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The Effect of Breakfast Cereal Coupons on the Nutritional Quality of Household Purchases

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Abstract

Grocery coupons require consumers to purchase specific products. This can alter a consumer's shopping basket. We examine what effect, if any, coupon use has on the nutritional quality of consumer purchases. We focus on breakfast cereals and evaluate their nutritional quality using fat, fiber, protein, sodium and sugar content. We find cereal purchases made with manufacturer or retailer coupons have greater sodium and sugar content. The change in fat, fiber and protein content are not economically significant. As part of a comprehensive marketing strategy, firms should evaluate how their customers use coupons to manage the cost and nutritional quality of their purchases.

Keywords: grocery coupons, breakfast cereal, nutrition

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Introduction

Given the vast number of products available at grocery stores, it is essential that food manufacturers and retail grocery store chains advertise to retain and attract new customers. For this purpose, Coca-Cola began promoting their product in 1887 with the first known coupons (Geuss 2010). Other food manufacturers followed suit and soon customer coupon use became prolific in the early part of the 20th century, especially during the Great Depression when consumers needed support to survive.

In the late 1990's, coupon use was in decline; however, during the latest economic recession, there was a dramatic increase in their use. In 2006, 2.6 billion coupons were redeemed, reversing a 15-year downward trend (CNN 2008). Their use peaked in 2011 and fell slightly to 2.9 billion coupons redeemed in 2012 (NCH Marketing Services 2013). For a time, coupons were primarily seen in Sunday newspaper ads. Now they are offered via multiple sources including daily papers, direct mail, mobile applications, online websites and directly at retail locations.

Coupons can encourage consumers to purchase items they would not given their budget and preferences. As such, coupons may motivate consumers to purchase more or less healthful products relative to their typical purchases and, knowingly or unknowingly, alter the nutritional content of their diet. Consumers may purchase cereals with better taste profiles, which often have higher levels of sugar or sodium. At the same time, coupons could also allow households to buy cereals with healthier nutritional content. Consequently, there are relevant health considerations pertaining to the tradeoff between price, taste and nutrition.

In addition, coupons play an important role as part of a comprehensive marketing strategy for firms. The interplay between price, taste and nutrition can influence the way firms choose to utilize coupons. Further, differences are likely to be present when comparing coupons provided by manufacturers with those offered by retailers. To date, there has been no research investigating how coupon-induced purchases impact the nutritional content of household purchases.

In this article, we examine the effect of retail and manufacturer coupons on the nutritional content of breakfast cereal purchases made by households, where nutritional content is measured in terms of fat, fiber, protein, sodium and sugar. We focus on breakfast cereals for several reasons. For one, breakfast cereal is regularly consumed in the US and is a popular choice for breakfast among children and adults. Further, breakfast cereal can be an important contributor to mental and physical health (Smith 1999). Finally, breakfast cereal is primarily purchased at retail stores for at home consumption so we can account for the entire basket of breakfast cereal purchases for most households.

For our analysis, we use AC Nielsen household-level purchase data for the greater New York area from 2006-2008, which includes household demographic information and daily household retail purchases of breakfast cereals. This data also identifies whether a coupon was used during purchase, the type of coupon used (retail vs. manufacturer) and the value of the coupon. Using this data, there are several estimation issues that we have to address.

First, unobserved household and market characteristics may effect a household's decision to use coupons and their cereal purchases. As such, the decision to use coupons is endogenous to the household purchase decision. Failing to account for unobserved characteristics would bias estimates of the effect of coupons on purchases. In addition, the effect of coupons on household purchasing behavior is likely to vary across households. Again, such heterogeneity can lead to biased estimates of the effect of coupons.

Another issue is that both household coupon use and cereal purchases are infrequent, resulting in numerous zeros in the data even after aggregating to the monthly level. This could represent infrequent use of coupons and cereal purchases or true corner solutions. In either case, we must control for censored observations for both coupons and cereal purchases.

To address these issues we estimate a two-step model similar to those proposed by Vella (1993) and Vella and Verbeek (1999). In the first stage, we estimate household coupon use using a cross-sectional Tobit model in each period to control for censored coupon use. As coupons come from both manufacturers and retailers, we do this for both types of coupons. From both of these Tobit models, we then calculate the generalized residuals in each period. In the second stage, we estimate the nutritional content of household cereal purchases as a function of coupon use using a random-effects Tobit model to control for censored purchase data. We include the generalized residuals from the first stage to control for endogenous coupon use. In addition, we include the interaction of the generalized residuals and the coupon variables to account for heterogeneous benefits of coupons.

Our results show that coupon use has a significant impact on the nutritional content of breakfast cereals purchased by households. Specifically, we find that cereal purchases made with coupons have higher average sodium and sugar content than purchases made without coupons. The average fat, fiber and protein content are also higher, but the difference is economically insignificant. In addition, we find that manufacturer coupons have a higher marginal impact than retailer coupons. Finally, our results reveal that coupon use is endogenous and has heterogeneous effects on household purchases, indicating that our two-step approach improves estimation by reducing bias.

In our study, it appears that consumers are choosing to redeem manufacturer and retailer coupons for products that are significantly higher in fat, fiber, protein, sodium and sugar. The increases in sodium and sugar are particularly large, which is a concern given their impact on consumer health. It is relevant to note that this is an empirical finding which may not generalize to all other markets. Given the prolific use of coupons by households, however, firms should evaluate how their customers use coupons to manage the cost and nutritional content of their purchases. This can be an important part of a comprehensive marketing strategy to promote products with better nutritional content (Chandon and Wansink 2012).

Motivation

Coupons play an important role in food marketing as they have a dual effect on consumers (Ward and Davis 1978). First, coupons inform and remind consumers about a product, thereby having an advertising effect. Further, coupons offer a price discount as well. Several authors

show that coupons have a positive impact on purchases for numerous food products. Ward and Davis (1978) and Lee and Brown (1985) find that even after accounting for consumer habit persistence, coupons have a positive impact on orange juice purchases. Dong and Kaiser (2005) find coupons impact US cheese purchases and that coupon use varies across ethnic groups. Dong and Leibtag (2010) find with fruit and vegetable purchases that price discounts using coupons have more of an effect than just price discounts, providing support for the dual effect of coupons. Finally, several authors find that coupons can lead to brand-switching as well (Gupta 1988; Neslin et al. 1985; Bawa and Shoemaker 1987).

Hawkes (2009) reviews the effect of sales promotions on food consumption patterns and finds that they tend to encourage consumers to eat more. Looking just at price discounts, however, Mhurchu et al. (2010) find they have no impact on nutrients that households purchase. To our knowledge, however, nobody has explicitly examined how coupons affect the nutritional content of purchases. If coupons affect consumer choices, an important health policy question is whether coupons contribute to a more or less healthful diet. In general, it is assumed that lower prices or excessive advertising for unhealthful foods leads to greater consumption, thereby reducing diet quality. The expected effect of coupons on diet is not as intuitively clear.

Consider that a household buys a basket of consumable goods identified by the vector x_j, with j = 1 to m. Given price vector (p) and income (w), the household will have preferences relative to some other basket of goods such that $x_j(p_j, w) \cdot p_j \geq x_k(p_k, w) \cdot p_k$ where k = 1 to n and at least one element of x_j is different from x_k. Next, assume that coupons are introduced, given by vector c, which affect price vectors p_j and p_k such that the preference ordering changes: $x_j\left(p_j(c), w\right) \cdot p_j \leq x_k\left(p_k(c), w\right) \cdot p_k$. This is not an unusual phenomenon as individuals often alter their purchases because of coupons.

Even one coupon can motivate a household to change multiple items in its basket of goods. Milkman and Beshears (2009) refer to this as a windfall effect. Specifically, they find that households who receive a coupon of value \$ c spend $\$c + \varepsilon$ on their total basket of goods where $\varepsilon > 0$. As such, in this study we consider how a household's entire basket of breakfast cereals changes given the use of at least one breakfast cereal coupon.

Of specific interest in this article is what happens to the nutritional content of household purchases after a coupon is introduced. Nutritional content can be measured in many dimensions, which we naively define using n, which is a vector with elements corresponding to each element in x. The household then purchases the aggregate nutritional content $n'x$. There are two important points to consider. First, there are different baskets of goods that provide similar nutritional content. In addition, household preferences are not necessarily inclusive of nutritional content. That is, households may not consider the nutritional content of the purchases they make.

After introducing coupons, we may observe several outcomes. It may be that $n_j'x_j = n_k'x_k$ so that there is no change in the nutritional content of household purchases when switching from $x_j$to x_k. In fact, a coupon could motivate a household to just purchase more of their usual basket of goods at a lower price. In this case, the household is better off and we would not observe any

change in the nutritional content received by the household. Alternatively, we may find that $n_j{}'x_j > n_k{}'x_k$ (or $n_j{}'x_j < n_k{}'x_k$) so that the nutritional content received from the basket of goods has changed. A change in nutritional content could be more or less healthful depending on the elements of *n.*

A priori, it is not clear how coupons will affect the nutritional content of a household's purchases. If a household is price sensitive, they may be willing to tradeoff better nutritional content for a price discount[1]. For example, a household may purchase a cereal that they know has worse nutritional content if it is cheaper. Alternatively, a coupon may allow a household to purchase a cereal with *better* nutritional content for a lower price. On the other hand, a household may not be concerned with nutritional content and seek only "better" taste, which is often a result of greater amounts of sodium or sugar. A coupon, therefore, may allow a household to purchase a better tasting cereal, with worse nutritional content, for a lower price. Given the different possible ways that coupons can affect a consumer's basket of good, the ultimate change in nutritional content is an empirical question.

Breakfast Cereal Nutrition

Breakfast cereals are regularly consumed in the US and a popular choice for breakfast among children and adults making them a relevant product to study. There is controversy regarding their overall nutritional benefit. After controlling for demographics and lifestyle differences, Smith (1999) found that those who consumed breakfast cereal every day reported better mental and physical health than those who consumed it infrequently. Additionally, cereal encourages complementary consumption of milk, which itself has important health benefits. Some research suggests that even sugar-sweetened cereals are beneficial to healthful diets as they provide important shortfall micronutrients that are often lacking in typical diets (Nicklas, O'Neil, and Myers 2004; Morgan, Zabik and Leveille 1981; Frary, Johnson and Wang 2004)[2].

At the same time, there is concern regarding the nutritional content of breakfast cereals, particularly for children. Harris et al. (2010) find that offering children high-sugar cereals leads to them consuming more total grams of cereal and more grams of sugar in their diet than children offered low-sugar cereal. As such, the nutritional profile of cereals that are consumed by children may have a greater impact on their total diet. Further, they note that the majority of children's cereals fail to meet national nutrition standards and suggest that recommendations of ready-to-eat breakfast cereals should consider their full nutrient profiles.

The purpose of this research is not to evaluate the nutritional content of breakfast cereals in general, as this is not our area of expertise, but to evaluate changes in the nutritional content of household purchases. Previous papers have examined breakfast cereal purchases using composite nutrition scores (Binkley and Golub 2011; Schwartz et al. 2010). This approach relies on

[1] In this context, we consider better and worse nutritional content in an abstract sense. Better nutritional content could mean that a cereal contains more fiber or protein and/or less fat, sodium or sugar. Worse nutritional content would be the opposite. Clearly there could be combinations of these nutrients as well. We discuss how we evaluate each nutrient more in the next section.

[2] Importantly, cereal manufacturers funded several of these studies.

systematically weighting various macro and micronutrients. While composite nutrition scores can be useful, they mask perceptible changes in specific nutrients of interest. With a composite score, a decrease in sugar could be compensated for with an increase in sodium. Consequently, we might not detect any impact of coupons on the nutritional content of cereal purchases using a composite score. Similarly, even if we did detect a change in a composite nutritional score, we would not necessarily be able to identify which nutrient, if any, was driving the change. We choose instead to focus separately on five main macronutrients provided in breakfast cereal: fat, fiber, protein, sodium and sugar[3]. By doing so, we are able to specifically identify how the nutritional content of purchases is changing.

We focus on these five macronutrients for several reasons. For one, these nutrients are clearly identified on nutrition facts panels and thus common information for all consumers. Further, the nutritional content of cereals varies across product category (i.e. children's cereals, adult cereals, etc.) as does the marketing of these cereals. Schwartz et al. (2008) state that cereals marketed to children contain more calories, sugar, and sodium and less fiber and protein per gram than non-children's cereals. Berning, Huang and Rabinowitz (2013) show that cereals advertised to adults tend to have higher levels of sodium and protein, whereas cereals advertised to children have larger amounts of fat and sugar per serving.

Even General Mills identified a "sweetness threshold" which determines cereals they market to children, stating that: "right around nine grams of sugar per serving, you're at the breaking point where the sugar level is so low that the sweetness is not enough for a kid to eat it on day two after trying it on day one" (Jargon 2011). Given the noted relationship of cereal advertising and nutritional content, it seems relevant to also examine the relationship of nutritional content and coupons.

There are also important nutritional considerations regarding these specific nutrients. Dietary fiber and protein are well-studied in the nutrition literature and are shown to provide important health benefits (Marlett 2002; Noakes et al. 2005). In addition, there is growing concern regarding the health effects of excessive sugar and sodium consumption (Johnson et al. 2009; Sacks et al. 2001), which are often abundant in breakfast cereals. As such, these five nutrients provide a relevant description of the nutritional content of household cereal purchases.

It could also be useful to examine the impact of coupon usage on the purchase of specific micronutrients. We choose not to pursue this for two reasons. First, a large majority of breakfast cereals in the US are fortified with vitamins (Harris et al. 2009). As such, it is not clear if there is sufficient variation in micronutrient content. In addition, the data used in this study does not provide complete information regarding micronutrient content. We next discuss the data in more detail.

[3] Binkley and Golub utilize a scoring mechanism that aggregates fat, fiber, protein, sodium and sugar. We examine the same nutrients separately.

Data

In this article, we use household level AC Nielsen data, which includes daily household retail grocery purchases made by households in the greater New York City Designated Marketing Area (DMA) from 2006-2008. For our analysis, we examine households that made breakfast cereal purchases during this time. Households will occasionally leave or enter a geographic region or stop participating with Nielsen altogether. The subtraction or addition of households to the data set shows up each calendar year, rather than at shorter intervals. For each year of data, we include households that make at least one breakfast cereal purchase for the given year. As an example, a household may be included in 2006 and 2007 but excluded in 2008 because they no longer make breakfast cereal purchases in the New York DMA. As such, the panel data set is unbalanced. Breakfast cereal is generally purchased at retail outlets such as grocery stores[4]. Although breakfast cereal purchased at a restaurant is not captured in this data set, we are relatively confident that we observe all of the breakfast cereal purchases for most households .

Our total data set includes 1,442 households that on average make purchases in 19.3 of the total 36 months (Table 1). The average household age (56) reflects the oldest household head, either female or male. The average household has less than one child and teenager. The majority of

Table 1. Data Summary Statistics

Variable	**Mean**	**St. Dev**	**Min**	**Max**
Total Households (count)	1,442			
Observations per HH	19.3	9.97	0	36
Age	56.7	12.4	26	94.0
Children	0.22	0.6	0	5.7
Teens	0.21	0.5	0	3.3
Renting	69%			
Not employed	26%			
Not married	28%			
Household Income				
Group	**Percentage**		**Group**	**Percentage**
Under $5,000	1.0%		$30,000-$34,999	5.7%
$5,000-$7,999	0.6%		$35,000-$39,999	4.8%
$8,000-$9,999	0.7%		$40,000-$44,999	5.4%
$10,000-$11,999	1.4%		$45,000-$49,999	5.7%
$12,000-$14,999	1.7%		$50,000-$59,999	9.4%
$15,000-$19,999	2.9%		$60,000-$69,999	9.3%
$20,000-$24,999	3.5%		$70,000-$99,999	20.9%
$25,000-$29,999	4.5%		$100,000 & Over	22.5%
Highest Education Level				
Grade School	0.3%		Some College	27.8%
Some High School	0.8%		Graduated College	33.4%
Graduated High School	16.04%		Post College Grad	21.6%

[4] Alternatively, with products such as carbonated soft drinks or salty snacks, households make purchases at restaurants and vending machines. Such purchases do not show up in these data sets.

households (69 percent) are renting their homes. About 26 percent of households are currently not employed, which primarily reflects retired households, but also includes a small percentage that report themselves as underemployed. The majority of households are married as well (72 percent). The household income is skewed towards the higher income categories and the highest level of household education for any household head is skewed towards college graduate (33.4 percent).

In addition to household demographics and purchase characteristics, the data also identifies whether households used a coupon for their purchase, the type of coupon used (retailer or manufacturer) and the value of the coupon. Manufacturer coupons are offered by the manufacturer to the consumer via numerous sources and can be redeemed nationwide. Retailer coupons are offered by specific grocery retail chains, which are generally regional, and are redeemable only at those stores. Households use retailer coupons more frequently (3.74 per year) than manufacturer coupons (2.58 per year) and the value of the retailer coupons is almost $0.70 higher than manufacturer coupons (Table 2). Compared with the frequency of purchases in Table 1, it appears that on average, households use coupons for about 32 percent of their purchases (calculated as 6.31/19.3). The average price paid per cereal is $3.24.

Table 2. Summary of coupon use, value and price paid

Variable	Mean	95% Confidence Interval	
Times used per year			
Manufacturer Coupons	2.58	2.54	2.62
Retail Coupons	3.74	3.68	3.80
Any Coupons	6.31	6.24	6.39
Value of coupons used			
Manufacturer Coupons	$1.37	$1.34	$1.39

The AC Nielsen purchase data describes product brand name (or private label name), flavor characteristics and UPC. The data does not, however, provide extensive information on a product's nutritional content. We rely on several sources to match products with a description of their macronutrient (Table 3). The largest single source of data is the USDA Agricultural Research Service's National Nutrient Database (2006-2008). This data is updated annually and contains the nutrient contents of most major brands of cereals. We supplement this data with Nutribase 9 Nutrition and Fitness Software (Personal Addition from www.nutribase.com), which provides detailed nutrition information for various cereal products. We also extract data from the Canadian Nutrient File database provided by Health Canada (2010). Much of the Canadian data is derived from the USDA data, but provides some product information that the USDA does not. After using these data sets, we still have to use online data sources for ~58 percent of the cereals purchased in the New York DMA. Brand label cereals for the largest manufacturers were found using manufacturer websites (General Mills, Kellogg's, Post and Quaker Oats). Less common cereals were found using the websites Calorie Count (caloriecount.about.com) or My Fitness Pal (myfitnesspal.com). If an online source was used, the data was verified with at least two online sources for consistency.

A large number of private label cereals also have online nutrition information available through grocery store websites (47.7 percent). In cases where we cannot find private label nutrition information, we substitute brand name equivalent nutrition information (52.6 percent). For example, with a private label product identified by AC Nielsen as "Bite size shredded wheat (frosted)", we would use Kellogg's brand Bite-Size Frosted Shredded wheat nutrition information. While this is not always a perfect substitute, private label products are often equivalent to their name brand counterparts in terms of ingredients.

Table 3. Breakfast cereal nutrition data sources

	All Cereals	**Brand Names**	**Private Labels**
Data Source	*n = 1081*	*n = 718*	*n = 363*
Online sources	57.8%	63.0%	47.7%
USDA National Nutrient Database (2008)	17.4%	26.2%	0.0%
USDA National Nutrient Database (2006)	15.9%	24.0%	0.0%
USDA National Nutrient Database (2007)	16.6%	24.9%	0.0%
Nutribase 9 Software (personal addition)	7.5%	11.3%	0.0%
Health Canada (2010)	5.5%	8.2%	0.0%
Comparable Cereal	18.5%	1.3%	52.6%

As can be seen in Table 3, cereals were often found in multiple sources, thus the columns sum to greater than 100 percent. Such repetition was used to check for consistency. While it is possible to link the year of the nutrition data with the year our products were purchased, we did not do this[5]. As such, product reformulation is not captured in our data set. At the same time, looking at a few reformulated cereals as an example (but not necessarily in our data set) we find that the macronutrients we are studying do not change dramatically. A sugar-sweetened, low-fiber cereal does not become a low-sugar, high-fiber cereal. There were 15 cereals (four private labels) for which we could not find nutrition information. Three of these cereals were one-time promotional cereals (for example Jerome Bettis' World Championship Crunch) and were purchased with low frequency. The remaining missing data were low-frequency purchases as well.

We normalize each nutrient by serving size (in grams) to allow for comparison and aggregation of different cereals in our analysis. The average serving size for cereals in our data is 31g or approximately 1 ounce. As a reference, we compare the average nutritional content of the cereals in our data set with two popular children's cereals (Table 4). The average cereal in our data set has lower levels of fat than Cheerios and lower levels of sodium than both Cheerios and Frosted Flakes. The fiber, protein and sugar content fall in between these two reference cereals. The sugar content in our data set, however, is seven times greater than that of Cheerios and about 70 percent as much as Frosted Flakes. Clearly, the sugar content is skewed towards the higher end.

[5] Based on verbal communication with the USDA, we find that the nutrition information in their database is not instantly (or even frequently) updated following a product reformulation.

Table 4. Nutritional content of breakfast cereals in data set compared with two popular cereals

Nutrient	Mean	St. Dev	95% Confidence Interval		*Cheerios*	*Frosted Flakes*
Fat (g) per g	0.051	0.051	0.048	0.054	0.071	0.000
Fiber (g) per g	0.074	0.074	0.070	0.078	0.107	0.033
Protein (g) per g	0.085	0.085	0.082	0.088	0.107	0.033
Na (mg) per g	4.244	4.244	4.073	4.416	5.714	4.667
Sugar (g) per g	0.257	0.257	0.249	0.264	0.036	0.367

We compare the demographics characteristics of households that make purchases using any coupon to those that do not (Table 5)[6]. As can be seen, coupon users are in slightly higher income and education levels. Further, they are older, more likely to be married, have fewer children but more teenagers. They are also more likely to be renting and not employed. While all comparisons are statistically significant, the actual differences do not seem economically significant. These results suggest that the households that use coupons are not that different from the households that do not use them.

Table 5. Purchases by household type and coupon use

	Purchase With Coupons				Purchase WithOUT Coupons				
	Mean	St. Dev	95%	CI	Mean	St. Dev	95%	CI	
Income category	21.79		21.66	21.92	21.45	5.76	21.37	21.53	*
Education level	4.63	1.02	4.60	4.65	4.57	1.04	4.55	4.58	*
Age	56.68	12.44	56.38	56.98	56.19	12.48	56.02	46.36	*
Renting	0.78				0.69				**
Not employed	0.26				0.24				**
Not married	0.17				0.22				**
Children	0.26	0.65	0.24	0.27	0.27	0.66	0.26	0.28	*
Teens	0.28	0.60	0.26	0.29	0.25	0.58	0.24	0.26	*

We also compare the types of purchases that are made with and without coupons (Table 6). Purchases with coupons tend to be higher in fat, sodium and sugar, and lower in fat and protein. Again, it is not clear if the difference in nutritional content is economically significant either. Other factors are also likely to impact coupon use, however, which we do not explicitly control for with this comparison. First, prices and income influence product demand and could therefore also influence the nutritional quality of purchases. Older households and households with higher levels of education may make different investments in their health compared with younger or less educated households. Households that are renting, single or not employed may also manage their financial resources differently than those that own a home, are married and employed. The composition of the household will likely influence purchases as well. In particular, households with children or teenagers are likely to have different taste preferences than those without. Finally, this comparison does not differentiate between the two types of coupons, the value of the

[6] For this calculation, households can appear as either a coupon user or a non-coupon user according to how they behave during their shopping trip. That is, in one period a household might be a coupon user whereas they may not be considered a coupon user in the next period.

coupons or the endogeneity of coupon use. We explore all of these issues further in the next section.

Table 6. Nutritional content of purchases with and without coupons

	Purchase With Coupons				Purchase WithOUT Coupons				
	Mean	**St. Dev**	**95%**	**CI**	**Mean**	**St. Dev**	**95%**	**CI**	
Fat (g) per g	0.041	0.021	0.040	0.041	0.039	0.028	0.039	0.040	*
Fiber (g) per g	0.075	0.047	0.074	0.076	0.076	0.056	0.076	0.077	*
Protein (g) per g	0.082	0.027	0.081	0.083	0.085	0.035	0.085	0.086	*
Na (mg) per g	5.374	1.774	5.331	5.417	5.092	2.197	5.062	5.121	*
Sugar (g) per g	0.235	0.108	0.233	0.238	0.231	0.122	0.230	0.233	*

* indicates significant difference between means using t-test at alpha = 0.05

Empirical Approach

The nutritional content of household breakfast cereal purchases is affected by numerous observable and unobservable characteristics. To study the effect of household coupon use on the nutritional content of cereal purchases made by households, while controlling for such factors, we specify the following model:

$$(1)\ NC_{it} = \alpha_i + \mu_i + \beta X_i + \delta_i coupon_{it} + \gamma price_{it} + \varepsilon_{it},$$

where *NC* is the nutritional content of the cereals purchased (measured using fat, fiber, protein, sodium or sugar) by household *i* at month *t, X* is a vector of household characteristics and ε is an idiosyncratic error term. We aggregate household purchases by month so that *coupon* is the real coupon value per ounce and *price* is the real weighted average price per ounce. Manufacturer and retailer coupons are estimated separately, but we describe the empirical model with the *coupon* variable for simplicity. The nutritional content is calculated on a per gram basis, e.g. sugar (g) per gram, and is therefore the weighted average per gram. The weights are based on the net weight of each cereal purchased each month.

The parameters $\alpha_i$and μ_i represent unobservable household and market characteristics. The term α_i is correlated with *coupon* and identifies potential endogeneity. In particular, unobserved household and market characteristics may be correlated with coupon use and purchasing certain types of *NC*. If we do not account for this term, the parameter estimate for coupons will be endogenous. The term μ_i is not correlated with any of the covariates and is essentially a random effect. $\beta$and γ are mean parameters to be estimated.

The effect of coupons on purchases varies according to δ_i, indicating a heterogeneous response to coupons. Coupons will cause some households to drastically change their purchases, whereas others will not. For example, certain households will view coupons as a reason to try a more indulgent cereal with added chocolate while others might seek more healthful cereal with added fiber. For other households, coupons will be a part of their normal shopping routine and have a minimal impact on their brand switching behavior. To account for this heterogeneity, we rewrite equation (1) as:

(2) $NC_{it} = \alpha_i + \mu_i + \beta X_i + (\delta_i - \bar{\delta})coupon_{it} + \bar{\delta}coupon_{it} + \gamma price_{it} + \varepsilon_{it},$

where $\bar{\delta}$ identifies the average effect of coupons on the nutritional content of household purchases. The term $(\delta_i - \bar{\delta})$ represents individual heterogeneity from the mean which will add bias to equation (1) if $(\delta_i - \bar{\delta}) \neq 0$.

To account for the bias identified by α_i, μ_i and $(\delta_i - \bar{\delta})$ we employ a two-stage approach. In the first stage we estimate coupon use as:

(3) $coupon_{it} = \pi X_i + \xi_{it},$

Given that coupon use is censored at zero, we estimate equation (3) using a cross-sectional Tobit model for each period *t* and calculate the generalized residuals for each period, $\hat{\xi}$. We use this to identify the following expectations:

(4) $E[\alpha_i | coupon_i, X_i] = \lambda\hat{\xi}_{it},$

(5) $E[\delta_i - \bar{\delta} | coupon_i, X_i] = \psi\hat{\xi}_{it}$

where $\lambda = \frac{Cov(\alpha_i, coupon_i)}{Var(coupon_i)}$ and $\psi = \frac{Cov(\delta_i, coupon_i)}{Var(coupon_i)}$.

We then insert (4) and (5) into equation (2) to create our final econometric specification:

(6) $NC_{it} = \mu_i + \beta X_i + \lambda\hat{\xi}_{it} + \psi\hat{\xi}_{it}coupon_{it} + \bar{\delta}coupon_{it} + \gamma price_{it} + \varepsilon_{it}.$

Households make infrequent purchases of cereal and even with aggregation we observe zero purchases in our data. As such, we estimate equation (6) using a random effects Tobit model, where μ_i is the random effects term. Using a t-test, we evaluate $\hat{\lambda}$ to determine if coupon use is endogenous. Additionally, we evaluate $\hat{\psi}$ to determine if there is heterogeneous response to coupons. Identification of the model relies on nonlinearity of equation (3) (Heckman and Navarro-Lozano 2004).

With our estimation approach, we are omitting the household's acquisition of coupons and focusing solely on their decision to use coupons. This is largely due to inadequate data regarding the supply of coupons by manufacturers and retailers. Implicitly, this assumes uniform access to coupons across households. Given the ubiquitous nature of coupons in today's market, compared to previous decades when coupons were found in Sunday newspapers, this may not be a heroic assumption. At the same time, a more robust analysis might consider the ability of consumers to acquire coupons. Further, we are ignoring any strategic behavior by firms (retailers and manufacturers) regarding the supply of coupons.

Results

We estimate equation (3) and (6) using the two stage procedure and five different dependent variables: fat (g), fiber (g) per serving, protein (g) per serving, sodium (mg) per serving and sugar (g) per serving. Further, we estimate the standard errors using 100 bootstrap iterations as the standard errors from the second stage Tobit are inefficient.

We first estimate our models with the coupon variables, the generalized residuals and interactions, and a limited number of other covariates including household income, age, and a month indicator to capture seasonal variation. We exclude other demographic variables from the model to focus on the impact of the coupon variables on the nutritional content of purchases. We find that manufacturer and retailer coupons have a significantly positive effect on the purchase of all five nutrients by households (Table 7, rows 1 and 2). The parameter estimate for the generalized residual for both the manufacturer and the retailer coupon are significant across all models (rows 3 and 4). This indicates that certain types of households are more likely to use manufacturer and retailer coupons to purchase cereals with different nutritional content than their typical purchases. The parameter estimate for the manufacturer residual interacted with the coupon variable is significant and negative across all nutrients (row 5). The same is for the retailer residual interacted with the coupon variable (row 6). This indicates that both manufacturer and retailer coupons have heterogeneous effects on purchases of cereals.

The effect of price is small and positive for fat, fiber and protein. This does not indicate a causative effect, i.e. higher prices lead to greater purchases of fiber cereals, but rather a correlation between the two variables. Prices are negatively correlated with sugar. Income has a positive effect on all nutrients except sodium and age has a negative association with fat, sodium and sugar. Finally, the random effects estimate is significant across all models

Table 7. Estimation results from two-stage model with limited covariates

	Dependent Variable				
Variables	**Fat**	**Fiber**	**Protein**	**Sodium**	**Sugar**
Manufacturer coupon	0.00115**	0.00281***	0.00326***	0.219***	0.00772***
Retailer coupon	0.00105***	0.000978*	0.00200***	0.179***	0.00678***
Manufacturer generalized residual	0.0151***	0.0261***	0.0245***	1.635***	0.0741***
Retailer generalized residual	0.0150***	0.0270***	0.0259***	1.679***	0.0756***
Manufacturer residual x coupon	-0.000424***	-0.000695***	-0.000929***	-0.0592***	-0.00224***
Retailer residual x coupon	-0.000383***	-0.000405***	-0.000639***	-0.0442***	-0.00199***
Price per ounce	0.000339***	0.000204***	0.000405***	0.00000692	-0.000214*
Income	0.000229***	0.000459***	0.000460***	0.00872	0.000828**
Age	-0.000196***	0.000037	-0.0000898	-0.0154***	-0.00188***
Month	-0.000189***	-0.000596***	-0.000608***	-0.0237***	-0.00162***
Constant	0.00196	-0.0121*	0.00198	1.715***	0.143***
Sgma u	0.0215***	0.0450***	0.0398***	2.435***	0.120***
Sigma e	0.0374***	0.0705***	0.0645***	3.981***	0.188***
Observations			48,816		
Number of HshldID			1,442		

*** p<0.01, ** p<0.05, * p<0.1

We next estimate the same models including additional demographic variables that may be endogenous to coupon use (Table 8). The impact of the coupon variables is similar across all models, as is the residual and interaction effects. With the newly added demographic variables,

we find that people who rent their homes and are not employed have small or insignificant differences. People who are single purchase less of all the nutrients, whereas having teenage children leads to an increase. Having children contributes to higher levels of fat, sodium, and sugar. This is perhaps not surprising as these cereals will have more favorable taste for children. Interestingly, households with a higher education level purchase less sugar. Overall, it appears that the impact of coupons is fairly robust across these two specifications.

Table 8. Estimation results from two-stage model with additional covariates

	Dependent Variable				
Variables	**Fat**	**Fiber**	**Protein**	**Sodium**	**Sugar**
Manufacturer coupon	0.000951**	0.00259***	0.00304***	0.197***	0.00668***
Retailer coupon	0.000924***	0.000805	0.00183***	0.165***	0.00612***
Manufacturer generalized residual	0.0154***	0.0264***	0.0249***	1.668***	0.0758***
Retailer generalized residual	0.0153***	0.0274***	0.0263***	1.710***	0.0771***
Manufacturer residual x coupon	-0.000397***	-0.000665***	-0.000899***	-0.0564***	-0.00211***
Retailer residual x coupon	-0.000366***	-0.000380***	-0.000614***	-0.0423***	-0.00190***
Price per ounce	0.000346***	0.000212***	0.000413***	0.000809	-0.00018
Income	0.0000328	0.000148	0.000204	-0.00774	0.000216
Age	-0.000149***	0.0000495	-0.0000695	-0.0104*	-0.00149***
Month	-0.000189***	-0.000597***	-0.000608***	-0.0237***	-0.00162***
Constant	0.00225*	0.00403*	0.00189	0.12	0.000315
Sigma u	-0.000164	0.00167	0.000515	-0.0881	-0.00808***
Sigma e	0.00126	0.00384*	0.00294	0.167	0.000909
Observations			48,816		
Number of HshldID			1,442		

*** p<0.01, ** p<0.05, * p<0.1

Implications

While many parameter estimates are statistically significant, a relevant question is what effect coupons might have on actual purchases, i.e. is their impact economically significant? Using our parameter estimates from our base model (Table 7), we calculate the average impact of manufacturer and retailer coupons on the nutritional content of cereal purchased by a household (Table 9). As a baseline, we use a 16.7 oz. box of cereal with a 32 gram serving size and assume a $1.70 coupon value, the average value of both types of coupons in our data set.

The first column reveals the average amount of fat, fiber, protein, sodium and sugar per serving size for cereal in our data (the initial amount per serving). The next column reveals the increase in each nutrient attributable to using a $1.70 manufacturer coupon. The third column reports the total amount of each nutrient that would be purchased with a coupon and the fourth column reports the percentage increase. Columns 5-7 report the same information based on the impact of a retailer coupon.

As can be seen, fat, fiber and protein increase by 29, 40 and 41 percent respectively when a manufacturer coupon is used. Given their low initial values, however, this does not result in a significant change in the actual amount of fat, fiber or protein purchased per serving. Alternatively, the amount of sodium purchased per serving increases by 71 mg, or 43 percent, when a manufacturer coupon is used. Given the general guidelines for maximum daily sodium consumption is 2,000 mg, this is a more significant change for a breakfast cereal.

Table 9. Simulated impact of coupon use on nutritional content of purchases

	Initial amount per serving	Increase from manufacturer coupon	Final amount per serving	% change	Increase from retailer coupon*	Final amount per serving	% change
Fat (g)	1.28	0.37	1.65	29.3%	0.34	1.62	26.8%
Fiber (g)	2.27	0.92	3.18	40.4%	0.32	2.58	14.1%
Protein (g)	2.57	1.06	3.63	41.3%	0.65	3.22	25.4%
Sodium (mg)	167.0	71.34	238.38	42.7%	58.31	225.35	34.9%
Sugar (g)	8.0	2.51	10.52	31.4%	2.21	10.21	27.6%

*The increase is calculated based on an average 16.7 oz. box of cereal, $1.70 coupon

The increase in sugar content per serving (2.51 grams) is statistically and economically significant as well. To put the increase into context, cereal purchased without a manufacturer coupon contains 25 percent sugar per serving. Cereal purchased with a manufacturer coupon contains 33 percent sugar per serving. Given the negative impacts of excessive sugar consumption and the fact that most people eat more than a serving of cereal, this is not a trivial increase. Although there is not a Recommended Daily Allowance of sugar, the American Heart Association recommends ~36 grams per day (9 teaspoons) for men with a 2200 calorie diet and ~20 grams per day (5 teaspoons) for women with an 1800 calorie diet (Johnson et al. 2009). The Institute of Medicine recommends added sugar limited to 25 percent of total kcal or ~ 138 grams for men and ~113grams for women (Accessed at www.IOM.edu on October 20, 2013). While our calculation does not represent household consumption, it is clear that the type of purchases being made with coupons make it more likely that households will consume greater amounts of sugar via their breakfast cereals.

The use of retailer coupons has a lower marginal effect on the nutrients that are purchased compared to manufacturer coupons. The increase in sodium and sugar are both economically significant however, suggesting that retailer coupons also lead to purchases of cereals with less healthful nutritional content.

Discussion

The use of coupons has increased greatly over recent years, particularly during the latest economic recession. Coupons play an important role in the retail environment as they have become widely accessible through many different sources. While there is evidence that coupons affect product choice, there has been no research to date on how coupons affect the quality of the choices made, which has important implications for consumers and firms.

Our preliminary results suggest that coupons do have an impact on the average nutritional content of breakfast cereals purchased by households. In summary, we find that manufacturer and retailer coupons lead to small increases in the purchase of beneficial nutrients like protein and fiber. Alternatively, they also lead to larger increases in potentially detrimental nutrients: fat, sodium and sugar. By focusing on these five nutrients individually, we are able to gain a better idea of how household purchases change given the use of coupons.

An important consideration is why do we observe this behavior by households? The behavior of households in our data set could reflect two different tradeoffs. Households may be giving up

more healthful nutritional content for a lower price. Alternatively, households could be purchasing better taste (via increased sodium and sugar) for a lower price. With our data, it is not clear which behavior is dominant, only that the purchase of sugar and sodium increase with coupon use.

From a firm's perspective, it is important to understand how consumers are using coupons. As healthful cereals are often more expensive, they may prohibit some consumers from purchasing them. Promoting healthful foods using coupons may be an effective way, therefore, to motivate consumers to make better choices. At the same time, if consumers are more concerned with better nutritional content, then large price discounts may not be as important to consumers. In particular, promoting better nutritional content may need to be part of a more comprehensive marketing plan that not only offers price discounts, but also promotes the nutritional content of the cereals.

If consumers are primarily interested in the taste of cereals (with high sodium or sugar) or are more price conscious than nutrition conscious, promoting healthful cereals with coupons may not be as effective of a marketing strategy. Coupon marketing programs such as double coupons or coupon stacking (using manufacturer and retailer coupons at the same time) may be effective marketing tools with consumers that are price sensitive and less concerned about nutritional quality. Some retailers even go so far as to accept other retailer coupons as part of a price match program. From a policy perspective, however, these strategies could have detrimental long-term impacts on household purchase quality.

It is interesting to note the difference in the effect of manufacturer and retailer coupons on purchases made by households. This could reflect a difference in the strategic use of coupons by manufacturers and retailers. Manufacturers often use coupons to promote new products or product lines. As such, a manufacturer coupon is more likely to result in brand switching and, therefore, a greater probability that a household purchases a cereal with different nutritional content from their typical purchase. Alternatively, retailers are more knowledgeable about their customer base and may choose to offer coupons for products that they know will be purchased as maintaining customer loyalty is a priority. Ultimately, what we find is that manufacturers and retailers are using coupons to promote cereals that are higher in sodium and sugar content than the average household purchase. Although firms may also use coupons to promote more healthful cereals as well, their use is minimal as consumers primarily redeem coupons for less healthful cereals.

As cereal is highly consumed in the US, further consideration should be given to how breakfast cereals are marketed using coupons. Firms may be able to help consumers with their search for healthful foods using combined marketing tools such as nutrition labels or displays. Households that are seeking a healthful diet and using coupons for price discounts need to be cognizant of the products they purchase when using coupons.

There are certain limitations to this study that suggest potential future research. For one, we are not able to monitor how household purchases change for all other food items. Although breakfast cereal is often a stand-alone meal, households may alter their purchases of other food products to compensate for changes in their breakfast cereal purchases. In addition, we are neither able to

account for consumption behavior nor track the health impacts of changes in purchase bundles. Over time, it is not clear what the cumulative effect would be. Finally, future studies may benefit from examining how firms strategically offer coupons as part of a comprehensive marketing strategy.

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