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# The Effects of Package Downsizing on Food Consumption

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Metin Cakir<sup>\*</sup>

Department of Bioresource Policy Business and Economics  
University of Saskatchewan

Joseph V. Balagtas<sup>†</sup>

Department of Agricultural Economics  
Purdue University

Abigail M. Okrent<sup>‡</sup>

USDA, Economic Research Service  
Food Economics Division, Food Markets Branch

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## Abstract

Package downsizing is common among the leading producers of packaged food products in the United States. In this study, we examine the effects of package downsizing on household food-at-home consumption and expenditure. We perform an exploratory data analysis of shelf stable tuna and peanut butter markets using Nielsen homescan data. The data comprise grocery store transactions made by a large panel of households over a period of 7 years, 2004-2010. We find that manufacturers use downsizing to implicitly increase prices. Consequently, the average annual household expenditures of both products are considerably higher than their levels before downsizing. The annual average volume consumption of peanut butter remains stable, whereas the volume consumption of shelf stable tuna is approximately 10 percent below its level before downsizing, in spite of an approximately 5 percent increase in the annual package consumption.

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<sup>\*</sup> Contact: metin.cakir@usask.ca

<sup>†</sup> Contact: balagtas@purdue.edu

<sup>‡</sup> Contact: aokrent@ers.usda.gov

## **Introduction**

Package downsizing is the marketing practice of reducing the volume of product per package in a way that the new size replaces the old one. In recent years, a large number of leading producers in the U.S. packaged food market downsized their products. For example, in 2007 General Mills downsized its Cheerios boxes from 10 oz., 15 oz., and 20 oz. to 8.9 oz., 14 oz., and 18 oz., respectively. Similarly, in 2008 leading ice cream brands Breyers and Edy's downsized their products from 16 oz. to 14 oz. and from 56 oz. to 48 oz. However, we do not know how consumers respond to this common marketing practice. In this study, we advance the literature by analyzing the effects of package downsizing on household food-at-home consumption and expenditure.

There is a growing body of literature on the effects of food marketing on consumer food consumption and diet. Researchers are increasingly interested in investigating the extent to which food marketing contributes to the heightened prevalence of obesity in the United States (see Chandon and Wansink, 2012; Glanz, Bader, and Iyer, 2012 for reviews). Specifically, this literature focuses on how marketers' pricing and promotion strategies or choice of product design affect consumer food-purchasing behavior and consumption. For example, Chan, Narasimhan, and Zhang (2008) and Wansink (1996) find that food price reductions and quantity discounts can accelerate consumption and increase energy intake. Goldberg (1990) and Dhar and Baylis (2011) emphasize the role of TV advertising on children's consumption of unhealthy food.

Our study contributes to research on the effects of packaging on consumer food-purchase and consumption behavior (see Chandon, 2012 for a review). Rolls (2003) and Young and Nestle (2002) document that food package and portion sizes in the United States have increased, and posit that this trend has contributed to increased prevalence of obesity. Also, experimental research tends to support the hypothesis that larger packages and portions lead to increased consumption. For example, in an experimental study Rolls et al. (2004) served potato chips to the participants in five different packages on five separate days. They show that subjects consumed significantly more potato chips as the package size increased. In another study Wansink (1996) provides participants with spaghetti or oil and asks how much of the product they would use if they were to cook for two adults. Participants were given the same amount of spaghetti or oil but in a small or large package size. The study finds that participants use more spaghetti and oil when products were in larger package sizes. In a recent study, Zlatevska, Dubelaar, and Holden (2012) perform a meta-analysis of 67 studies to quantify the influence of unit size on consumption and find that consumption increases by about 22% when serving size doubles.

Our study differs from previous studies on the effects of package size in two aspects. First, the extant literature on the effects of package size on consumption primarily uses experimental methods, and is limited in several important ways. For example, experiments are typically designed to measure consumption for a package or portion size in a single, given meal, and thus ignore the effects on food consumption over time. Another limitation is that the experiments ignore food purchase behavior, which precedes

consumption; thus, these experiments ignore the role of product price, price and attributes of competing products, or other factors, such as promotion, that influence purchase behavior. In this study, we overcome these limitations by using market data provided by Nielsen Homescan.

Second, this study is among the first to focus on consumption response to package downsizing of food products. Specifically, we advance the literature by asking the following question: how does package size affect consumer food-at-home consumption and expenditure? To answer this question, we analyze consumer response to downsizing of several products to identify whether consumers decrease their consumption of a product, or maintain or increase their consumption levels by increasing their purchase frequency of a product, or display differential response to downsizing of different types of products.

To achieve the objective we perform two complementary analyses. First, we perform an exploratory analysis of consumption rates of shelf stable tuna and peanut butter before and after package downsizing events. This analysis documents consumption and expenditure trends and shows the extent to which the category volume consumption has changed relative to its unit (i.e., package) consumption. In the subsequent analysis, we will perform econometric investigations for both product categories to identify the effects of downsizing on consumption.

## **2. Data**

We employ a rich set of household scanner data from Nielsen Homescan. The data set comprises information on price and quantity of products, product characteristics, and timing of purchase for each grocery store transaction made by a large panel of U.S. households over a period of 7 years, 2004–2010. Nielsen selects participating households based on their demographic information to construct a nationally representative sample. Each participating household is provided with a scanner to record their purchases. Our sample includes households who record a purchase of any product in at least 10 out of 12 months of the year. We use the data on shelf stable tuna and peanut butter purchases for the analysis.

## **3. Exploratory Data Analysis**

In the following we provide an exploratory analysis of shelf stable tuna and peanut butter markets. The analysis provides brief information on market structure, identifies package downsizing events, and examines per household consumption and expenditure trends in each market.

### *3.1 The Shelf Stable Tuna Market*

The shelf stable tuna market in the United States is characterized by high concentration and branding. Figure 3.1 presents the volume share of major manufacturers in the market. The top three nationally branded shelf stable tuna manufacturers hold approximately 75 percent of the total volume of market. The total volume share of the top three store brands have increased from 7.5 percent in 2004 to approximately 13 percent in 2010. Each of the major manufacturers has a single leading brand such that the brand shares in

this market are approximately the same as the manufacturer shares. Each of the leading brands offers its product in variety of forms (e.g., chunk or solid), styles (e.g., in water or oil), multi packages, and package sizes.

Insert Figure 3.1 Here

### *3.1.1 Identifying Downsizing*

In figure 3.2 we present the volume consumption of shelf stable tuna by its package size. We observe that package downsizing of 6 oz. tuna is common. At the beginning of the study period the total volume sales of 6 oz. tuna was approximately 80 percent of the market. Starting from 2007 manufacturers downsized their tuna products from 6 ounces to 5 ounces. By 2010, 5 oz. tuna products became the norm size, having approximately 75 percent of the market. We observe increasing volume shares of 4.5 oz. and 7 oz. tuna products starting from 2008. The increase in volume share of 4.5 oz. tuna is mainly due to introduction of a new group of products by a major brand. On the other hand, the increase in the share of 7 oz. tuna is due to a brand introducing a new size to its product line, along with its 5 oz. products.

Insert Figure 3.2 Here

In table 3.1 we compare average price per ounce and price per package of 6 oz. tuna before and after the downsizing. The top three national brands downsized their products in 2007, whereas the top two store brands downsized in 2008. There is strong evidence that manufacturers used downsizing to effectively increase prices. For all brands the

percentage change in price per ounce of tuna is considerable higher than the percentage change in price per package. For example, national brand 1's average price per package of 6 oz. tuna has increased by 8.6 percent during the period after downsizing. However, its average price per ounce has increased by 17.5 percent.

Insert Table 3.1 Here

### *3.1.2 Consumption and Expenditure Trends*

In table 3.2 we report annual average per-household tuna consumption in terms of volume and number of packages, as well as expenditure for all sizes. The trends show that household volume consumption of tuna has decreased considerably after downsizing events, meanwhile household expenditure increased. At the beginning of the study period the average household consumption was 82 oz., or approximately 13 packages. From 2004 to 2006 average household consumption fell by one package corresponding an approximately 6-ounce decrease in volume consumption. Starting from 2007, which is the period after downsizing, we observe a sharp decrease in the volume consumption. For example, the volume consumption in 2010 is approximately 11 percent lower than its level in 2007. On the other hand, package consumption and expenditure during the same period have increased by 5.6 percent and 14 percent, respectively.

Households can switch to buy different size products due to downsizing. For example, 5-ounce tuna might have become more preferable for the consumers of 3-ounce tuna.

Similarly, after downsizing some consumers might have preferred to switch to the larger sizes instead of purchasing 5-ounce tuna. To examine whether consumers switch away



from the downsized products we report the consumption and expenditure trends for only downsized products in table 3.3. We observe that consumption per package and expenditure has increased in 2009 and 2010 in comparison to their levels when downsizing events were underway in 2007 and 2008. The consumption and expenditure trends of downsized products display almost the same pattern as the trends for the category consumption. Thus, at this level of aggregation we do not observe a strong evidence of household switching behavior.

Insert Table 3.2 Here

Insert Table 3.3. Here

### *3.2 The Peanut Butter Market*

In this section we repeat the exploratory data analysis for the peanut butter market in the United States. Similar to the shelf stable tuna market, the peanut butter market is an oligopolistic market with high concentration of few firms. In figure 3.3 we present the volume share of major peanut butter manufacturers. The top three nationally branded peanut butter manufacturers hold approximately 70 percent of the total volume. Store brands have significant shares. In 2010 total market share of the top three store brands was about 13 percent. There is some degree of brand proliferation in the market as manufacturer 1 owns 5 brands of peanut butter. Each of the other manufacturers own only one brand. Manufacturer 1's leading brand has the highest brand share in the market, followed by the brands of manufacturers 2 and 3.

Insert Figure 3.3 Here

### *3.2.1 Identifying Downsizing*

In figure 3.4 we present the volume consumption of peanut butter by its package size.

Unlike shelf stable tuna, there does not exist a single norm size for peanut butter. Until 2008, over 80 percent of the peanut butter sales were in 18 oz., 28oz., and 40oz.

packages. Most of the top brands have all three popular sizes in their product line. In

2008 manufacturers 2 and 3 downsized their peanut butter products from 18 ounces to 16.3 ounces. However, downsizing is not common across all manufacturers.

Manufacturer 1 and the other top store brands did not downsize any of their products. In

2010, the volume sales in downsized packages were only 16 percent of the total market.

Insert Figure 3.4 Here

In table 3.4 we compare average price per ounce and price per package of 18-ounce

peanut butter before and after the downsizing. Two major national brands downsized

their products in 2008, whereas the top national brand and the top two store brands did

not downsize. Same as the case of tuna, there is strong evidence that manufacturers used

downsizing to implicitly raise prices. For national brands 1 and 2, the percentage change

in price per ounce of peanut butter is considerable higher than the percentage change in

price per package. For example, national brand 2 raised its price per ounce by 13 percent

with a combination of package downsizing and raised the package price by 5 percent. On

the other hand, during the same period national brand 1 raised its prices by 14 percent

without downsizing.

Insert Table 3.4 Here

### *3.2.2 Consumption and Expenditure Trends*

In table 3.5 we report annual average per-household peanut butter consumption in terms of volume and number of packages, and expenditure for all sizes. The trends show that household volume consumption of peanut butter remained relatively stable throughout the study period, meanwhile household expenditure increased due to increased prices. However, there is a slight difference in consumption between the periods before and after downsizing events. The average volume and package consumption are higher for the period between 2008 and 2010, when downsized products were taking place in the market. In other words, contrary to the response to downsizing of shelf stable tuna, households might have increased their purchase frequency of peanut butter to maintain or increase consumption. For a further examination, in table 3.6 we report consumption and expenditure trends of the reduced size category only, i.e., including only 18 oz. and 16.3 oz. packages. The trends of reduced size category display a different pattern than the trends of average consumption of all sizes. In the former case, the average volume consumption is slightly lower for the period between 2008 and 2010, whereas the package consumption remains relatively stable.

Insert Table 3.5 Here

Insert Table 3.6 Here

### *3.3 Summary*

Package downsizing is common in the shelf stable tuna market. All the top manufacturers downsized their tuna products from 6 ounces to 5 ounces during the period 2007-2008. In 2010, 5 oz. tuna sales comprised 75 percent of the market volume. After downsizing the increase in price per ounce of all brands was proportionately higher than the increase in price per package, that is manufacturers used downsizing as a hidden price increase. The household volume consumption of shelf stable tuna decreased due to downsizing. The average annual volume consumption is approximately 10 percent below its level before downsizing, in spite of an approximately 5 percent increase in the annual package consumption.

Package downsizing is less common in the peanut butter market. Only two of the top 5 manufacturers downsized their 18-ounce peanut butter products to 16.3 ounces in 2008. In 2010, 16.3 oz. peanut butter sales comprised about 16 percent of the market volume. As in the case of tuna there is evidence that manufacturers used downsizing as a hidden price increase. However, there is no clear evidence that downsizing affected household peanut butter consumption in a systematic way.

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## Tables and Figures

Table 3.1: Per Unit and Per Package Prices of the Norm Size (6 oz.) Before and After Downsizing

Brand	Year	Average Price Per Ounce			Average Price Per Package		
		Before (\$)	After (\$)	Percent Change	Before (\$)	After (\$)	Percent Change
N. Brand 1	2007	0.154	0.181	17.5	0.888	0.964	8.60
N. Brand 2	2007	0.161	0.202	25.5	0.958	1.088	13.6
N. Brand 3	2007	0.125	0.165	32.0	0.750	0.896	19.5
S. Brand 1	2008	0.103	0.139	35.0	0.601	0.720	19.8
S. Brand 2	2008	0.107	0.135	26.2	0.643	0.724	12.6

Notes: 1. “Year” denotes the year when the package downsizing occurred, 2. Only single package sales are used to calculate the average prices, 3. “Before” includes the observations starting between 2004 and the year of the downsizing event, “After” includes the observations between the year of the downsizing event and 2010.

Table 3.2: Annual Household Consumption and Expenditure of Shelf Stable Tuna

Year	Number of Households	Consumption		Expenditure (dollars)
		(Ounces)	(Packages)	
2004	26728	82.00	13.30	10.78
2005	25505	79.45	12.91	11.16
2006	24363	75.93	12.38	11.09
2007	40317	76.07	12.46	11.20
2008	37539	71.25	11.88	11.93
2009	37530	66.44	12.60	13.43
2010	37407	67.99	13.16	12.79

Notes: 1. Only single package purchases are used in calculations.

Table 3.3: Annual Household Consumption and Expenditure of 6 oz. (5 oz.) Shelf Stable Tuna

Year	Number of Households	Consumption		Expenditure (dollars)
		(Ounces)	(Packages)	
2004	23592	72.76	12.15	8.86
2005	22769	72.69	12.15	9.27
2006	21601	69.76	11.68	9.26
2007	34896	69.56	11.65	9.26
2008	32040	63.88	10.97	9.80
2009	32648	61.34	12.10	11.31
2010	32629	63.81	12.71	10.85

Table 3.4: Per Unit and Per Package Prices of the 18 oz. Peanut Butter Before and After Downsizing

Brand	Year	Average Price Per Ounce			Average Price Per Package		
		Before (\$)	After (\$)	Percent Change	Before (\$)	After (\$)	Percent Change
N. Brand 1	None	0.109	0.125	14.1	1.970	2.246	14.1
N. Brand 2	2008	0.105	0.118	13.0	1.847	1.939	5.0
N. Brand 3	2008	0.097	0.117	21.3	1.724	1.909	10.1
S. Brand 1	None	0.082	0.094	14.9	1.476	1.695	14.9
S. Brand 2	None	0.073	0.080	10.5	1.305	1.442	10.5

Notes: 1. “Year” denotes the year when the package downsizing occurred, 2. Only single package sales are used to calculate the average prices, 3. “Before” includes the observations starting between 2004 and the year of the downsizing event, “After” includes the observations between the year of the downsizing event and 2010. If a downsizing event has not occurred 2008 is used as the cutting point.

Table 3.5: Annual Household Consumption and Expenditure of Peanut Butter

Year	Number of Households	Consumption		Expenditure (dollars)
		(Ounces)	(Packages)	
2004	28874	113.66	5.13	11.19
2005	28180	114.31	5.18	10.89
2006	27215	113.89	5.18	11.07
2007	45386	114.33	5.10	11.50
2008	43879	115.48	5.20	12.70
2009	43157	116.72	5.31	13.40
2010	42516	115.04	5.33	12.82

Table 3.6: Annual Household Consumption and Expenditure of 18 oz. (16.3 oz.) Peanut Butter

Year	Number of Households	Consumption		Expenditure (dollars)
		(Ounces)	(Packages)	
2004	21816	77.24	4.29	7.15
2005	21578	78.51	4.37	6.94
2006	20381	79.37	4.42	7.20
2007	33761	75.09	4.19	7.06
2008	31790	75.46	4.26	7.65
2009	31060	75.93	4.34	8.17
2010	30547	76.40	4.42	7.92

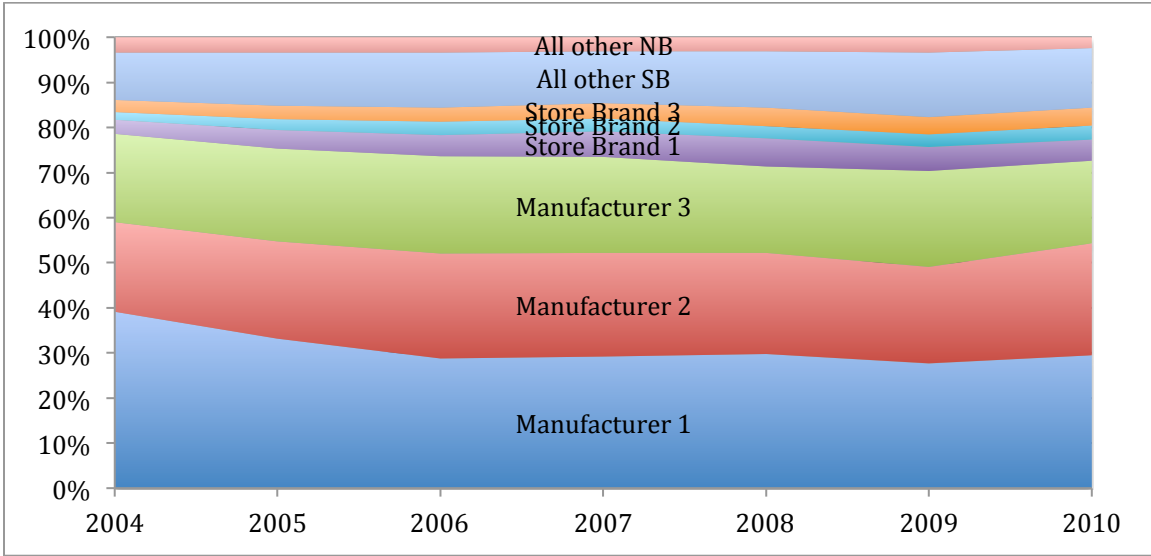


Figure 3.1: Manufacturer Shares of Shelf Stable Tuna Market

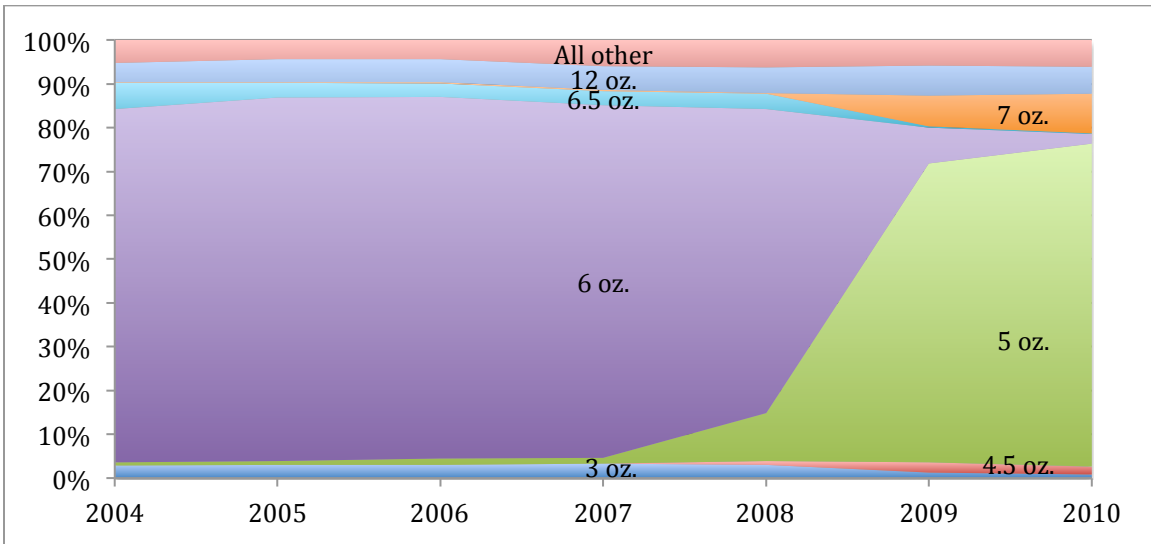


Figure 3.2: Annual Volume Consumption of Shelf Stable Tuna by Package Size



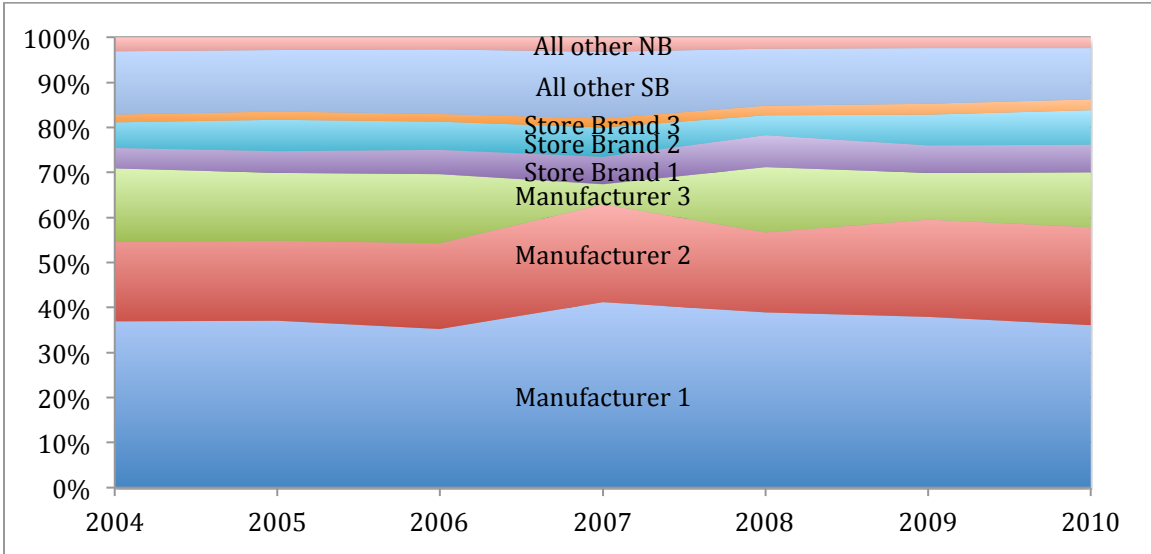


Figure 3.3: Manufacturer Shares of Peanut Butter Market

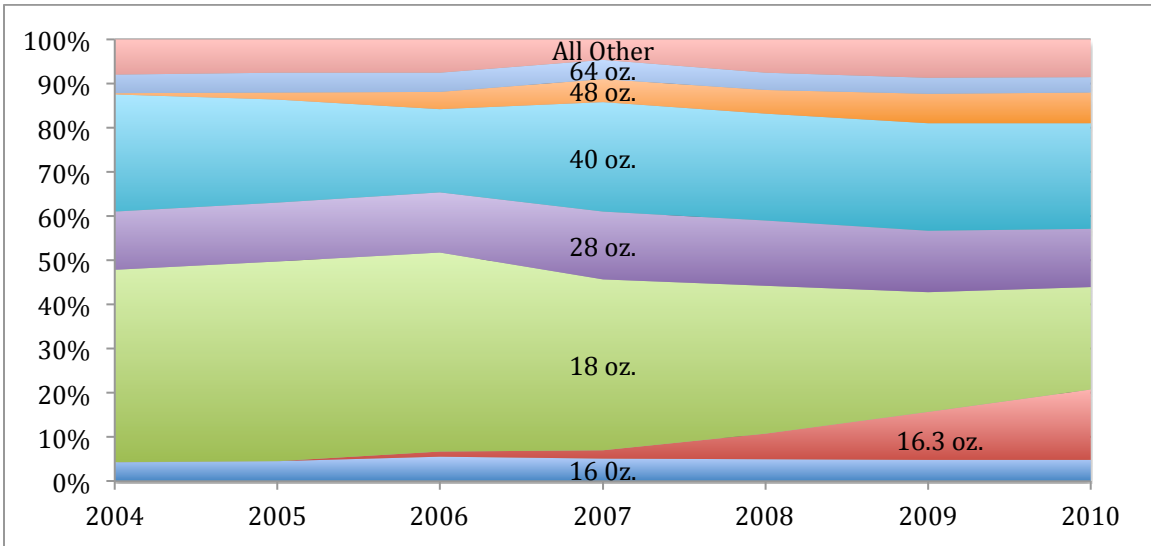


Figure 3.4: Annual Volume Consumption of Peanut Butter by Package Size