Can Information Costs Confuse Consumer Choice?
Nutritional Labels in a Supermarket Experiment

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Research Objectives

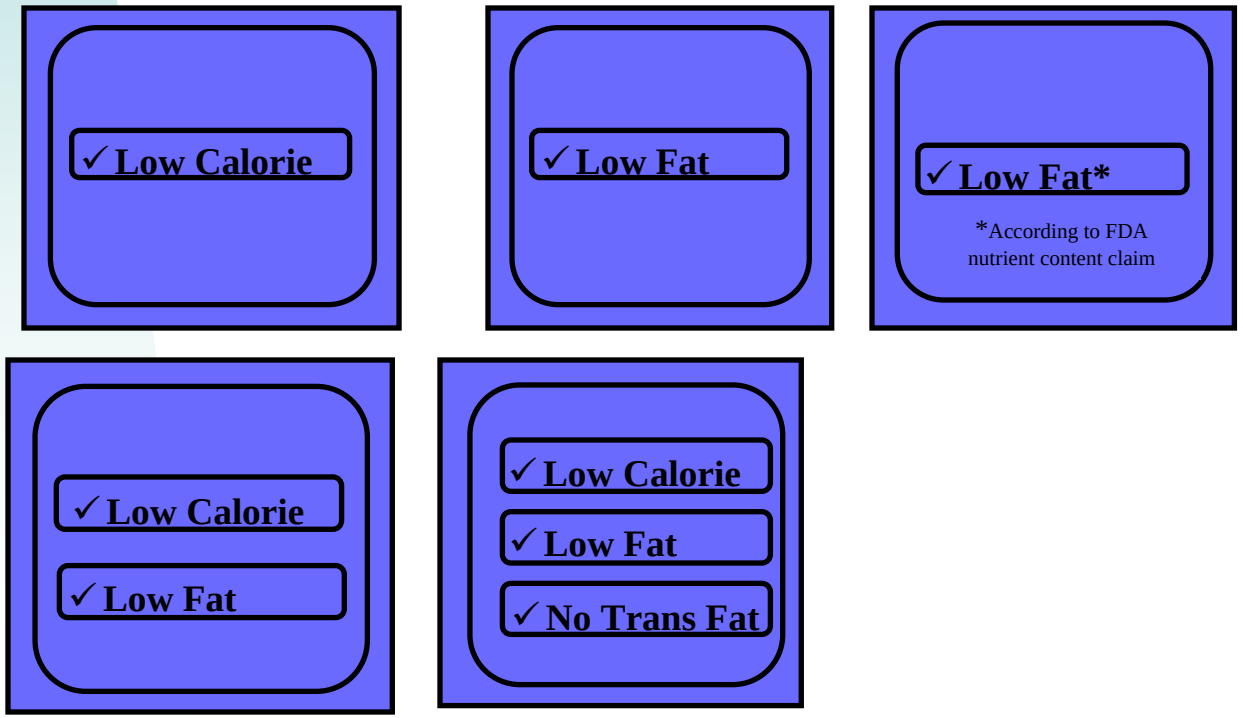
- Measure the effects of nutritional information on consumer purchasing decisions using a field experiment
- Store level scanner data
  - Total effect on quantity sold
  - Willingness to pay (WTP) for labels (preliminary)
- Transaction level data (in progress)
  - Purchase history
  - Purchase amount
  - Entry of new consumers into category

Motivation

- Consumers devote minimal time and effort to processing grocery product information at the point of purchase
- Does including nutrition information in a “easy-to-process” shelf-label format
  - decrease the search costs associated with obtaining nutritional information and
  - result in healthier product-selection decisions?
- Grocery retailers have an opportunity to assist consumers in making healthier purchase decisions.

Costs Processing Available Information?

- Display more salient fashion repetition of already available information, e.g. No Trans Fat
- Provide a relative scale among alternatives (new format)



Descriptive statistics : Treatments

A. Treatments

1	low calorie label
2	low fat label
3	low fat label and FDA disclaimer
4	low calorie and low fat label
5	low calorie, low fat, and low transfat label

B. Treatment Characteristics

	treatment stores					control stores				
	1	2	3	4	5	1	2	3	4	5
Low Calorie Labels	22	-	-	5	1	21.83 (2.04)	-	-	4.71 (0.59)	1 (.031)
Low Fat Labels	-	21	-	4	1	-	21.01 (1.94)	-	3.91 (0.39)	0.971 (.167)
Low Fat/FDA Labels	-	-	15	-	-	-	-	21.01 (1.94)	-	-
No Transfat Labels	-	-	-	-	12	-	-	-	-	15.22 (1.19)
Low Calorie/Low Fat Labels	-	-	-	12	2	-	-	-	17.11 (1.67)	1.86 (0.34)
Low Calorie/No Transfat Labels	-	-	-	-	3	-	-	-	-	2.90 (0.52)
Low Fat/ No Transfat Labels	-	-	-	-	3	-	-	-	-	3.74 (0.52)
Low Calorie/Low Fat//No Transfat Labels	-	-	-	-	16	-	-	-	-	15.24 (1.51)
Total Labels	22	21	15	21	38	21.83 (2.04)	21.01 (1.94)	21.01 (1.94)	24.92 (2.25)	40.99 (3.19)

Note: For the control stores, we report the mean number of products that would have been treated as well as the standard deviation in parenthesis.

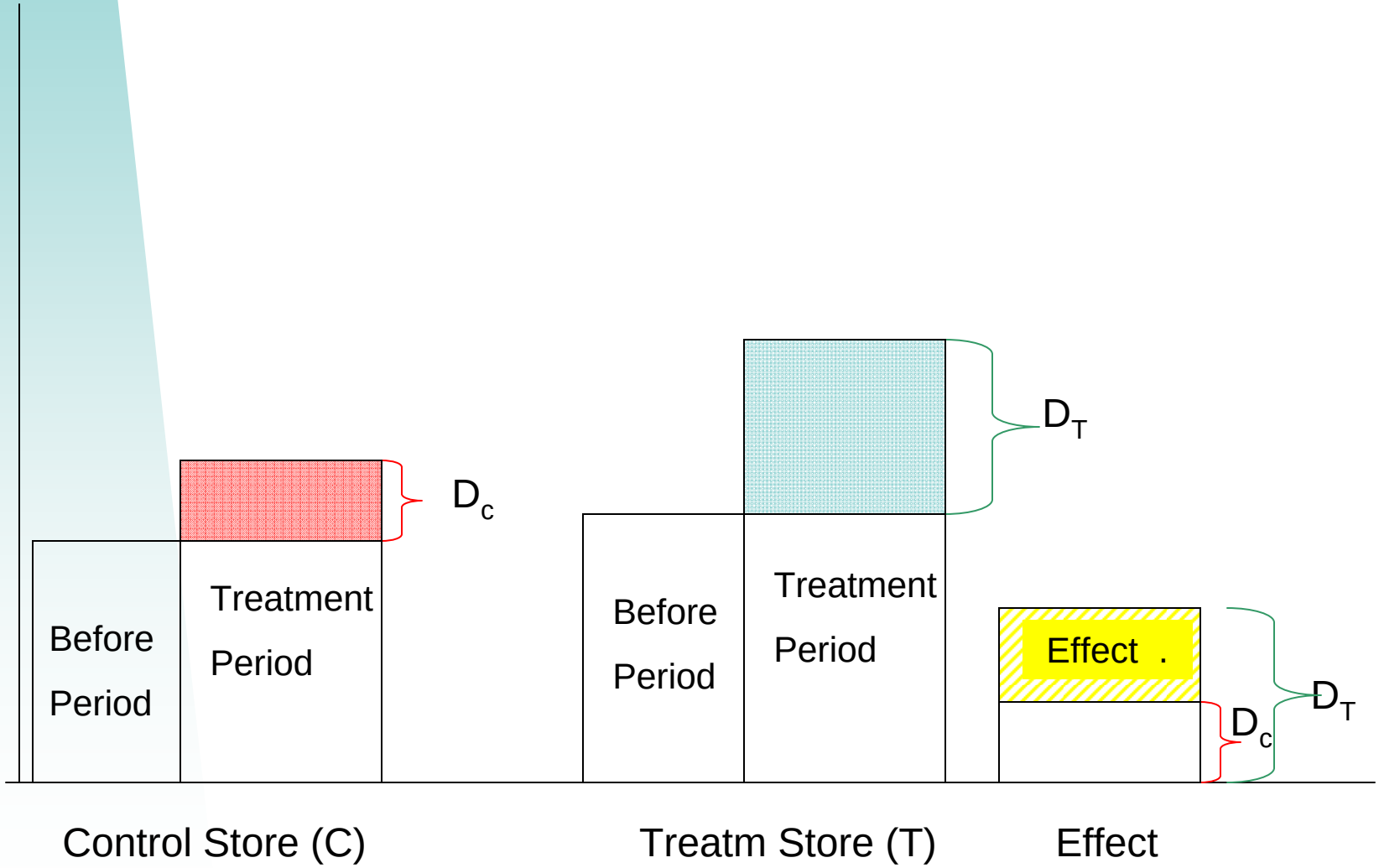
- T & C are similar with respect to product assortment & sample of treated products (except T3 smaller store)
- T & C stores serve similar demographics (representative of national averages)
- T larger category sales than average controls' sales but within one std dev

Data

Treatments during 4 weeks starting Oct 10, 2007:

- 32 stores (5 treatment and 27 control stores)
- Store level product weekly sales over four years (focus on narrow window around experiment 14 weeks, five weeks prior and post)
- Socio-demographic statistics provided by the United States Census Bureau (by zip code) to “match” Treatment and Control Stores
- Nutritional facts information from products

Empirical Strategy – Difference in Difference



Average Effects

Average Treatment Effect on Treated (Differences-in-Differences)												
dependent variable: (log) quantity microwave popcorn (by week, by store)												
independent variables:	1		2		3		4		5		6	
treated stores * treated weeks	-0.030		-0.029		-0.031		-0.030		-0.028		-0.031	
(treatment effect)	0.035		0.034		0.034		0.033		0.032		0.032	
treated stores	0.119	**	0.142	***	0.143	***	0.139	***	-0.329	***	-0.327	***
	0.052		0.045		0.043		0.040		0.121		0.120	
treated weeks	0.042	***	-0.017		-0.016		-0.021		-0.027		-0.026	
	0.015		0.014		0.014		0.014		0.013		0.031	
price	-		-0.248	***	-0.242	***	-0.266	***	-0.286	***	-0.282	***
			0.009		0.009		0.010		0.008		0.008	
organic claim	-		-		-0.160	**	-0.726	***	-0.857	***	-0.863	***
					0.064		0.108		0.061		0.062	
low calorie claim	-		-		-0.038		0.020		0.142	***	0.131	***
					0.037		0.040		0.037		0.037	
low fat claim	-		-		-0.111	***	-0.004		-0.003		-0.016	
					0.031		0.036		0.059		0.059	
no trans fat claim	-		-		0.274	***	0.038		-0.009		-0.009	
					0.046		0.071		0.030		0.030	
whole grain claim	-		-		-0.102	**	-0.091		-0.083	**	-0.088	**
					0.048		0.058		0.038		0.038	
brand fixed effects	no		no		no		yes		yes		yes	
store fixed effects	no		no		no		no		yes		yes	
week fixed effects	no		no		no		no		no		yes	
Number of observations	11997		11997		11997		11997		11997		11997	
R2	0.003		0.184		0.206		0.229		0.332		0.34	

Standard errors clustered at product-store level

Effects by Label Treatment

combined

dependent variable: (log) quantity microwave popcorn (by week, by store)											
independent variables:	Low calorie		Low fat		Low fat (FDA)		Low cal/fat		Low cal/fat/trar		
treated store*treated weeks	0.086		-0.101		-0.284	***	-0.155	*	0.004		
(treatment effect)	0.083		0.085		0.095		0.089		0.068		
treated weeks	0.020	*	0.127	***	-0.010		-0.018		0.060	*	
	0.044		0.044		0.043		0.040		0.031		
price	-0.249	***	-0.278	***	-0.283	***	-0.264	***	-0.282	***	
	0.010		0.010		0.010		0.009		0.009		
organic claim	0.011		0.002		0.027		0.020		-0.803	***	
	0.082		0.077		0.081		0.080		0.064		
low calorie claim	0.135	**	0.114	***	0.108	***	0.197	**	0.111	***	
	0.052		0.041		0.041		0.042		0.039		
low fat claim	-0.008		0.198	***	0.215	***	0.062	*	-0.050		
	0.068		0.035		0.036		0.063		0.066		
no trans fat claim	-0.219	***	-0.439	***	-0.231	***	-0.176	**	-0.004	**	
	0.040		0.067		0.056		0.036		0.032		
whole grain claim	0.035		0.236	***	-		0.053	*	-0.087	***	
	0.036		0.067				0.035		0.039		
pink ribbon	-		-		-		0.179	*	0.520	*	
							0.097		0.074		
brand, store, week fixed effects	yes		yes		yes		yes		yes		
Number of observations	5768		5434		5381		6663		9810		
R2	0.331		0.305		0.335		0.332		0.339		

Standard errors clustered at product-store level

-low fat label: average decrease of 27.5%

-No trans fat label: average increase 23%
-But not in combination with other claims

-All claims label: has highest information content but also info costs, has no effect

dependent variable: (log) quantity microwave popcorn (by week, by store)

independent variables:	low cal/fat		low cal/fat/trans fat	
interacted treatment effects				
low calorie	-0.168		-	
	0.104			
low fat	-0.275	*	-	
	0.160			
no trans fat	-		0.230	*
			0.135	
low cal/fat	-0.126		-0.333	
	0.106		0.328	
low cal/trans fat			-0.319	*
	-		0.179	
low fat/trans fat			-0.246	
			0.279	
low cal/fat/trans fat	-		0.009	
			0.110	
treated weeks	-0.023		0.065	**
	0.040		0.031	
price	-0.268	***	-0.280	***
	0.010		0.009	
brand, store, week fixed effects	yes		yes	
Number of observations	6963		9810	
R2	0.331		0.336	

Effects on Unlabeled

Average Treatment Effect on Untreated (Differences-in-Differences)

dependent variable: (log) quantity microwave popcorn (by week, by store)

independent variables:	pooled labels		low calorie		low fat		low fat (FDA)		low cal/fat		low cal/fat/trans fat	
treated stores*treated weeks	0.063		0.066		0.022		0.162	**	0.048		0.079	
(treatment effect)	0.043		0.070		0.056		0.068		0.060		0.096	
treated weeks	-0.002		0.008		-0.00	***	0.004		0.031		-0.077	
	0.042		0.032		0.034		0.032		0.034		0.050	
price	-0.244	***	-0.262	***	-0.253	***	-0.252	***	-0.252	***	-0.255	***
	0.010		0.009		0.009		0.009		0.009		0.011	
organic claim	-		-0.572	***	-0.592		-0.584	***	-0.515		-	
			0.103		0.101		0.101		0.146			
low calorie claim	-		-0.256	***	-0.349	***	-0.358	***	-		-	
			0.083		0.044		0.046					
low fat claim	-		0.110		-		-		-		-	
			0.080									
no trans fat claim	-		-0.062		0.229	***	0.220	***	0.285		-	
			0.079		0.079		0.079		0.132			
whole grain claim	-		-0.094		-0.106		-0.106		-0.110		-	
			0.065		0.067		0.067		0.067			
pink ribbon	-		-		-0.201		-		-0.069		-	
					0.172				0.176			
brand, store, week fixed effects			yes		yes		yes		yes		yes	
Number of observations	6788		10732		10968		10744		9632		5447	
R2	0.374		0.352		0.360		0.360		0.347		0.385	

Results using Store Level Data

- Evidence consistent with information costs mattering
  - Increases in quantity sales due to no trans fat labels
  - Decreases in quantity sales due to low fat labels (with FDA claim)
  - Increase in quantity sales due to low calorie labels (significant at aggregate monthly effects rather than weekly)
  - No inference on unlabeled products (except for low fat FDA claim labels)
  - Dissipation of effect when combining claims in single label
- Total category sales decrease 4% due to our labels so labels do not seem to induce consumption
- we will further investigate with hh data if new consumers enter and how “old” consumers are affected
- Our results were robust to
  - Different store and time control structures
  - Estimation of placebo effects

Additional Evidence

- Results and significance may be affected by remaining uncertainty of how well average sales in the 27 control stores serve as a counterfactual

- Synthetic control (SC) method reduces this uncertainty

  - SC store (created as a combination of all controls)
  - Best match to the treatment store in pre period
  - match stores based store characteristics

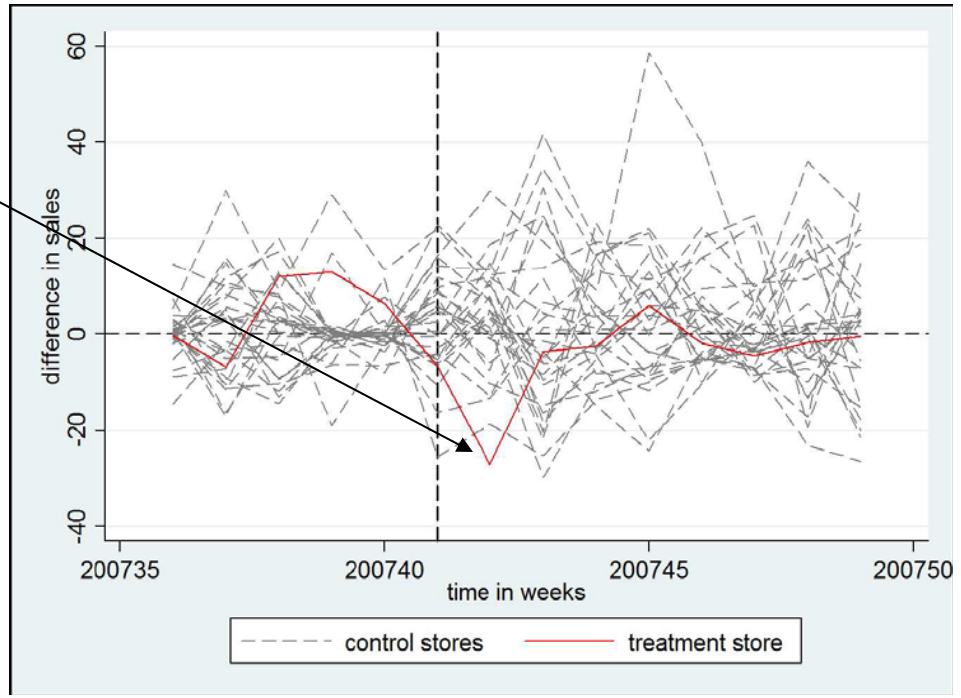
  - Investigate significance of treatment effects by estimating placebo effects for the 27 stores that were never treated

- One treatment unit in this approach, so for each label treatment
  - we look at aggregate sales by week and store (not by product)

Treatment vs. synthetic control (SC) store

Results confirm DD findings:

1. Low fat label less 27.7 units sold/ week
2. Drop is larger than distribution of random changes
3. No trans fat increase in sales in the T relative to SC
4. Low Cal labels increase sales significantly
5. Other label analysis confirms results in D in D.



Difference in total units of weekly sales for low fat labeled products

T-SC (red line)
random changes (placebos/ grey lines)

Recap

- Consumer purchases are affected by nutritional labels
- Effects differ depending on nutritional facts
  - some claims have NO effect, some +, some -
- Disclosure of source (FDA aprov) discourages sales even more
- More nutrients on label have smaller impacts on change in sales than a label with just one claim
- Do consumers make inferences about the nutritional content of non-labeled products? Generally No (except one treatment)

Implications of Results using Store Level Data

- Consumers do not fully incorporate currently available nutritional information
- Consumers might have taste preferences with respect to certain nutrients
- Consumers do not perceive FDA approved labels as more credible in this context
- Consumers do not make inferences on unlabeled products
- Information costs might prevent welfare improving changes to food choice in context of nutritional labeling

Future Work - preliminary

- **Willingness to Pay**
  - Demand estimates of no trans fat labels WTP 62 c
  - Demand estimates of low fat labels WTP of -60 c
- **Transactions by Household Data**
- product sales by masked household id over 2 years
- No distinct differences in frequency of purchases post T
- Higher percentage of new consumers respond to T
- Less overall expenditures, larger transaction price savings
- Effects seem to dissipate after treatment period

Conclusion

- Treatment Effects imply that
  - Consumers do not fully incorporate currently available nutritional information
  - Consumers might have taste preferences with respect to certain nutrients
  - Dissipation of effect when combining claims in single label
- Evidence consistent with information costs mattering

- Significant Estimates of WTP consistent with reduced form Treatment Effects
- No distinct differences in frequency of purchases before & after
- Higher percentage of new consumers respond to treatment
- Less overall expenditures, larger transaction price savings
- Effects seem to dissipate after treatment period

Thank you!

Just in case questions slides on work in progress and also for discussant to see what we did

Demand and Label WTP Estimation Strategy

Indirect latent utility from consumer *i* choosing product j in week *t*

$$U_{ijt} = +d_j + x_{jt}\,\beta - \alpha_i\, p_{jt} + \xi_{jt} + \varepsilon_{ijt}$$

d_j product constant characteristics

x_{jt} observed product characteristics, such as our added label

ξ_{jt} unobserved product characteristics

ε_{ijt} consumer preferences about unobserved product characteristics

The probability of buying *j* among the alternatives is the probability that *j* yields maximum U .

Demand and Label WTP Estimation Strategy

Given distribution of ε noise of consumer preferences that will yield a certain probability of purchases as a function of (d, β, α)

Demand model is estimated to find parameters that give model predicted probabilities of purchase that are the closest to observed frequencies of purchases of brands in the choice set.

To obtain an estimate for the WTP for an attribute *x* in dollars, as price is in dollars, divide the estimated marginal U of attribute β by marginal U of price α .

Results using Store Level Data

Marginal Utility Estimates for WTP

Constant	−9.51*	−8.99*
	(0.00)	(0.00)
Price	−0.32*	−0.28*
	(0.00)	(0.00)
RC Price	0.12*	0.04
	(0.04)	(0.84)
Average in Store 1	0.05	
	(0.39)	
LowCalLowFat label in Store 1		−0.03
		(0.74)
Low Cal Label in Store 1		−0.12
		(0.24)
Low Fat Label in Store 1		−0.19
		(0.31)
Low Fat Label in Store 2	−0.12*	−0.15*
	(0.12)	(0.05)
Low Fat FDA Label in Store 3	−0.06	−0.09
	(0.50)	(0.37)
Low Cal Label in Store 4	0.00	−0.01
	(0.99)	(0.84)
Average in Store 5	0.02	
	(0.70)	
Low Fat Store 5		−0.17
		(0.59)
Low Cal Store 5		−0.57*
		(0.02)
No Transfat Store 5		0.18*
		(0.03)

Results:

- Prefer not to buy the products we labeled
- - Constant negative
- No trans fat WTP= 62 cents
- Low Fat WTP = - 60 cents

Results using Individual Level Data

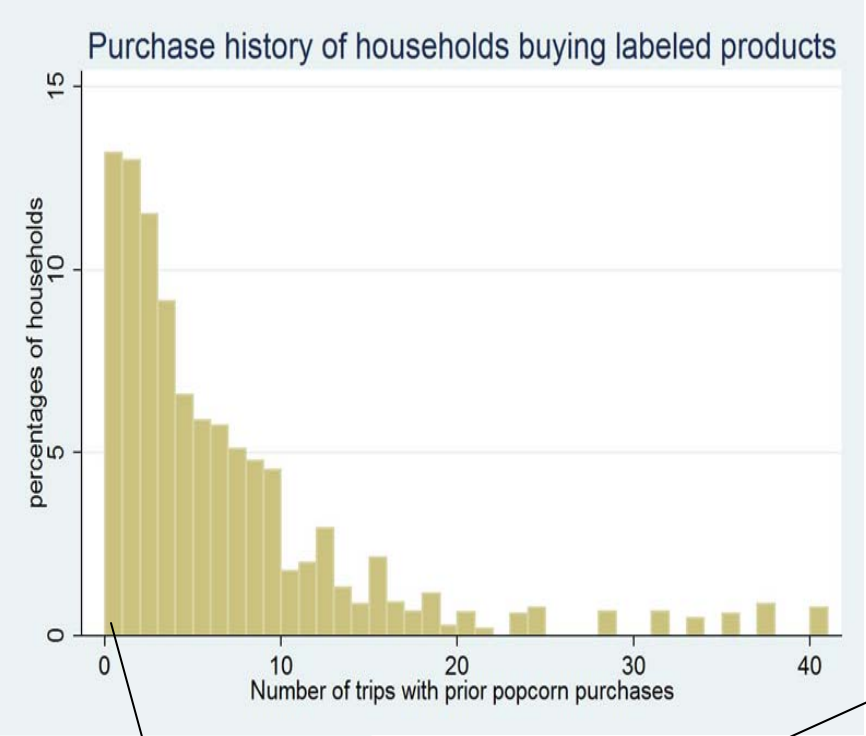
- Differences in households that respond to labeling treatment versus households that do not:
  - No distinct differences in frequency of purchases before and after
  - Higher percentage of new consumers respond to treatment
  - Slightly less units purchased when buying labeled products
  - Lower individual transaction and total transaction amount for households responding to treatment
  - Responding households buy more on sale/have more savings
  - Treatment effects seem to dissipate after treatment period

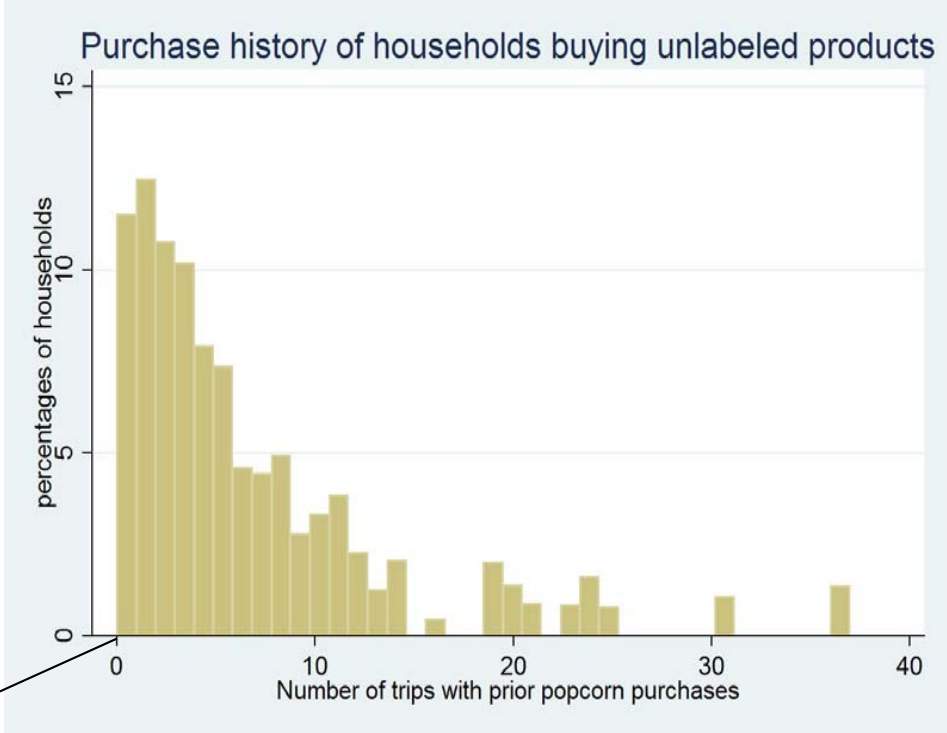
Differences in consumer type

Differences in households that buy labeled and unlabeled products during treatment period		
variable	**mean**	
	labeled purchases	unlabeled purchases
transaction net amount	85.23	90.24
total transactions amount	1340.79	1385.79
average transaction price promotions	25.35	24.8
average unit price	2.73	2.82

- Less overall expenditures
- larger transaction price savings

For households that buy in Treatment Period what did they pre-treatment popcorn purchases look like?





- Conclusion:

Higher percentage of new consumers respond to treatment

Specific treatment effect: low fat (store 2)

- Households in treatment store

	number of hholds	%
total households	6641	100.00
households w/observed low fat purchases	2105	31.69
households w/observed purchases during treatment	474	7.14
households w/ observed low fat purchases during treatment	289	4.35
households w/observed low fat purchases and purchases during treatment	186	2.8
households w/observed low fat purchases and low fat purchases during treatmen	161	2.42

- For 25 households w/ observed low fat products that did not buy low fat (labeled) products during treatment, what did they buy? (top seve products):

POP SECRET MICRO POPCORN HOMESTYLE
POP SECRET MICRO POPCORN BUTTER
POP SECRET HOMESTYLE MICRO POPCORN
POP SECRET MICRO PCRN HOMESTYLE SNACK S
ORV RED MICRO POPCORN BUTTER
ORV RED MICRO POPCORN MVIE THTR BTR
POP SECRET MICRO POPCORN MOVIE THTR BTR

and bought low fat products after the treatment period again