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Abstract

Not only does information about food recalls play a vital role in changing the demand for implicated food products, but it also impacts the demand for close substitutes. The study aims to identify the structural change in demand for cookie dough due to the 2009 cookie dough recall of Brand1, one of the most publicized single brand recalls in recent years. The study utilizes Barten's synthetic differential demand system, and introduces a sentiment analysis technique to identify the tone of media publicity and its effect on demand. The results suggest a spillover effect in the cookie dough market and finds that media sentiment has an effect on consumption.

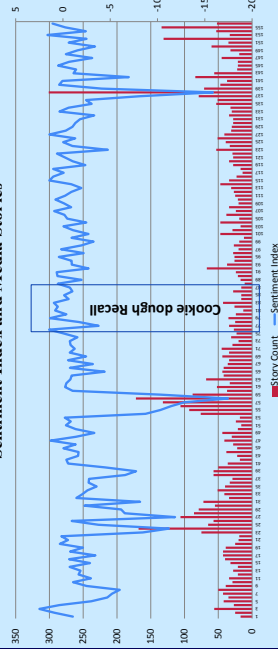
Objective

- To estimate the change in **consumer demand relationships** for the refrigerated cookie dough market after a food safety outbreak was announced.
- To identify the tone of the information and estimate the **spillover effect of media sentiment on the refrigerated cookie dough brand** in general.

Data

- The study used Nielsen HomeScan data from years 2008, 2009 and 2010 to identify consumer purchases. The data was aggregated on weekly basis across the households.
- Recall period: 19th June 2009-18th Aug 2009
- Media tracking and Sentiment Analysis
- The media stories were collected from major media sources (*national and local newspapers, network and cable TV, radio, news magazines, and the internet*) using keywords identifying/referring to the food safety incidence.
- We used a natural word processing algorithm to identify the tone (positive or negative) of the articles using certain keywords and assigned a sentiment score, between +2 to -2.
- Sentiment scores were aggregated over each week by taking net differences. The score was reversed and moved to a base value of 100.

Sentiment Index and Media Stories



Method

- The study adopts a demand system approach, a differential demand system called Barten's Synthetic Model (BSM). BSM nests four demand systems viz. Rotterdam, CBS, NBR, and AIDS.
- The structural change of demand for cookie dough was determined by comparing price elasticities from the pre-recall (77 weeks) and post-recall (72 weeks) period.
- The models with different autoregressive orders and lags of sentiment index were tested. A Likelihood Ratio hypothesis test was conducted to identify the appropriate lag length for the model.
- The final model chosen for the study was AR(2) model with the first lag of the sentiment index.

Model

Barten's Synthetic Model:

$$w_i d \log q_i = (\beta_i + \lambda w_i) d \log Q + \sum_{j=1}^n (y_{ij} - \mu w_i (\delta_{ij} - w_j)) d \log p_j + \varepsilon_i, i = 1, \dots, n$$

Divisia Volume Index:

$$d \log Q = \sum_{i=1}^n w_i d \log q_i$$

Adding up:

$$\sum_{i=1}^n \beta_i = 1 - \lambda, \text{ and } \sum_{i=1}^n \gamma_{ij} = 0, j = 1, \dots, n,$$

Homogeneity:

$$\sum_{i=1}^n \gamma_{ij} = 0, j = 1, \dots, n,$$

Symmetry:

$$\gamma_{ij} = \gamma_{ji}, i, j = 1, \dots, n, i \neq j$$

Results

- The results show all the compensated own-price elasticities were negative in accordance with the law of demand. The results also show a significant structural change from a pre-recall to a post-recall period.
- The results for the compensated cross-price elasticities indicated a strong substitution effect between Brand1 and Brand2 in the pre-recall period, with magnitudes decreasing from pre-recall to post-recall period.
- The sentiment elasticity for Brand2 was significant in both time periods. In the pre-recall period, the sentiment elasticity was negative, which meant an increase in bad sentiment in media coverage decreased consumption of Brand2.
- The sentiment elasticity for Brand2 in the post-recall period was positive, suggesting that the increase in bad sentiment towards Brand1 cookie dough during the recall, increased the consumption for Brand2 cookie dough in the post-recall period.
- The results from tests identifying change in elasticities from pre-recall to post-recall period confirm the changes in compensated own-price elasticities were significant.
- The test also confirms a significant change in the sentiment elasticity of Brand2 in two periods.

Compensated Own Price and Cross Price Elasticities, Expenditure Elasticity, and Sentiment Elasticity for Refrigerated Cookie Dough Brands during Pre-Recall and Post-Recall Periods

	Compensated Own Price Elasticity				Expenditure Elasticity			
	Brand1	Brand2	Store brand	Other brands	Brand1	Brand2	Store brand	Other brands
Pre-Recall								
Brand1	-0.74***	0.41***	0.19**	0.14	-1.01***	0.98***	0.11	
Brand2	0.40***	-0.58***	0.14**	0.03	-0.67***	0.34***	-0.35*	
Store brand	0.27**	0.21**	-0.51***	0.04	-0.61***	0.50***	0.20	
Other brands	0.16	0.04	0.03	-0.24	-0.77	2.21***	0.12	
Post-Recall								
Brand1	-0.22**	0.11	0.06	0.05	-0.38***	0.63***	-0.24	
Brand2	0.10	-0.25***	0.12	0.02	-0.37***	0.44***	0.48*	
Store brand	0.08	0.17	-0.20	-0.05	-0.30	0.49***	0.02	
Other brands	0.05	0.03	-0.04	-0.03	-0.65	2.41***	-0.32	

* indicates statistical significance at the 0.10 level, ** at the 0.05 level, *** at the 0.01 level. All elasticities are calculated at the sample mean. The number of weekly observations for pre-recall period was 74 and for post-recall period was 72. For confidentiality purposes, the major brands in the cookie dough market are called Brand1 and Brand2. Brand1 was indicated in the 2009 cookie dough recall.

Test for Differences in the Selected Pre-recall and Post-recall Elasticities

	χ^2 statistics	p-value
Compensated Own-Price Elasticity		
Brand1 = -0.5225***	15.91	<.0001
Brand2 = -0.3179***	12.5	0.0004
Store brand = -0.3165**	6.16	0.0131
Other Brands = -0.2053	0.2	0.6531
Compensated Cross-Price Elasticity		
Brand1_Brand2 = 0.2984***	10.37	0.0013
Brand1_Store = 0.1257	2.54	0.1113
Brand2_Brand1 = 0.3024***	11.09	0.0009
Brand2_Store = 0.0206	0.08	0.7708
Store_Brand1 = 0.1879*	2.89	0.089
Store_Brand2 = 0.0378	0.14	0.7085
Sentiment Elasticity		
Brand2 = -0.8308***	18.94	<.0001

Conclusion

- By using BSM, the study finds the 2009 cookie dough recall of Brand1 had an effect on the demand of refrigerated cookie dough brands.
- We found a strong substitution effect between Brand1 and Brand2, suggesting a significant spillover effect in this market.
- Even though the study did not find a direct effect of media sentiment on Brand1 itself, media sentiment did boost the consumption of its substitute, Brand2.

References

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- Baklanovskan, R., Capps Jr, O. & Salin, V. (2012). Impact of Food contamination on Brands: A demand Systems Estimation of Peanut Butter. *Agricultural and Resource Economics Review* 41(3): 1-13.

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