Medicaid Expansion and Food Choices: The Case of Carbonated Soft Drinks

Xi He, Rigoberto A. Lopez, and Rebecca Boehm*

University of Connecticut

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*The authors are, respectively, Ph.D. student and Professor in the Department of Agricultural and Resource Economics, and postdoctoral fellow in the Zwick Center for Food and Resource Policy at the University of Connecticut, Storrs, 06269.Funding from the Zwick Center for Food and Resource Policy at the University of Connecticut is gratefully acknowledged.

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1. Introduction

In 2010, the U.S. Congress passed and President Barak Obama signed into law the Patient Protection and Affordable Care Act (ACA). The ACA expanded health care access to millions of Americans by creating individual and employer-based insurance mandates, expanding Medicaid and the Children's Health Insurance Program (CHIP), providing subsidies for health insurance premiums based on household income, and introducing new regulations on healthcare and insurance providers (Henry J. Kaiser Family Foundation 2013). While the ACA was meant to improve access to and quality of health care for all Americans, it specifically targeted low-income individuals, given the significant expansion of the Medicaid program.

Medicaid enrollment in expansion states began January 1, 2014, with some states adopting a modified version of the expansion as early as 2006 (Massachusetts) and 2011, and other states adopting the expansion after January 2014. Currently, approximately 74.5 million Americans are participating in Medicaid (U.S. Centers for Medicaid and Medicare Services 2017). Research comparing expansion versus non-expansion states has found increases in the number of low-income individuals with insurance coverage, reduced emergency room trips and hospital stays, and improvements in beneficiaries' self-assessed health (Simon, Soni and Cawley 2017; Sommers et al. 2016; Nikpay, Buchmueller and Levy 2016). The Medicaid expansion has also reduced the number of unpaid bills and debt (medical and otherwise) sent to third-party collectors among individuals residing in zip codes with high rates of low-income uninsured individuals (Hu et al. 2016). These findings suggest that the provision of health care through the expansion of Medicaid relaxes a household's budget constraint. Since food is a normal good, Medicaid expansion should increase food expenditures for households who benefit from this policy change.

Relaxation of the household budget constraint and an increase in food expenditures may lead to changes in diet quality among low-income households. Housing, food, and transportation are the largest budget share categories for low-income households (Majerol, Tolbert and Damico 2016), so small decreases in other expenses, such as health care may lead to increased spending on food. In the public health nutrition literature, there is a large body of evidence that says poorer U.S. households would eat healthier food if they had more resources to do so (Aggarwal et al. 2016;Rao et al. 2013). However, others argue that eating healthfully in the U.S. is not cost

prohibitive (Carlson and Frazão 2012;Stewart et al. 2016). Thus, the impact of healthcare provision on diet quality among low-income households is ambiguous.

At the same time, increased healthcare provision may lead to changes in diet quality irrespective of its effect on household financial resources. For example, in three states that expanded the Medicaid program under the ACA, Sommers et al. (2016) found increased utilization of outpatient care and preventive care services, and improved self-reported health among low-income individuals. Increased utilization of medical services may result in increased knowledge of nutrition and healthy foods. For example, type 2 diabetes and cardiovascular disease can be managed through improved nutrition. Primary care physicians recommend diet changes to patients with these diseases given current standards of care. Consequently, provision of health care may improve diet quality by changing preferences for food.

The effect that healthcare provision has on diet quality among low-income populations in the U.S. is especially important given their high rates of diet-related chronic disease including obesity, Type 2 Diabetes, and cardiovascular disease (Seligman, Laraia and Kushel 2010). A large body of evidence links these diet-related chronic diseases to the consumption of energy-dense foods, especially sugar-sweetened beverages (SSBs) (Han and Powell 2013). Significant attention both in academic and policy circles has focused on reforming federal nutrition policies so that they promote healthy diets among low-income populations in the U.S. This includes the controversial discussion about restricting purchase of SSBs among Supplemental Nutrition Assistance Program (SNAP) participants and taxing SSBs to reduce demand among all income groups. However, very little attention has been paid to how healthcare provision might change diet quality, including consumption of energy-dense foods and SSBs, especially among low-income populations. Passage of ACA provides an opportunity to investigate how healthcare provision to poorer individuals in the U.S. impacts diet quality.

Consequently, this paper examines the impact of Medicaid participation on food choices using purchases of carbonated soft drinks (CSD), the main subcategory of SSBs, as a case study product. CSD purchases provide a useful case study for several reasons. First, CSDs constitute the main source of added sugars in the American diet . Second, SSB consumption, including CSD consumption has been linked to obesity, type 2 diabetes, tooth decay, and other health problems . Third, reducing SSB, including CSDs, consumption in the U.S. is a major focus of public health

efforts and various policy options have been considered including taxes, restrictions in federal nutrition programs, and educational campaigns (Pomeranz 2012).

This paper uses a quasi-natural experiment approach to identify the causal impact of the Medicaid expansion on CSD purchases and propensity to purchase sugar-sweetened CSDs among a nationally representative sample of low-income U.S. households. We utilize the variation in the expansion of Medicaid across U.S. states after the passage of the ACA for our identification strategy. A mixed logit demand model is used to estimate consumer per capita sugar purchased and valuation of CSD sugar content after the Medicaid expansion. Our results show that poor, uneducated consumers increase their purchase of sugar-sweetened CSDs after Medicaid expansion. We hypothesize that this is due to increased discretionary income resulting from newly acquired healthcare provision. However, more highly educated poor consumers decrease their purchase of CSDs. This implies that the impact of Medicaid expansion on food choices is conditional on household education. Policies should be designed to avoid unintended diet quality consequences from Medicaid expansion in order to improve the long-term well-being of poor households.

2. Conceptual Analysis

The conceptual model focuses on the effects of Medicaid expansion on the changes of consumer valuation of healthy vs. unhealthy food options. The model is based on the following assumptions. First, let the food choices in question be divided into two groups: healthy and unhealthy goods. Second, let the consumer utility be separable from the consumption of non-food products. Third, Medicaid participation enhances the consumer budget by an amount *m* by relieving the budget constraint. Fourth, Medicaid participation provides nutritional information to encourage healthy food and discourage unhealthy food so that the potential marginal utility of this education is positive for healthy food and negative for unhealthy food. Finally, adopt a constant elasticity of substitution (CES) utility function depicted by:

$$\upsilon(H,U) = A[(\beta + \theta\varepsilon)H^{\gamma} + (1-\beta-\theta\varepsilon)U^{\gamma}]^{1/\gamma}, \quad (1)$$

where A is a scale parameter; H is the quantity of healthy food; U is the quantity of unhealthy food; β is the utility weight of the healthy relative to the unhealthy food; θ equals one if the consumer participates in Medicaid expansion (and zero otherwise), ε indicates nutrition education received under Medicaid expansion, and $\gamma = (\sigma - 1)/\sigma$, where σ is the constant elasticity of

substitution between healthy and unhealthy foods. The term $(1-\beta-\theta\varepsilon)$ is an indicator of the preference for unhealthy goods. In the absence of Medicaid, the lower bound for $\beta = 0$ when there is no utility weight assigned to healthy food and β =1 when there is absolute preference for healthy food..

We define the consumer's budget constraint as $y + \theta m$, where m is the Medicaid subsidy applicable to participants and *y* is the budget in the absence of Medicaid. The consumer's choice problem then becomes maximizing the following Lagrangian function:

$$\text{Max } F(H,U,\lambda) = A[(\beta+\theta\varepsilon)H^{\gamma} + (1-\beta-\theta\varepsilon)U^{\gamma}]^{1/\gamma} + \lambda[y+\theta m - P_h H - P_u U], \quad (2)$$

where P_j is the price of food *j* (*H* or *U*) and other notation is as defined above. The first-order conditions for the maximization of (2) yields the following Marshallian demands for healthy and unhealthy foods:

$$H^* = \left(\frac{\beta+\theta\varepsilon}{P_h}\right)^{\sigma} \frac{y+\theta m}{\omega}, \quad U^* = \left(\frac{1-\beta-\theta\varepsilon}{P_u}\right)^{\sigma} \frac{y+\theta m}{\omega} \quad (3)$$

where P_j is the price of food *j*, $\omega = (\beta+\theta\varepsilon)^{\sigma} P_h^{1-\sigma} + (1-\beta-\theta\varepsilon)^{1-\sigma} P_u^{1-\sigma}$, and other notation is as defined above.

Holding the nutrition education effect ε constant, it is clear that the income effect of Medicaid expansion will lead to an increase of both types of foods under this model. Taking the ratio of both expressions in (3) yields:

$$\frac{H^*}{U^*} = \frac{\beta+\theta\varepsilon}{1-\beta-\theta\varepsilon}\frac{Ph}{Pu}. \quad (4)$$

Thus, the nutrition education effect changes the ratio of healthy to unhealthy foods to the extent that it is effective and regardless of the level of the income effect. That is, nutrition education shifts the linear income expansion path towards healthy food if nutrition education is effective. If the consumer ignores the additional nutrition education (ε=0), then consumer preferences are unaltered, being subject only to the income effects. Also note that the indirect utility function is given by $V(Ph, Pu, y) = y\omega$, thus retaining the potential for changes in the weight consumers place on healthy vs. unhealthy food as a result of consumer nutrition education. Given that a higher level of indirect utility increases the probability that a particular product is chosen, whether from

changes in Medicaid consumer income or nutrition education effects, the following propositions are made.

Proposition 1: Medicaid participation releases the consumer's budget constraint which results in an increase of the valuation of a normal food product, resulting in a greater probability of increasing its consumption, regardless of its healthiness.

Proposition 2: By increasing the nutrition education of participants, Medicaid participation can result in a decrease in the valuation of unhealthy food products, thus increasing the probability of reducing consumption of unhealthy products.

Proposition 3: Whether or not participation in Medicaid results in an increase or decrease of the valuation (and probability of purchase) of unhealthy food products depends on the strengths and direction of the underlying income and education effects.

3a.) If the nutrition education effects of Medicaid are weak relative to the increased income effects, the consumer will increase their consumption of unhealthy food products.

3b.) If the nutrition education effects of Medicaid are strong relative to the increased income effects, the consumer will decrease their consumption of unhealthy food products.

Whether Medicaid expansion improves or worsens the diet quality of low-income households is an empirical question. To that end, we propose the following empirical model to test some of the propositions and ultimately assess the impact of Medicaid on diet quality using carbonated soft drinks data.

3. Empirical Strategy

We analyze the impact of Medicaid expansion on consumers' CSD choices using a mixed logit model, which is used to analyze heterogeneity in consumer preferences for product attributes (McFadden and Train 2000; Walker and Ben-Akiva 2002). Compared with other random coefficient logit models like BLP (Berry, Levinsohn, and Pakes, 1995), a mixed logit model incorporates individual-level information efficiently and is less computationally intensive. Compared with the difference-in-difference (DID) approach commonly used to investigate the impact of Medicaid expansion on overall CSD consumption, a mixed logit model can investigate the effect of Medicaid expansion on individual's evaluation of each product attribute. In our case,

we use the mixed logit model to estimate the change in consumer's willingness to pay (WTP) for sugar caused by Medicaid expansion.

3.1 Consumer Choices

We assume that consumer i chooses a product $j = \{1, \dots \dots, J\}$ from a set of competing products to maximize their utility:

$$u_{ijst} = \alpha_i p_{jst} + \beta_i X_{kj} + \delta_i D_{ijst-1} + s_j(\gamma_{1i} + \gamma_{2i} Med_{ist}) + \xi_{jst} + \epsilon_{ijst}, \quad (5)$$

where p_{jst} is the price of product brand j in market s at time t. X_{kj} is a vector of brand $j's$ observable product attributes other than sugar. Specifically, we include sodium and caffeine in the model.[1] We also include a dummy, D_{ijst-1}, to capture brand loyalty. D_{ijst-1} equals 1 if the consumer purchased the same CSD during their previous buying trip. . s_j denotes the sugar content of brand j and is the product attribute of major interest. In addition, we include a variable Med_{ist} to indicate whether or not a consumer i in market s participates in Medicaid at the moment they purchase of CSDs, and of course, such participation is conditional on whether or not a state participates in Medicaid expansion. $Med_{ist} = 1$ indicates that the consumer i resides in market s and participates in the Medicaid program at time t. The specification shows that Medicaid expansion applies only to participating states at a given moment in time. Since we are interested in any changes in sugar consumption via CSDs, we interact Med_{ist} with sugar to assess the impacts of these variables in shaping sugar content preferences for Medicaid participants. The parameter γ_{2i} captures the Medicaid participation effect by measuring changes in consumer valuation of sugar content offered in the choice set. ξ_{jst} denotes unobserved consumer characteristics. ϵ_{ijst} is an *iid* error term. Parameters $\alpha_i, \beta_i, \gamma_{1i}, \gamma_{2i}$ follow normal distributions and vary across consumers.

Because we are particularly interested in income (to test for the income effect) and formal education (the education effect) in shaping the preference for sugar content, we further specify that the response to Medicaid expansion is heterogeneous and varies by demographics, which is specified as:

[1] Although calories content is also an important attribute of CSDs, we drop it from our analysis because our main attribute of interest is sugar content and sugar content is highly correlated with calories. See Table 1 for details.

$$\gamma_{2i} = \overline{\gamma_2} + \theta D_i + \kappa\psi_i, \quad (6)$$

where D_i denotes consumer demographics, ψ_i is a standard multivariate normal distribution with the scaling factor κ. Price endogeneity is a lesser issue than when using market level data such as is typical of the BLP model because we are using data at the individual consumer level where price is exogenous.

Combining equations (5) - (6), the final utility is specified as:

$$u_{ijst} = \alpha_i p_{jst} + \beta_i X_{kj} + \delta_i D_{ijst-1} + \gamma_{1i} s_j + (\overline{\gamma_2} + \theta D_i + \kappa\psi_i) s_j Med_{ist} + \xi_{jst} + \epsilon_{ijst}, \quad (7)$$

The probability of consumer i purchasing product j is:

$$P_{ijst} = \frac{\exp(\mu_{ijt})}{1+\sum_{r=1}^{J}\exp(\mu_{irt})} \quad (8)$$

3.2 Impact of Medicaid Expansion on Consumer Choices

The coefficient of the term γ_{2i} measures how a consumer responds to the Medicaid expansion. If the marginal effect takes a positive sign, it means that consumers pay more attention to sugar content because of the Medicaid expansion. Conversely, it means consumers put less weight on sugar content after the health care expansion. Changes in the marginal effect of sugar content on of choice probability $\partial P_{ijst}/\partial s_j$ due to the Medicaid expansion are expressed as:

$$\frac{\Delta(\partial P_{ijst}/\partial s_j)}{\Delta\phi_{ist}} = \int(\overline{\gamma_2} + \theta D_i) L_{ijst}(\psi)\left(1 - L_{ijst}(\psi)\right) g(\psi) d\psi \quad (9)$$

where $L_{ijst}(\psi)$ is the conditional probability on ψ. If the marginal effect is negative, it means that consumers put less weight on sugar content in their decision making after the Medicaid expansion. We also calculate sugar and calorie intake changes due to the Medicaid expansion through simulation to better understand the impact of joining Medicaid on low income households' CSD choices.

3.2 Evaluation of Consumer Welfare

To quantify the welfare effects of participating in Medicaid expansion, we calculate the expected consumer surplus:

$$CS = E(u_{ijst})/\alpha_i \quad (10)$$

and consumer welfare change due to Medicaid expansion is given by:

$$\Delta CS = \frac{E(u_{ijst})}{\alpha_i} - E(u_{ijst})/\alpha_i \quad (11)$$

If we assume the change is the same across all consumers, total consumer welfare changes are ΔCS times market size.

4. Data and Identification of Medicaid Participants

The data used in this study comes from the Nielsen Consumer Panel dataset at the University of Chicago Kilts Center for Marketing.[2] We use CSD purchase data over 156 weeks, from January 2013 to December 2015, for low-income households that reside in all the US states, excluding Hawaii and Alaska. These data span one year prior to the Medicaid expansion in January 2014, and two years after to generate enough variation in the Medicaid participation status of low-income households for identification. Figure 1 denotes the 31 states were participating in Medicaid expansion as of December 31, 2015. Our identification comes from both consumer choices in states that adopted and did not adopt Medicaid expansion, as well as consumer choices in years before and after Medicaid expansion.

We include 17 CSD brands belonging to the three dominant CSD companies: Coca-Cola, Pepsi, and Dr. Pepper. The total sales of the 17 brands from 2013 to 2015 compose take up a market share of 53.68%. Brand characteristics that can affect consumer choices include price, company, and nutrition characteristics, such as calories, sugar content, sodium, and caffeine. Table 1 presents the nutritional characteristics of the brands included in the sample. Because our main nutrition characteristic of interest is sugar and there is a high degree of correlation between calories and sugar (as shown in Table 1), we include only sugar in our analysis and exclude calories.

A disadvantage of Nilsen scanner data is that it does not provide information about household' Medicaid participation status, and lack of information about participation status both before and after state-level decisions to participate in the Medicaid expansion makes it difficult to assess the impact of Medicaid participation on households' CSD choices. Therefore, we need to rely on other

[2] Access to the Nielsen Consumer Panel data was obtained through the Zwick Center for Food and Resource Policy at the University of Connecticut. For access to the data (at a fee) researchers are directed to the University of Chicago Kilts Center for Marketing to request permission.

external data sources to identify households that participate in Medicaid. To deal with this problem, we first retain only households clearly eligible to receive benefits, that is, those with income below the 133% federal poverty line, which varies over household size and across years. It bears noting that because the Nielsen scanner data divides household income into 20 category bins and does not provide detailed household income, we use the mean of each category bin to approximate the real household income.[3] Next, we rely on data from the American Community Survey (ACS), which provides the Medicaid participation information needed to estimate the low-income households' probability of participating Medicaid. The ACS data are collected by the Census Bureau and provide information on a yearly basis about the nation and people. Based on the ACS data from 2013 to 2015, we estimate the impact of household characteristics on Medicaid participation using the following logit model:

$$Prob(Med_{ist} = 1) = X'_{ist}\delta + \theta_s + \vartheta_t + \omega_{it}, \tag{12}$$

where $Med_{ist} = 1$ indicates that household i in state s join in Medicaid at time t. X'_{ist} is a vector of household demographics including household size, the presence of children, and the race of the household head. $\theta_s \; and \; \vartheta_t$ represent state and time fixed effects. ω_{it} is an error term. Table 3 presents the estimation results for equation (12). We find that households with more members are more likely to participate in Medicaid, while households with children are less likely to participate. In addition, compared with Whites, African Americans are more likely to participate, while Asian Americans are less likely to participate. Based on the estimation results, we predict the probability of enrolling in Medicaid for the households in our sample.

Figure 2 presents the predicted probability of a state's participation over time in both Medicaid expansion and non-expansion states for low-income housheolds in the Nielsen dataset over time. There is a clear trend that the Medicaid participation rates for households in expansion and non-expansion states have increased, though the participation rate in expansion states is always higher than that in the non-expansion state. In addtion, our predicted state-level participation rate is highly correlated with the actual participation rate calculated from ACS data, further validating our method for predicting the Medicaid participation status of Nielsen households.

[3] For example, if a household's income is in the range $8000-$9999, we set the household income at $9000.

Ideally, our identification should come from households that participate in Medicaid after the Medicaid expansion. If we assume that no low-income households participated in Medicaid before Medicaid expansion, and that all joined Medicaid after the expansion, our estimates would be biased because there might be consumers who were participating in Medicaid even before the expansion. Therefore, we only consider households with a probability of higher than 0.48, which is the average predicted probability for all households in 2014, as those that actually participate in Medicaid after the program expansion. In addition, to alleviate the confounding impact of non-participants we exclude from our sample household in expansion states whose predicted probability is higher than 0.48 before the Medicaid expansion and households in non-expansion states, and whose predicted probability is higher than 0.48. In the end, our sample consists of 12,526 households with a total number of 133,235 purchase transactions over 156 weeks in 52 designated metropolitan areas (DMAs).[4]

Table 2 presents the summary statistics for consumer CSD purchases across all periods and states. Column (1) presents the descriptive statistics for all purchase in the sample. Column (2) and (3) presents the statistics for purchase in non-expansion and expansion states, respectively. Columns (4) and (5) show the characteristics for purchase by Medicaid non-participants and participants in expansion states, respectively, and the last column provides the t-test results for comparing the difference between characteristics of Medicaid non-participants and participants in the Medicaid expansion states. One noticeable trait is that, on average, consumers in non-expansion states purchase fewer CSDs than their counterparts in expansion states. However, consumers in expansion states spend less on CSD after the Medicaid expansion. This might indicate that consumers in expansion states buy fewer CSDs after enrolling in the Medicaid program. However, it also seems likely that Medicaid participants buy CSDs with significantly more sugar and calories, and less caffeine. In addition, Medicaid participants generally have smaller families, no children, and less education, which is in line with the estimation results about participation from equation (12).

5. Empirical Results

[4] We excluded about 11.5% of purchases by non-participants from our initial sample. Before excluding non-participants from our sample, we have a total of 148,897 purchases by 13,523 households.

We first present estimation results for the mixed logit model and provide estimates of the impact of Medicaid expansion on the marginal effects of sugar, and then test for the mechanisms of the empirical findings.

5.1 Mixed logit results

Table 4 presents the estimation results for the mixed logit model. Model (1) investigates only the heterogeneity of Medicaid participation across income. Model (2) includes only the heterogeneity of Medicaid participation across education levels, while model (3) takes into account consumer heterogeneity across both income and education. We focus on the estimation results under model (3). As expected, consumers' willingness to pay decreases with price and increases with last time purchase dummy. As for CSD attributes other than sugar, consumers' willingness to pay increases with caffeine but decreases with sodium. As for sugar, consumers are more likely to pay more for higher sugar content, and the marginal effect of sugar content on consumers' buying decisions does not significantly change after Medicaid expansion, as illustrated by the insignificant coefficient for the term *Sugar*Med*. However, there exists great heterogeneity over different demographic groups. The coefficient for *Sugar*Med*Income* is significantly positive, indicating that households with lower income are more responsive to the Medicaid expansion. On the other hand, the coefficient for *Sugar*Med*Edu* is significantly negative, indicating that college-educated households respond more to the Medicaid expansion program.

5.2 Changes in price elasticities of demand

We calculate consumer's demand elasticity for each brand and conduct a counterfactual simulation under which there is no Medicaid expansion and derive the simulated price elasticity when then there is no Medicaid expansion. The simulated price elasticity when there is no Medicaid expansion, the actual price elasticity with Medicaid expansion, and the percent change are presented in Table 5. There is a clear trend that price elasticity after Medicaid expansion significantly decreased across all brands, within the range of -0.5%~-11.16%, indicating that consumers are becoming less sensitive to CSD price, indicating that they may be paying more attention to CSD nutrient characteristics than to price.

5.3 Changes in marginal effect of sugar on CSD choices

After obtaining the estimation results, we also use equation (9) to measure the impact of Medicaid expansion on the marginal effects of sugar. Figure 3.1 shows the density distribution of the effects for households with no college education and for households with at least a college education. The figure indicates that, on average, Medicaid expansion increases the marginal effects of sugar on consumer's CSD choices, though there is great heterogeneity. Specifically, most households with no college education put more weight on sugar after the Medicaid expansion, while more households with college education put less weight on sugar after Medicaid expansion. Figure 3.2 shows the density distribution of the effects for households with high income and households with low income. The figure indicates that the changes in the marginal effect of sugar on CSD choices affect high-income households more than they do low-income households. The two figures indicate that high-income households and households without a college education put more emphasis on sugar content after joining Medicaid.

6. Robustness checks

We conduct two robustness checks to test the validity of our main results. First, we regard households with a probability higher than 0.48 as Medicaid participants in the main analysis. We further test the robustness of the mixed logit estimation when we set the threshold criteria at 0.52, which is the average predicted participation rate of households in the Medicaid expansion states. The second robustness check tests the potentially confounding impact the Children's Health Insurance Program (CHIP) and redoes the analysis by excluding households with children from our sample.

6.1 A Different participation criteria

Our main analysis depends critically on the selection of households with a probability higher than 0.48 to participate in Medicaid as actual Medicaid participants. To test whether our results are robust to this selection criteria, we set the criteria at 0.52, the mean probability of participation in 2015 and redo the analysis. Table 6 presents the estimation results, and the main findings still hold.

6.2 The Potential Impact of CHIP

The Medicaid and Children Health Insurance Program (CHIP) eligibility rules are closely related. For example, the income eligibility standards for adults who are parent caretakers and those who are not are very different. To validate our main results, we exclude households with children from

our sample and re-estimate the mixed logit model. Table 7 presents the estimation results, and our major findings remain unchanged.

7. Concluding Remarks

This paper analyzes the impact of the ACA Medicaid expansion on the CSD choices of low-income households. Specifically, we focus on the effects of Medicaid expansion on consumers' choices of CSD products with different sugar levels. Based on 12,526 households' 133,235 choices from among 17 CSD brands, we estimate a mixed logit model with 2,264,995 observations.

We have three major findings. First, consumers spend less on CSD after the Medicaid expansion. Second, whether consumers put more or less weight on the sugar content depends on their demographics, and there is clear evidence that consumers with higher education put less weight on sugar than do consumers with less education. Third, we find that the net impact of Medicaid expansion on consumer's CSD choices depends on the tradeoff between the income effect and the education effect. In summary, this article analyzes consumer behavior changes caused by Medicaid expansion, and we highlight the role of education in changing low-income households' diet quality and overall health.

Our consumer welfare analysis indicates that consumers' surplus increases by $0.001 per purchase. However, considering that consumers also increase their sugar intake, we need to take into account the external health costs of consuming more sugar to have a complete estimate of consumer welfare change. Future research can be directed toward the overall market size effect of Medicaid participation on CSD consumption to quantify the overall associated welfare change of Medicaid expansion.

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Table 1. Nutritional Characteristics of CSD Brands in the Sample

Brand	Calories per 12 oz	Sugar g/12 oz	Sodium mg/12 oz	Caffeine mg /12 oz	Market share (2013-2015)
Coca-Cola					
Coke Regular	140	39	50	35	9.10%
Coke Diet	0	0	40	47	7.99%
Coke Zero	0	0	40	35	3.09%
Sprite Regular	144	38	70	0	2.13%
Fanta Regular	160	44	55	0	0.57%
Pepsi					
Pepsi Regular	150	41	30	38	7.32%
Pepsi Diet	0	0	35	35	5.82%
Mountain Dew	170	46	65	54	4.29%
Mountain Dew Diet	0	0	50	54	2.87%
Sierra Mist Regular	165	45	105	54	0.64%
Sierra Mist Diet	0	0	38	0	0.47%
Dr. Pepper					
Dr. Pepper Regular	150	40	55	42	3.64%
Dr. Pepper Diet	0	0	55	42	2.34%
Sunkist Regular	190	50	70	40	0.64%
Sunkist Diet	0	0	110	41	0.66%
7 UP Regular	140	38	40	0	1.14%
7 UP Diet	0	0	65	0	2.34%

Table 2. Summary Statistics of Variables Used in Demand and Participation Models

	(1)	(2)	(3)	(4)	(5)	(6)
				Treatment states		
	All purchase	Control states	Treatment states	Medicaid non-participants	Medicaid participants	T-tests of (4) and (5)
Total price paid	6.412	6.105	6.619	6.706	6.424	0.282***
	(7.379)	(6.875)	(7.692)	(7.804)	(7.433)	
Ounces	250.322	239.009	257.923	261.646	249.617	12.029***
	(291.704)	(272.853)	(303.480)	(306.577)	(296.291)	
Price ($/oz)	0.026	0.026	0.026	0.026	0.026	0.00***
	(0.003)	(0.003)	(0.004)	(0.004)	(0.004)	
Calories (12 oz)	100.262	100.846	99.870	96.988	106.298	-9.31***
	(71.734)	(70.934)	(72.264)	(73.092)	(69.959)	
Sugar (g/12 oz)	27.315	27.460	27.217	26.440	28.951	-2.511***
	(19.511)	(19.285)	(19.661)	(19.893)	(19.018)	
Sodium	49.024	49.682	48.582	48.520	48.721	-0.201
	(16.258)	(15.261)	(16.881)	(16.794)	(17.073)	
Caffeine	35.897	36.134	35.739	36.042	35.063	0.979***
	(15.210)	(14.897)	(15.415)	(15.198)	(15.869)	
Household size	2.369	2.366	2.372	2.070	3.044	-0.974***
	(1.359)	(1.301)	(1.396)	(1.195)	(1.568)	
Presence of children	0.268	0.277	0.262	0.266	0.254	0.012***
	(0.443)	(0.447)	(0.440)	(0.442)	(0.435)	
High education	0.618	0.628	0.611	0.619	0.591	0.028***
	(0.486)	(0.483)	(0.488)	(0.486)	(0.492)	
Number of observations	133235	53545	79690	55024	24666	

Table 3. Medicaid Participation Results

	Medicaid participation
Household size	0.298***
	(0.001)
Presence of children	-0.754***
	(0.004)
Black	0.627***
	(0.005)
Asian	-0.154***
	(0.008)
Other races	0.284***
	(0.005)
Year=2014	0.407***
	(0.004)
Year=2015	0.531***
	(0.004)
Constant	-1.476***
	(0.012)
State fixed effects	Yes
Number of observations	1,709, 617
Log-likelihood	-1086117.0

Note: Standard errors are in the parenthesis. *, **, *** denote significance level of 10%, 5%, and 1%, respectively.

Table 4. Mixed Logit Demand Results

	(1)		(2)		(3)	
Variable	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.
Price	-5.661***	-0.516	-5.672***	-0.308	-5.675***	-0.303
	(0.989)	(1.876)	(0.989)	(1.927)	(0.989)	(1.926)
Last purchase dummy	3.483***	-2.030***	3.479***	2.011***	3.478***	2.009***
	(0.025)	(0.086)	(0.025)	(0.084)	(0.025)	(0.083)
sodium	-0.0217***	-0.000594	-0.0217***	0.000179	-0.0217***	0.000180
	(0.000)	(0.001)	(0.000)	(0.001)	(0.000)	(0.001)
caffeine	0.0172***	-0.000118	0.0173***	0.000188	0.0173***	0.000190
	(0.000)	(0.001)	(0.000)	(0.001)	(0.000)	(0.001)
Coca-Cola dummy	0.443***	0.0329	0.441***	0.0506**	0.441***	0.0506**
	(0.011)	(0.021)	(0.011)	(0.021)	(0.011)	(0.021)
Pepsi dummy	-0.0991***	0.00531	-0.0994***	-0.00895	-0.0993***	-0.00890
	(0.012)	(0.022)	(0.011)	(0.022)	(0.011)	(0.022)
sugar	0.0164***	-0.000147	0.0163***	0.000236	0.0163***	0.000234
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Sugar* *Med*	-0.00287**	-0.000169	0.00802***	-0.0000831	0.00171	-0.000109
	(0.001)	(0.001)	(0.002)	(0.001)	(0.002)	(0.001)
Sugar* *Med* *Income	0.000593***				0.000610***	
	(0.000)				(0.000)	
Sugar* *Med* *Edu			-0.00107**		-0.00125***	
			(0.000)		(0.000)	
Number of observations	2,264,995		2,264,995		2,264,995	
Log-likelihood	-210641.6		-210611.7		-210598.3	

Note: Standard errors are in the parenthesis. *, **, *** denote significance level of 10%, 5%, and 1%, respectively.

Table 5: Changes in Consumer's Price Elasticity of Demand

Brand	Simulated price elasticity without Medicaid expansion	Actual price elasticity with Medicaid expansion	Percent change
Coca-Cola			
Coke Regular	-2.717	-2.129	-8.88%
Coke Diet	-2.372	-2.322	-0.58%
Coke Zero	-2.481	-2.428	-0.60%
Sprite Regular	-3.029	-2.456	-8.46%
Fanta Regular	-3.426	-2.475	-10.19%
Pepsi			
Pepsi Regular	-2.821	-2.129	-9.57%
Pepsi Diet	-2.453	-2.403	-0.50%
Mountain Dew	-3.381	-2.35	-10.59%
Mountain Dew Diet	-2.501	-2.448	-0.54%
Sierra Mist Regular	-3.493	-2.479	-10.40%
Sierra Mist Diet	-2.533	-2.479	-0.62%
Dr. Pepper			
Dr. Pepper Regular	-3.076	-2.385	-9.19%
Dr. Pepper Diet	-2.522	-2.468	-0.59%
Sunkist Regular	-3.778	-2.467	-11.16%
Sunkist Diet	-2.555	-2.5	-0.59%
7 UP Regular	-3.036	-2.457	-8.47%
7 UP Diet	-2.549	-2.496	-0.55%

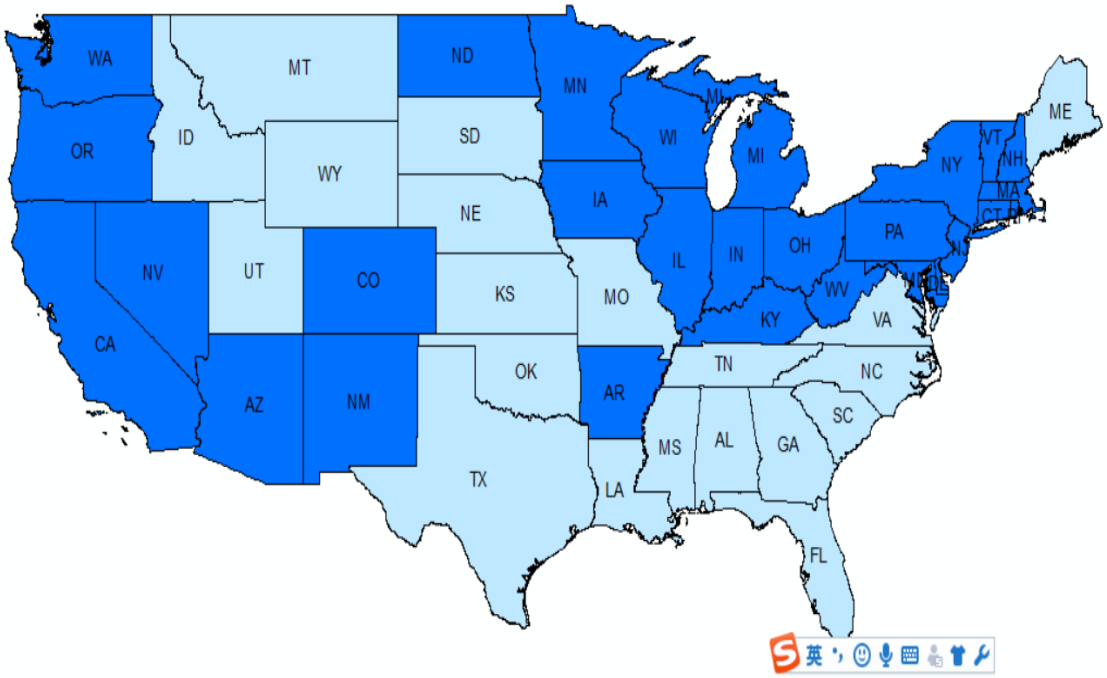
Table 6: Robustness check 1: Alternative Probability of Participation (0.52)

Variable	Mean	Std. Dev.
Price	-5.658***	-0.302
	(0.989)	(1.923)
Last purchase dummy	3.478***	2.008***
	(0.025)	(0.083)
sodium	-0.0217***	0.000156
	(0.000)	(0.001)
caffeine	0.0172***	0.000194
	(0.000)	(0.001)
Coca-Cola dummy	0.442***	0.0506**
	(0.011)	(0.021)
Pepsi dummy	-0.0992***	-0.00906
	(0.011)	(0.022)
sugar	0.0164***	0.000238
	(0.000)	(0.000)
Sugar* *Med*	0.000876	0.000135
	(0.002)	(0.001)
Sugar* *Med* *Income	0.000724***	
	(0.000)	
Sugar* *Med* *Edu	-0.00172***	
	(0.000)	
Number of observations	2,264,995	
Log-likelihood	-210589.6	

Table 7: Robustness check 2: Households Without Children

Variable	Mean	Std. Dev.
Price	-5.696***	0.380
	(1.135)	(2.202)
Last purchase dummy	3.398***	1.084***
	(0.033)	(0.134)
sodium	-0.0198***	0.000784
	(0.000)	(0.001)
caffeine	0.0157***	0.000169
	(0.000)	(0.001)
Coca-Cola dummy	0.380***	0.0346
	(0.014)	(0.026)
Pepsi dummy	-0.0719***	0.0563**
	(0.013)	(0.025)
sugar	0.0110***	0.000101
	(0.000)	(0.000)
Sugar* *Med*	0.00163	0.000145
	(0.003)	(0.001)
Sugar* *Med* *Income	0.000359**	
	(0.000)	
Sugar* *Med* *Edu	-0.000528	
	(0.001)	
Number of observations	1,658,061	
Log-likelihood	-147402.3	

Figure 1. Sstates Adopting Medicaid Expansion as of December 31, 2015.



Note: States in darker color had adopted Medicaid expansion by the end of 2015, while states in light color had not. Specifically, there are 26 states: AR, AZ, CA, CO, CT, DC, DE, HI, IA, IL, KY, MA, MD, MN, ND, NJ, NM, NV, OH, OR, RI, VT, WA, WI, WV, that had adopted Medicaid expansion as of January 2014. MI adopted the ACA expansion in April 2014. NH enrolled in August 2014. PA, IN, and AK enrolled in January 2015, February 2014, and September 2015, respectively.

Figure 2. Predicted Probability of Medicaid Participation in Medicaid Expansion and Non-expansion States

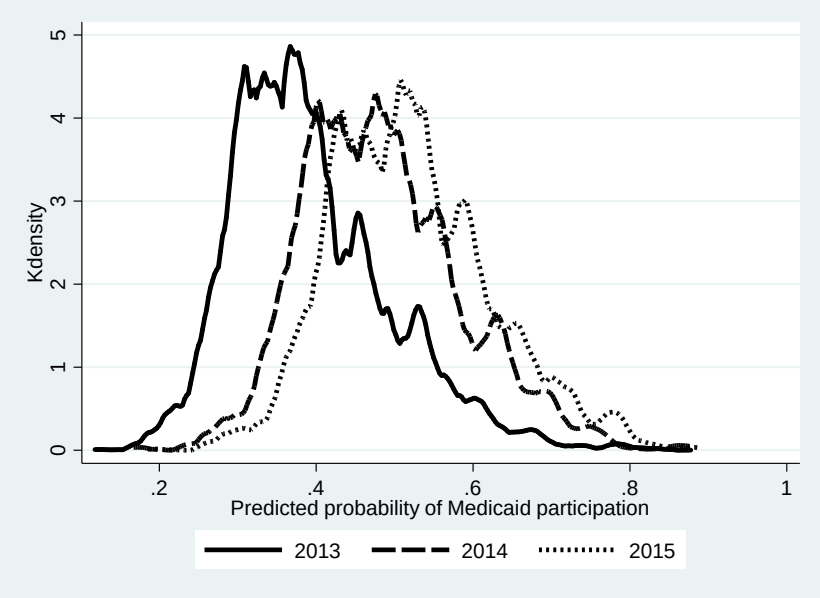


Figure 2.1 Medicaid expansion states

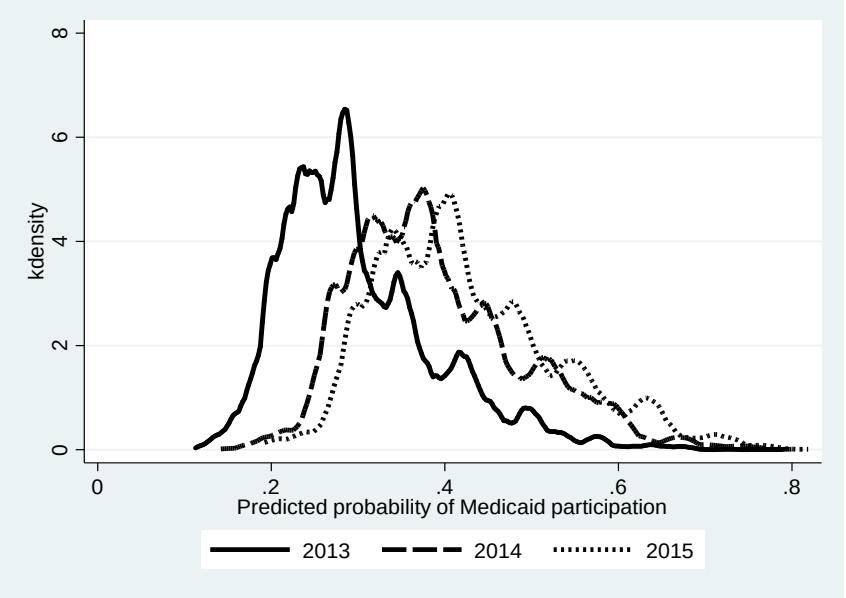


Figure 2.2 Medicaid non-expansion states

Figure 3. Density Distribution of the Impact of Medicaid Expansion on Marginal Effects of Sugar

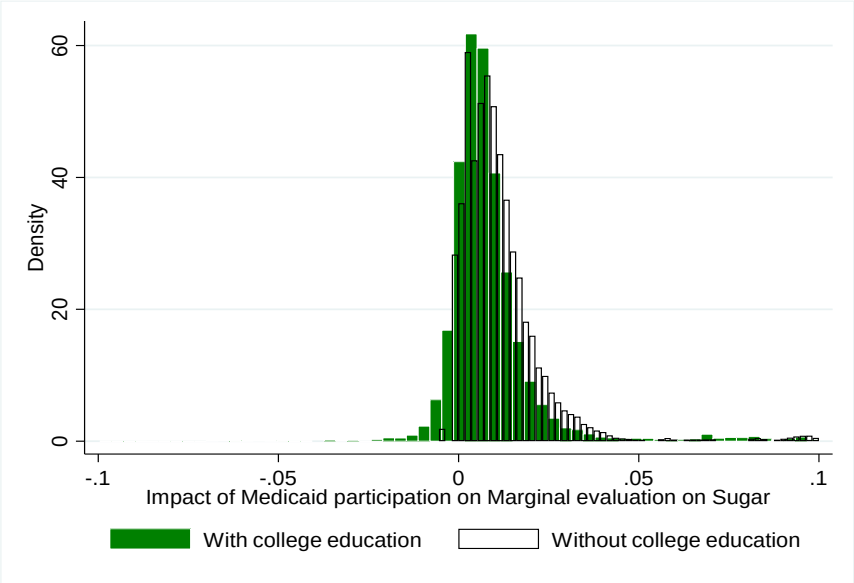


Figure 3.1

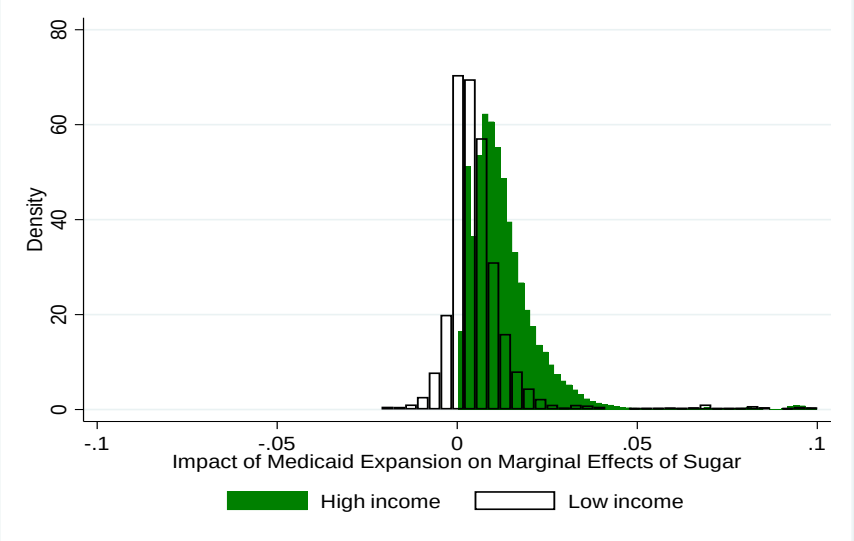


Figure 3.2

Note: The average change in the marginal effect of sugar content on choice probability caused by Medicaid participation is 0.008 for households with a college education, 0.012 for households without a college education, 0.013 for low-income households, and 0.006 for high-income households.