possessions. Some individuals, like retirees, have low income but high wealth. Others, like new doctors, have little wealth but high income. The NLSY79 is one of the few nationally representative U.S. data sets collecting both income and wealth information. The Pearson correlation of 0.59 between income and wealth in the 2008 data, the first year the soda questions were asked, shows these two socioeconomic measures are related, but not identical.

Wealth, or net worth, is calculated by subtracting all debts from a family’s total assets (in dollars). The NLSY79 contained a detailed wealth module 15 out of the 26 times the survey has been fielded. Each module asked respondents to report details about their assets, such as the

current market value of their home, mortgage, savings, possessions, stocks, and bond holdings, and their liabilities, such as mortgages, credit card debt and unsecured loans. Zagorsky (1999) provides details on response rates, handling of missing values, and accuracy of the NLSY79 wealth data.

Every NLSY79 survey wave asks respondents four sets of income questions. First, respondents answer questions about income from wages, salaries, tips, and self-employment. The second set of questions collects information on government transfers. The third set asks about private transfers such as child support, alimony, and gifts. Finally, respondents list income from other sources such as scholarships, interest, dividends, and rent. For the most important items, like wages, the questions are asked once about the respondent's income and then a second time about the spouse or partner. For less important items, such as interest or dividends, a single question asks how much money both the respondent and spouse, if applicable, received. Total Net Family Income (TNFI) sums the various components from each survey wave's income module and is measured in dollars. All wealth and income variables are adjusted for inflation and presented in 2012 dollars, which is the final year of wealth information.

#### *4.6 Estimation Methods*

We first provide descriptive information on soda drinking. The descriptive information is based on all four years of data that are available. Then we report three types of regressions which first models who drinks and does not drink soda. Then regressions estimate how often soda is drunk. Finally, regressions are discussed which measure changes over time. While the descriptive data uses four years of data, the regressions only use the 2008 and 2012 data because the NLSY79 did not collect wealth information in 2010 and 2014. Respondents who answered

soda questions in both 2008 and 2010 have the survey's responses entered as two separate lines of data in each regression, which boosts the number of observations.

## **5. Results and Discussion**

### *5.1 Descriptive Analysis*

The majority of respondents (70.2%) report drinking soda at least once in one of the four weeks under investigation. While many reported drinking soda, the majority of boomers (51%) drank relatively little and consumed between zero and four sodas over the 28 day period. Moreover, the number who reported ever drinking a soda declined in each survey with 52.8% reporting drinking any soda during the seven days captured in 2008, 49.3% drinking any in 2010; 47.4% in 2012 and 44.3% in 2014.

The falling consumption of soft drinks is visually seen by examining Figure 3, which tracks soda drinking by age. The figure shows as young baby boomers age they drink less soda. In their early 40's the typical young baby boomer drank almost four sodas per week (3.8 at age 43). By the time they were age 57 the typical respondent had reduced their drinking by more than half to 1.6 sodas per week. This graph of falling consumption as people age means soda taxes likely have relatively little impact on the middle age and elderly and will primarily fall on younger members of society.

Figure 3: Average Number of Sodas Drunk Per Week by Age in NLSY79 Cohort

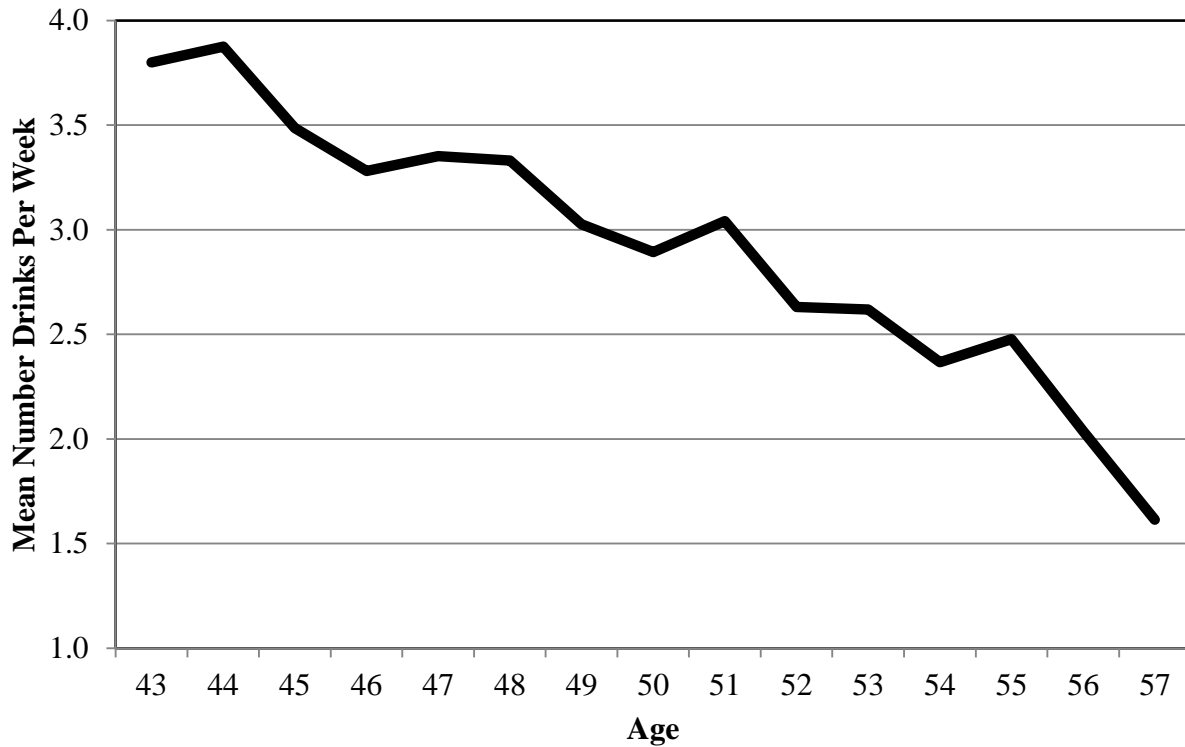


Table 2 presents mean and median wealth and income by soda drinking status in inflation adjusted dollars. The first column of numbers shows values for all respondents and provides a comparison for the three columns to the right. The columns show a consistent pattern. Respondents who never reported drinking a soda have the highest net worth and income. Respondents who are heavy drinkers, which are individuals who reported drinking on average at least one soda per day, have the lowest financial values. Respondents who reported drinking at least 1 soda in any of the four week periods, which includes the heavy drinkers, had financial values partway between those who never drank and heavy soda drinkers.

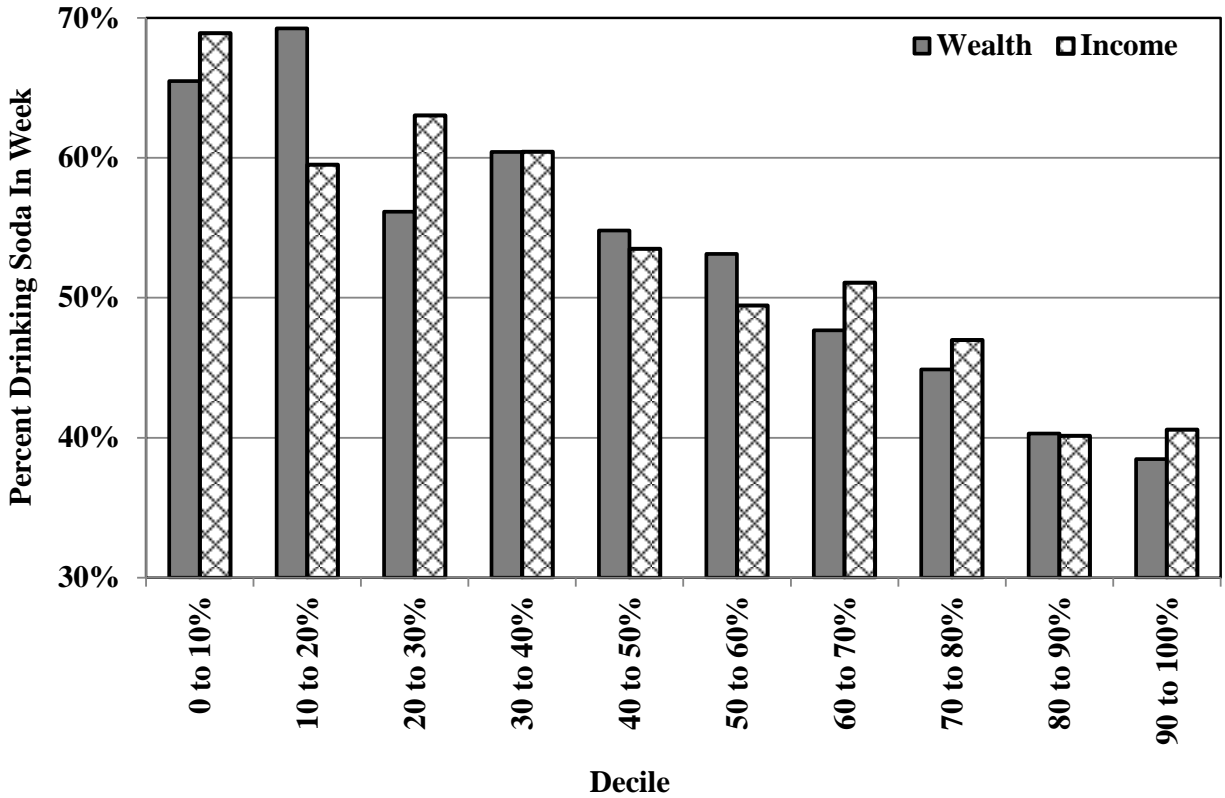
Table 2: Wealth and Income by Soda Drinking Status Over 4 Weeks. (In 2012 \$)

<b>Mean Values</b>	<b>All Respondents</b>	<b>Never Drank</b>	<b>Drank At Least 1 Soda</b>	<b>Heavy Drinker</b>
<b>Times Drank Soda</b>	10.9	0	15.5	26.5
<b>Net Worth 2008</b>	\$369,974	\$560,478	\$292,700	\$224,279
<b>Net Worth 2012</b>	\$353,989	\$543,241	\$280,298	\$203,932
<b>Income 2008</b>	\$94,230	\$121,219	\$83,286	\$72,756
<b>Income 2010</b>	\$90,874	\$117,482	\$79,995	\$68,192
<b>Income 2012</b>	\$91,010	\$118,822	\$79,899	\$67,502
<b>Income 2014</b>	\$70,916	\$91,132	\$62,344	\$51,672
<b>Median Values</b>	<b>All Respondents</b>	<b>Never Drank</b>	<b>Drank At Least 1 Soda</b>	<b>Heavy Drinker</b>
<b>Times Drank Soda</b>	4.0	0	9.0	21.0
<b>Net Worth 2008</b>	\$149,768	\$276,593	\$108,279	\$67,111
<b>Net Worth 2012</b>	\$125,800	\$252,400	\$91,300	\$47,100
<b>Income 2008</b>	\$72,900	\$93,270	\$65,396	\$54,675
<b>Income 2010</b>	\$70,798	\$90,850	\$62,653	\$52,855
<b>Income 2012</b>	\$68,400	\$88,000	\$60,000	\$50,000
<b>Income 2014</b>	\$41,792	\$54,025	\$38,080	\$30,000
<b>Number Respondents</b>	8,186	1,983	6,203	3,184

Figure 3 shows the percentage of boomers who drank soda by income and wealth deciles in 2008. Both income and wealth show a falling pattern of consumption as people move into higher income and wealth brackets. The poorest 20% people have some of the highest consumption with approximately two-thirds drinking soda. While the richest have the lowest consumption, roughly forty percent of individuals in the richest decile of income and wealth reported consuming soda in 2008. Figures for the other years show similar results, but are not included for space reasons.



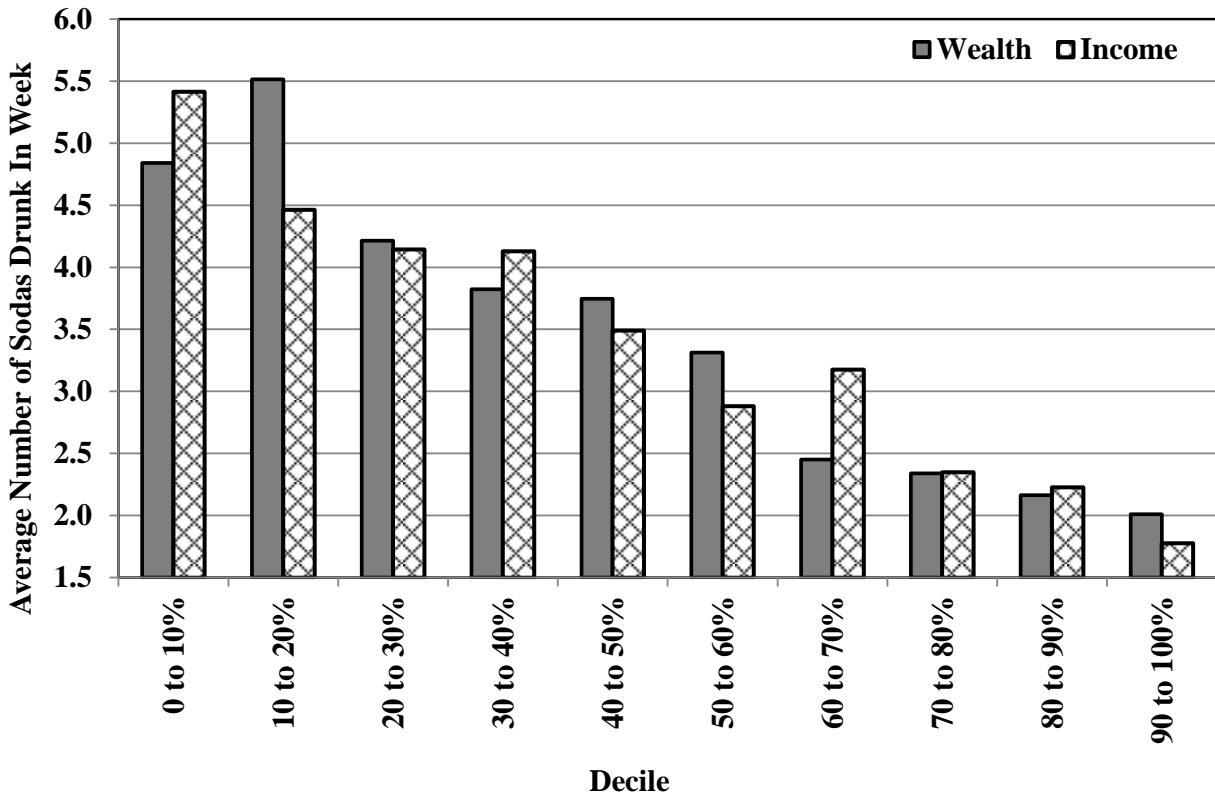
Figure 3: Percentage Who Drank Soda by Income and Wealth Deciles In 2008



Note: Individuals with income below \$15,100 were in the 0% to 10% decile. Those with income greater than equal to \$15,100 but below \$28,950 were in the 10% to 20% decile. The other income decile cutoffs are \$42,800, \$56,800, \$69,600, \$85,600, \$105,000, \$128,600, and \$177,000. Wealth decile cutoffs were below \$1, \$7,400, \$37,500, \$83,400, \$146,500, \$222,000, \$325,000, \$498,500, and \$882,300.

Figure 4 shows the number of sodas consumed by income and wealth deciles in the week tracked in 2008. Like figure 3, this graph suggests a falling pattern of soda consumption as income and wealth increase. The poorest 20 percent of respondents drink approximately five sodas in a week. The richest group reported drinking less than two sodas a week.

Figure 4: Average Number of Sodas Drunk Per Week by Income and Wealth Deciles In 2008



Note: Includes people who drank no soda. See figure 3 for decile cutoffs.

### 5.2 Analysis Who Drinks Soda

Table 4 presents logistic regression results which can determine the probability a respondent drank or didn't drink soda in the two week study period after controlling for wealth, income and other explanatory variables. We provide two different specifications. Columns (1) and (2) use actual wealth and income values, while columns (3) and (4) use binary indicators which track the respondent's income and wealth quintile. The quintile regressions ensure monetary outliers do not influence the results.

The table's coefficients indicate both wealth and income are negatively associated with the likelihood an adult drinks soda. This is consistent with the gradient hypothesis that the poor

drink more soda than the wealthy. In regressions 3 and 4, which use quintiles, the negative coefficients get larger and more statistically significant as wealth and income increases.

With respect to the demographic variables, all four specifications indicate that older individuals are less likely to drink soda than younger, women are less likely to drink than men, and each additional year of education reduces the chance of drinking. The Black, Hispanic, and married variables are all positively associated with the likelihood of drinking soda.

Among the other variables, being a worker raise the likelihood of drinking soda, but working more hours reduces the chance. Among the health variables, checking the nutritional label, checking ingredients, trying to lose weight and getting exercise are consistently negatively associated with the likelihood of drinking soda. BMI is positively associated, but is not statistically distinguishable from zero. Overall, this table offers support for the hypothesis that adults who are more interested in health are less likely to drink soda.

Numerous other regressions were run beyond those presented. Adding squared variables for wealth and income to capture non-linear effects did not change the results. Including variables which tracked the type of location a respondent lived such as living in urban, suburban or rural areas and if they lived in Southern states resulted in coefficients which were not statistically significant. Including more information on the respondent such as the number of people living in their home, their body weight, or the number of siblings also did not result in statistically significant values.

Table 4: Logistic Regressions for Soda Consumption

	(1) Ever Drink	Std. Err.	(2) Ever Drink	Std. Err.	(3) Ever Drink	Std. Err.	(4) Ever Drink	Std. Err.
Wealth	-1.6e-7	4.0e-8***	-1.5e-7	4.1e-8***				
Income	-2.3e-6	3.3e-7***	-2.1e-6	3.4e-7***				
Wealth Q2					-0.09	0.06	-0.08	0.07
Wealth Q3					-0.06	0.07	-0.06	0.07
Wealth Q4					-0.25	0.07***	-0.21	0.07***
Wealth Q5					-0.41	0.08***	-0.36	0.08***
Income Q2					-0.02	0.06	-0.01	0.07
Income Q3					-0.12	0.07*	-0.04	0.07*
Income Q4					-0.25	0.07***	-0.17	0.08**
Income Q5					-0.48	0.08***	-0.41	0.09***
Black	0.68	0.05***	0.67	0.05***	0.64	0.05***	0.64	0.05***
Hispanic	0.29	0.05***	0.28	0.06***	0.27	0.05***	0.27	0.06***
Age	-0.05	0.01***	-0.05	0.01***	-0.05	0.01***	-0.05	0.01***
Female	-0.53	0.04***	-0.35	0.04***	-0.53	0.04***	-0.35	0.04***
Married	0.04	0.04	0.04	0.04	0.11	0.04**	0.08	0.05*
Highest Grade	-0.07	0.01***	-0.04	0.01***	-0.06	0.01***	-0.03	0.01***
Born in USA			-0.07	0.08			-0.06	0.08
Worker			0.15	0.07**			0.18	0.07**
Hours Work			-6.0e-5	2.6e-5**			-6.0e-5	2.7e-5**
Ever Smoke			-0.08	0.04**			-0.09	0.04**
Check Nutrition			-0.65	0.05***			-0.63	0.05***
Check Ingredients			-0.14	0.05***			-0.15	0.05***
BMI			0.006	0.004			0.006	0.004
Lose Weight			-0.29	0.04***			-0.28	0.04***
Exercise			-0.07	0.06			-0.05	0.06
Intercept	3.97	0.32***	3.64	0.36***	3.93	0.33***	3.58	0.36***
Pseudo R <sup>2</sup>	0.10		0.14		0.10		0.14	
Num. Obs.	12,431		12,275		12,431		12,275	

Note: \*\*\* p < 0.01, \*\* p < 0.05, \* p < 0.10.

Logistic regression coefficients are difficult to interpret directly. To show the impact table 4, contains the probability a white 45 year-old unmarried person with a high school education drinks soda based on different wealth and income values. The table uses the coefficients from regression (3) to calculate the probabilities.

A woman with the above characteristics who is in the bottom 20th percentile of both the income and wealth distribution has almost a sixty percent (57.3%) chance of drinking soda at least once in the two week period. Changing just her income and wealth to the top 20th percentile lowers her chance of drinking a soda to about thirty-five percent (35.6%), which is almost a twenty-two percentage point drop.

Table 5, shows changing the gender of the person to male and keeping all other characteristics the same boosts the chance of drinking soda. A male in the bottom 20th percentile has almost a seventy percent (69.5%) chance of drinking soda, which is over twelve percentage points more than a woman with similar characteristics. Changing the man’s income and wealth to the top 20th percentile lowers his chance of drinking soda to 48.3%, which is a 21.2 percentage point drop.

Table 5: Predicted Soda Drinking of Baseline Respondent as Income and Wealth Change

Wealth and Income	Probability Woman Drinks Soda	Probability Man Drinks Soda
Bottom 20 <sup>th</sup> Percentile	57.3%	69.5%
20 <sup>th</sup> to 40 <sup>th</sup> Percentile	54.5%	67.0%
40 <sup>th</sup> to 60 <sup>th</sup> Percentile	52.8%	65.5%
60 <sup>th</sup> to 80 <sup>th</sup> Percentile	44.9%	58.0%
Top 20 <sup>th</sup> Percentile	35.6%	48.3%

Note: See figure 3 note for percentile cutoffs.

### 5.3 Analysis How Much Soda is Drunk

Table 6 present regression results, which use as a dependent variable the number of sodas drunk among all respondents during the two week period. Columns 1 and 3 are barebones

regressions which focus on wealth, income and basic demographic factors. Columns 2 and 4 extend the barebones regressions by including other health related variables such as getting exercise and checking nutritional labels. Columns 1 and 2 use wealth and income directly, while columns 3 and 4 do quantile regressions to ensure outlying monetary values do not exert undue influence.

In general, wealth is negatively associated with the number of times a respondent drank soda. The richer a person the less soda they drank. The regressions using the actual income and wealth values show a smaller impact than the quantile regressions. For example, a \$1 million increase in wealth is associated with a decreased consumption of only about half a soda in the two week period. In the quintile specification, only the top three wealth quintiles are statistically significant. Those in the wealthiest quintile drank over two fewer sodas in the two week period than those in the lowest wealth quintile.

Table 6: Regressions Explaining Number of Sodas Drunk In Two Week Period

	(1)		(2)		(3)		(4)	
	Number Drunk	Std. Err.	Number Drunk	Std. Err.	Number Drunk	Std. Err.	Number Drunk	Std. Err.
Wealth	-6.0e-7	2.4e-7**	-4.5e-7	2.4e-7*				
Income	-1.0e-5	1.9e-6***	-1.0e-5	1.9e-6***				
Wealth Q2					-0.44	0.38	-0.32	0.38
Wealth Q3					-0.73	0.40*	-0.64	0.40
Wealth Q4					-2.53	0.43***	-2.13	0.43***
Wealth Q5					-2.87	0.47***	-2.34	0.47***
Income Q2					-1.21	0.38***	-1.21	0.40***
Income Q3					-1.75	0.41***	-1.57	0.43***
Income Q4					-2.15	0.45***	-1.96	0.47***
Income Q5					-3.18	0.50***	-3.01	0.53***
Black	1.03	0.28***	0.85	0.28***	0.39	0.28	0.37	0.29
Hispanic	-0.75	0.31**	-0.70	0.33**	-1.03	0.31***	-0.91	0.33***
Age	-1.12	0.04***	-1.07	0.04***	-1.11	0.04***	-1.07	0.04***
Female	-2.35	0.23***	-1.14	0.25***	-2.42	0.23***	-1.17	0.24***
Married	-0.22	0.25	-0.07	0.25	-0.58	0.27**	-0.58	0.27**
Highest Grade	-0.73	0.05***	-0.48	0.05***	-0.60	0.05***	-0.41	0.05***
Born in USA			0.63	0.49			0.58	0.48
Worker			0.69	0.42*			1.12	0.42***
Hours Work			-8.8e-5	1.5e-4			-7.0e-5	1.6e-4
Ever Smoke			0.84	0.24***			0.67	0.24***
Check Nutrit.			-3.50	0.31***			-3.25	0.31***
Check Ingred.			-0.84	0.32***			-0.92	0.31***
BMI			0.02	0.02			0.01	0.02
Lose Weight			-1.69	0.26***			-1.62	0.21***
Exercise			-2.33	0.33***			-2.10	0.26***
Intercept	73.99	1.95***	70.50	2.12***	73.91	1.97***	70.20	2.13***
R <sup>2</sup>	0.11		0.14		0.12		0.15	
Num. Obs.	12,431		12,275		12,431		12,275	

Note: \*\*\* p < 0.01, \*\* p < 0.05, \* p < 0.10.

Income is also negatively related to the number of sodas consumed and has a stronger relationship than wealth. For example, a \$100,000 increase in income is associated with a decreased consumption of about one soda. In the quintile specification, all income quintiles are statistically significant. Like wealth, those in the highest income group drank about three fewer sodas than those in the lowest income quintile.

Combined, however, the wealth and income effects are quite large. Individuals in the top 20th percentile in both income and wealth drink between 5.3 and 6 fewer sodas in the two week period than individuals in the bottom 20th percentile of both.

The other coefficients in the regressions show blacks drink more soda than whites, while Hispanics drink less. Older individuals drink less soda than younger, and women drink less than men. The more education a respondent has completed the less soda they drink. Individuals who work drink more soda than people not working. However, this is mitigated because the more hours someone works the less soda they drink. Smokers drinks more soda than non-smokers.

Health habits are important in understanding soda drinking. People who check nutritional labels or the ingredients in the food they eat drink less soda. People who are trying to lose weight drink less soda as do people who get exercise. Interestingly, there appears to be no relationship between BMI and soda drinking.

#### *5.4. Does Soda Drinking Change as Wealth and Income Change*

Because the NLSY79 tracks the same individuals in each survey it is possible to investigate if changes in wealth and income are associated with changes in soda consumption. Because the NLSY79 did not include wealth questions in 2010 or 2014, this section compares data from the 2008 and 2012 survey waves.



Plotting changes in income and wealth against changes in soda drinking does not show any association (Figures 5 and 6). Moreover, the top and bottoms of the graphs show that even extremely large changes in income/wealth are not associated with changes in soda drinking.

The correlation between the change in wealth and the change in soda drinking is  $-0.004$  ( $p = 0.75$ ) and the correlation between the change in income and fast food intake is  $-0.009$  ( $p = 0.56$ ), indicating the lack of linear association, although a non-linear association is possible. Together the graphs and correlations do not support the hypothesis that becoming richer or poorer leads adults to change their soda drinking. Instead they support the idea that among middle-aged people soda drinking is not changed when economic circumstances change.

Figure 5: Change in wealth from 2008 to 2012 and change in soda consumption

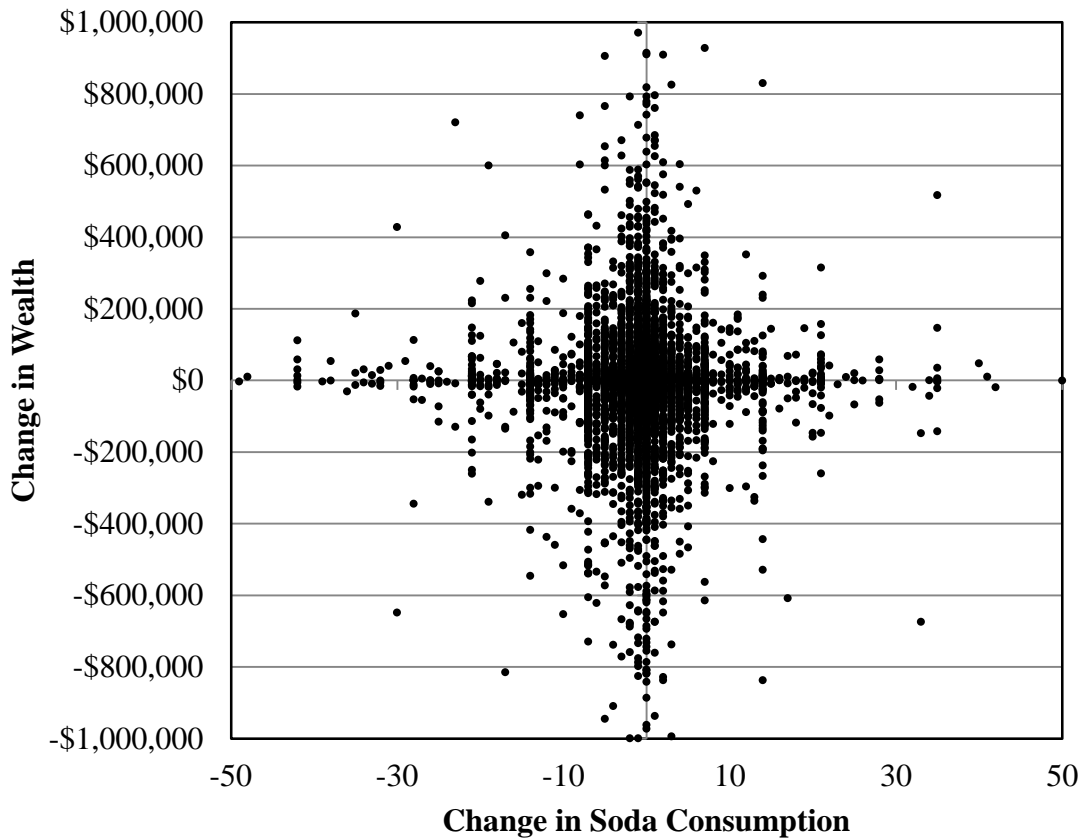
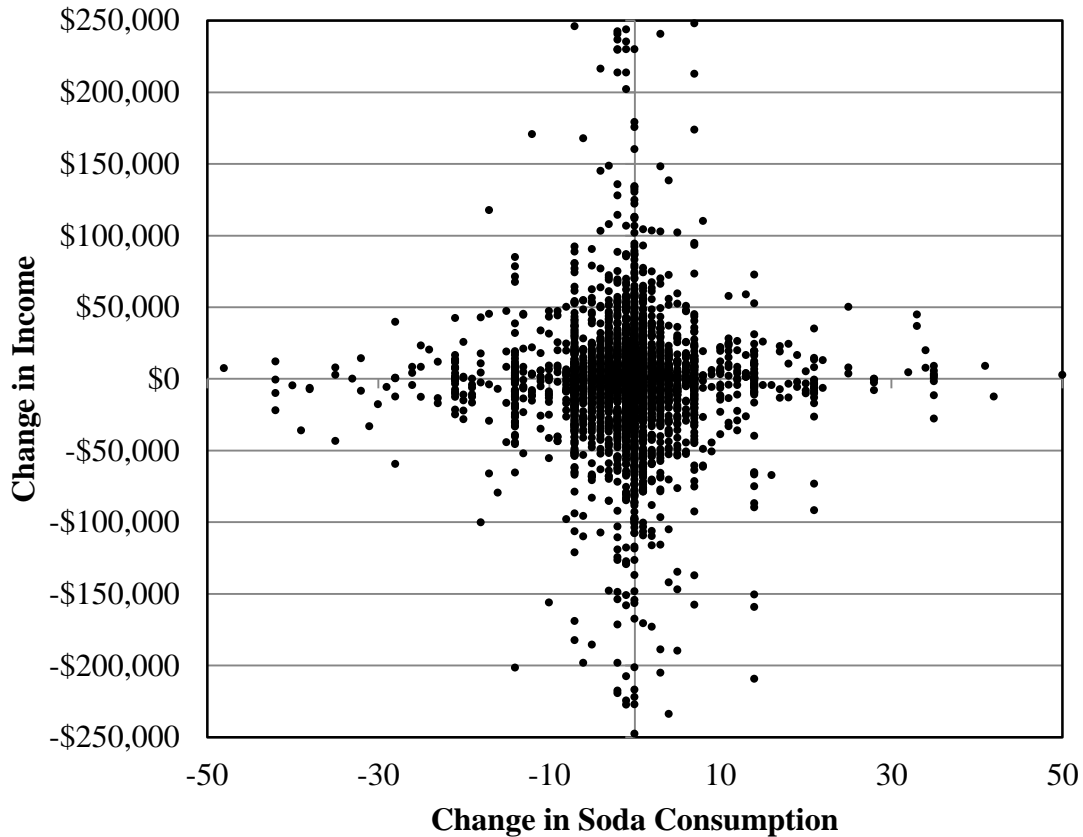


Figure 6: Change in income from 2008 to 2012 and change in soda consumption



Regressions which explain the change in soda are not shown because they provide no evidence that becoming richer or poorer is related to soda consumption. For example, an OLS regression using the change from 2008 to 2012 in income, wealth, marital status, family size, BMI, exercise and geographic location as explanatory variables had an adjusted R-squared of zero, meaning these variables had no ability to explain the change in soda drinking. Moreover, the coefficients on the change in wealth ( $p=0.82$ ) and income ( $p=0.61$ ) were statistically indistinguishable from zero, suggesting these two factors have no relationship to a change in soda drinking.

Overall, the longitudinal data suggest soda drinking is inelastic with respect to income and wealth changes. While further research is needed, this suggests but cannot prove, soda drinking is a not easy to change habit, which soda taxes will not alter for frequent drinkers.

## 6. Conclusions

Who will be impacted the most by soda taxes? This research used a national wide random sample of young baby boomers and found consumption, and hence soda taxes, will primarily fall on younger poor individuals. Overall, the results suggest a simple relationship between soda and socioeconomic status. The richer you are the less likely you are to ever drink soda. Additionally, among those that do drink, the richer you are the fewer sodas drunk. Comparing the richest 20 percent of young baby boomers to the poorest 20 percent showed the wealthiest group had roughly a 21 percent lower chance of ever drinking soda. Moreover, the wealthiest group consumed 5 sodas per week less than the poorest.

The results of this analysis must be tempered with some caveats. First, self-reported soda drinking may be miss-reported. Furthermore, the data do not include information on the amount drunk. Drinking a 42 ounce “supersize” cola is recorded the same as drinking a 7.5 ounce mini-can. Third, the NLSY79 respondents were all in their 40s and early 50s at the time of the soda surveys. Children and younger adults may have different soda consumption patterns. Finally, the analyses are not part of a true experiment and thus cannot establish causality.

From a public health perspective soda taxes at first glance appear to be an optimal policy. These taxes should only burden individuals who consume large amounts of sugary drinks and should have no impact on individuals who drink only healthier beverages, like water or milk. While these taxes appear ideal for reducing obesity and improving general health they might not be optimal. This research finds that soda taxes are paid primarily by the poorest people. This means these taxes are highly regressive and will impact those that can least afford them.

## References

- American Heart Association. 2014. "Frequently Asked Questions about Sugar," [www.heart.org](http://www.heart.org), accessed August 22, 2017.
- Bere, Elling; Elin Sørli Glomnes; Saskia J. Te Velde and Knut-Inge Klepp. 2008. "Determinants of Adolescents' Soft Drink Consumption." *Public Health Nutrition*, 11(1), 49-56.
- Bleich, S., Wang, Y., Wang, Y. and Gortmaker, S. 2009. "Increasing consumption of sugar-sweetened beverages among US adults: 1988–1994 to 1999–2004," *American Journal of Clinical Nutrition* 89:372–81.
- Braveman, P. 2006. "Health Disparities and Health Equity: Concepts and Measurement," *Annual Reviews of Public Health* 27:167–94.
- Braveman, P., Cubbin, C., Egerter, S., Williams, D., Pamule, E. 2010. "Socioeconomic Disparities in Health in the United States: What the Patterns Tell Us," *American Journal of Public Health* S1: S186-S196.
- Bray, G. and Popkin, B. 2013. "Calorie-sweetened Beverages and Fructose: What have We Learned 10 Years Later," *Pediatric Obesity* 8:242–248.
- Cook County Government. 2017 "Sweetened Beverage Tax" Accessed Jan. 17, 2018, <https://www.cookcountyil.gov/service/sweetened-beverage-tax>
- Darmon, N. and Drewnowski, A. 2008. "Does Social Class Predict Diet Quality?" *American Journal of Clinical Nutrition* 87: 1107-17.
- De Coen, Valerie; Stijn Vansteelandt; Lea Maes; Inge Huybrechts; Ilse De Bourdeaudhuij and Carine Vereecken. 2012. "Parental Socioeconomic Status and Soft Drink Consumption of the Child. The Mediating Proportion of Parenting Practices." *Appetite*, 59(1), 76-80.
- Della Torre, S., Keller, A., Depeyre, J., and Kruseman, M. 2016. "Sugar-Sweetened Beverages and Obesity Risk in Children and Adolescents: A Systematic Analysis on How Methodological Quality May Influence Conclusions," *Journal of the Academy of Nutrition and Dietetics* 116:638-659.
- Deshmukh-Taskar, P., Nicklas, T. Yang, S., and Bereson, G. 2007. "Does Food Group Consumption Vary by Differences in Socioeconomic, Demographic, and Lifestyle

- Factors in Young Adults? The Bogalusa Heart Study,” *Journal of the American Dietetic Association* 107: 223-234.
- Ervin, R. and Ogden, C. 2013. “Consumption of Added Sugars among U.S. Adults, 2005–2010,” NCHS Data Brief 122, Hyattsville, MD: National Center for Health Statistics.
- Fletcher, Jason M.; David E. Frisvold and Nathan Tefft. 2010. “The Effects of Soft Drink Taxes on Child and Adolescent Consumption and Weight Outcomes.” *Journal of Public Economics*, 94(11), 967-74.
- Grimm, Gebra Cuyun; Lisa Harnack and Mary Story. 2004. "Factors Associated with Soft Drink Consumption in School-Aged Children." *Journal of the American Dietetic Association*, 104(8), 1244-49
- Han, E. and Powell, L. 2013. “Consumption Patterns of Sugar-Sweetened Beverages in the United States,” *Journal of the Academy of Nutrition and Dietetics* 13:43-53.
- Hu, F. 2013. “Resolved: There is Sufficient Scientific Evidence that Decreasing Sugar-sweetened Beverage Consumption will Reduce the Prevalence of Obesity and Obesity-related Diseases,” *Obesity Reviews* 14: 606–619
- Hu, F. and Malik, V. 2010. “Sugar-sweetened Beverages and Risk of Obesity and Type 2 Diabetes: Epidemiologic Evidence,” *Physiology & Behavior* 100: 47–54.
- Japsen, B. 2012. “U.S. Workforce Illness Costs \$576B Annually from Sick Days to Workers Compensation,” *Forbes* September 12, 2012.
- Keehan, S., Stone, D., Poisal, J., Cuckler, G., Sisko, A., Smith, S., Madison, A. Wolfe, C. and Lizonitz, J. 2017. “National Health Expenditure Projections, 2016-25: Price Increases, Aging Push Sector To 20 Percent of Economy,” *Health Affairs* 36(3): 553 – 563.
- Kirkpatrick, S., K. Dodd, J. Reedy, and S. Krebs-Smith. 2012. "Income and Race/Ethnicity are Associated with Adherence to Food-Based Dietary Guidance among U.S. Adults and Children," *Journal of the Academy of Nutrition and Dietetics* 112(5): 634-635.
- Kit, K., Fakhouri, T., Park, S., Nielsen, S., and Ogden, C. 2013. “Trends in sugar-sweetened beverage consumption among youth and adults in the United States: 1999–2011,” *American Journal of Clinical Nutrition* 98: 180-188.

- Ma, J., Sloan, M., Fox, C., Hoffmann, U., Smith, C., Saltzman, E., Rogers, G., Jacques, P., and McKeown, N. 2014. "Sugar-Sweetened Beverage Consumption is Associated with Abdominal Fat Partitioning in Healthy Adults," *Journal of Nutrition* 144: 1283–1290.
- Malik, V., Schulze, M. and Hu, F. 2006. "Intake of Sugar-sweetened Beverages and Weight Gain: A Systematic Review," *American Journal of Clinical Nutrition* 84:274–88.
- Marmot, M. 2004. *Status Syndrome*. Bloomsbury, London.
- Mozaffarian, D., Hao, T., Rimm, E., Willett, W. and Hu, F. 2011. "Changes in Diet and Lifestyle and Long-Term Weight Gain in Women and Men," *New England Journal of Medicine* 364(25): 2392 – 2404.
- Ogden, C. L.; B. K. Kit; M. D. Carroll and S. Park. 2011. "Consumption of Sugar Drinks in the United States, 2005-2008." *NCHS Data Brief*, (71), 1-8.
- Pase, Matthew P.; Jayandra J. Himali; Paul F. Jacques; Charles DeCarli; Claudia L. Satizabal; Hugo Aparicio; Ramachandran S. Vasan; Alexa S. Beiser and Sudha Seshadri. In Press. "Sugary Beverage Intake and Preclinical Alzheimer's Disease in the Community." *Alzheimer's & Dementia: The Journal of the Alzheimer's Association*.
- Rehm, C., Matte, T., Van Wye, G. Young, C., and Frieden, T. 2008. "Demographic and Behavioral Factors Associated with Daily Sugar-sweetened Soda Consumption in New York City Adults," *Journal of Urban Health: Bulletin of the New York Academy of Medicine* 85(3): 375 -385. doi:10.1007/s11524-008-9269-8
- Rehm, C., Peñalvo, J., Afshin, A., Mozaffarian, D. 2016. "Dietary Intake among US Adults, 1999-2012," *JAMA* 315(23):2542-2553. doi:10.1001/jama.2016.7491
- Rosinger, A., Herrick, K., Gahche, J., and Park, S. 2017. "Sugar-sweetened Beverage Consumption among U.S. Adults, 2011–2014," NCHS Data Brief No. 270, Hyattsville, MD: National Center for Health Statistics.
- Schmidt, L. 2014. "New Unsweetened Truths about Sugar," *JAMA Internal Medicine* 174(4): 525-526.

- Steward, W., Ricci, J., Chee, E. and Morganstein, D. 2003. "Lost Productive Work Time Costs from Health Conditions in the United States: Results From the American Productivity Audit," *Journal of Occupational and Environmental Medicine* 45: 1234–1246.
- United States Department of Agriculture. n.d. "Basic Report 14148 Beverages, Cola, Regular," National Nutrient Database for Standard Reference Release 28, [ndb.nal.usda.gov/ndb/foods/show/4228?manu=&fgcd=](http://ndb.nal.usda.gov/ndb/foods/show/4228?manu=&fgcd=), accessed August 22, 2017.
- Vereecken, Carine A.; Joanna Inchley; S. V. Subramanian; Anne Hublet and Lea Maes. 2005. "The Relative Influence of Individual and Contextual Socio-Economic Status on Consumption of Fruit and Soft Drinks among Adolescents in Europe." *European Journal of Public Health*, 15(3), 224-32.
- Wang, Y. and Chen, X. 2011. "How Much of Racial/ethnic Disparities in Dietary Intakes, Exercise, and Weight Status can be Explained by Nutrition- and Health-related Psychosocial Factors and Socioeconomic Status among US Adults?" *Journal of the American Dietetic Association* 111(12): 1904-1911.
- Wang, D., C. Leung, L. Yanping, E. Ding, S. Chiuve, F. Hu, W. Willett. 2014. "Trends in Diet Quality among Adults in the United States, 1999 to 2010." *JAMA Internal Medicine* 174(10): 1587-95.
- Welsh, J., Sharma, A., Grellinger, L., and Vos, M. 2011. "Consumption of added sugars is decreasing in the United States," *American Journal of Clinical Nutrition* 94:726–34.
- Willmsen, Christine. 2017. "Seattle Isn't the First City to Tax Soda: Here's How We Stack Up," *Seattle Times*.
- Witters, D. and Liu, D. 2013. "In U.S., Poor Health Tied to Big Losses for All Job Types," Gallup, [www.gallup.com/poll/162344/poor-health-tied-big-losses-job-types.aspx?version=print](http://www.gallup.com/poll/162344/poor-health-tied-big-losses-job-types.aspx?version=print), accessed August 22, 2017.
- Zagorsky, Jay L. ed. 1997. *Nlsy79 Users' Guide 1997*. Columbus, OH: Center for Human Resource Research, The Ohio State University.
- \_\_\_\_\_. 1999. "Young Baby Boomers' Wealth." *Review of Income and Wealth*, 45(2), 135-56.