Methodology and Data Used

The first measure of nutritional quality change used here is the Padberg index. Calculating Padberg's nutritional quality index consists of three main procedures. In the first procedure, the initial scoring system was designed to assign points according to the quantity of each nutrient listed on the label and to give each nutrient an equal weight. Each nutrient, therefore, has the possibility of receiving 0 to 100 points. Definitions of nutrient content claims as published in the *Federal Register* (1993) were used to establish thresholds for scoring. Each nutrient on the label, except sugars and calories from fat, was considered in the scoring system. For example, if the product qualified under the new regulation to make a high fiber content claim, it received a score of 100 for the fiber content. On the other hand, if it could not qualify to make any fat content claims, it received a score of 0 for that nutrient. The total of quality points was then divided by the number of nutrients to obtain the average initial score for a product. The initial scoring system is summarized in table 1.

Assigning quality points based on the requirements for nutrient content claims alone would require the use of step functions. In the step function, each step would motivate product formulators to add (or subtract) nutrients to reach the nearest threshold awarding the next step of nutritional quality points. These steps could distort the quality index measure. In the second procedure, therefore, the researchers smoothed the step functions by averaging them. With the smooth functions, product formulators get quality points for any nutrient changes—whether near a step or not. The point functions for the nutrients are shown in table 2.

In the third procedure, the authors estimated the relative importance of different nutrients using a survey conducted among dieticians (Kim and Padberg, 1993; Padberg and others, 1993). In other words, the quality points assigned in the second procedure for each nutrient in each product were multiplied by the estimated weights that dieticians implicitly placed on each nutrient. We use Padberg's weights on nutrients in our calculation of the indexes. We assume that the relative ranking of nutrients by their importance has not changed since his survey was conducted in 1993. The weights used are shown in table 2.

The final nutritional quality index is the sum of weighted quality points from each nutrient. Its value ranges from 0 to 100, where 100 indicates excellent nutritional quality. The nutrition quality index for the example product—veal marsala—presented in table 2, is 9.4. The low value of the index reveals a low overall nutritional quality rating of this product. Padberg's index is thus a composite index that measures the nutritional quality of a food product based on important nutrients listed on the label (its overall nutritional profile). This index reflects current scientific understanding of nutrition and dietary recommendations for the average American consumer. The role of the index is to evaluate the overall nutritional quality of a food product as opposed to evaluating the nutritional quality of individual consumer diets.

Table 1—The initial scoring system for food products

	Scoring groups				
Nutrient	100	75	50	25	0
			Nutrient per serving		
Calories	274	275-343	344-412	413-481	>482
Fat (g)	<0.5	0.5-6	7-12	13-19	>20
Saturated fat (g)	<0.5	0.5-1.5	2-3	4-5	>6
Cholesterol (mg)	<2	2-46	47-68	69-89	>90
Sodium (mg)	<80	81-319	320-519	520-719	>720
Carbohydrates (%DV)	>20	19-17	16-14	13-10	<10
Dietary fiber (%DV)	>20	19-17	16-14	13-10	<10
Protein (%DV)	>20	19-17	16-14	13-10	<10
Vitamin A (%DV)	>20	19-17	16-14	13-10	<10
Vitamin C (%DV)	>20	19-17	16-14	13-10	<10
Calcium (%DV)	>20	19-17	16-14	13-10	<10
Iron (%DV)	>20	19-17	16-14	13-10	<10

g = Grams, mg = Milligrams, %DV = Percent of daily value.

In using and evaluating the Padberg index, it is important to recognize that it is one of a large possible family of such indexes that could be constructed. Other researchers may wish to refine the index by adjusting the initial scoring system or weights assigned to each nutrient in the overall score. We view the Padberg index as a good starting point in developing an overall measure of nutritional quality that can be applied on a product-by-product basis. Because the index is one of many possible ones that could be used, the methodology applied here also evaluates quality shifts by investigating changes in individual nutrients in food products. The Padberg index is then used to analyze the nutritional quality of new and exiting food product brands. Finally, market share data are used to produce preliminary weighted Padberg indexes that reflect the nutritional quality of foods purchased by consumers.

The analysis is based on a unique supermarket data set that consists of a complete census of all product offerings in the most popular package size in 20 food categories collected in a superstore in New England. The data provide information on brand names, nutrient content levels, nutrition and health claims made, and product prices for the years 1992-95, 1997, and 1999. This method does not result in data being collected on every product offered for sale in the United States in a particular food category in a given year. However, it does result in data being collected on all the major brands, many minor brands, and private-label products. Here we report results for five selected food categories. The brands included in the data set for 1997, for example, cover 60.2 percent, 87.4 percent, 73.3 percent, 75.8 percent, and 62.5 percent of national sales for the entrees, soup, salted snacks, cookies, and processed meats and bacon categories, respectively. These five categories were selected to range across a spectrum from high to medium levels of formulation and to represent foods that are important in consumer diets. In 1996, these food categories represented about 22 percent of national scanner-tracked food sales (table 3).

The categories were also selected because the most complete nutritional data were available for them. For the data set used here, nutrient content values were missing for products that did not carry a nutrition information panel in a particular year. In addition, information on saturated fat, fiber, and sugar was not required and very often not reported on nutrient content panels in 1992 and 1993. Since Padberg's index is a composite index based on most of the product nutrients listed on the Nutrition Facts label, products with incomplete information had to be excluded from the study. Table 4 reports the number of products in each selected food category and shows the extent of the missing data problem in the years analyzed. Because of the lack of data for the early years, complete analysis for 1992-97 was only possible for processed meats and bacon.[2] The other food categories are analyzed for

[2]For the processed meats and bacon category, information reported on pre-1994 nutrition panels was comparable to that reported on post-1994 panels in that the amounts of only very few nutrients were missing. Therefore, the percentage of usable observations was 73.1 percent in 1992 and 89.5 percent in 1993. For the remaining food product categories, information on pre-1994 panels was not directly comparable with information on post-1994 panels because of missing data for the saturated fat, cholesterol, and carbohydrate variables. The percentage of usable observations was in the 50- to 60-percent range, making analysis of the pre-NLEA period inappropriate.

Table 2—Nutrition index: Example product—Veal marsala

Nutrient	Nutrient per serving	Point functions	Quality points	Weights	Weighted points
Calories	453	232-0.481X	14.1	0.06	0.8
Fat (g)	24	102.56-5.128X	0	.30	0
Saturated fat (g)	13	109-18.15X	0	.17	0
Cholesterol (mg)	182	153-1.7X	0	.03	0
Sodium (mg)	627	112.5-0.156X	14.7	.15	2.2
Carbohydrates (%DV)	4	-100+10X	0	.07	0
Fiber (%DV)	3	-100+10X	0	.09	0
Protein (%DV)	68	-100+10X	100.0	.04	4.0
Vitamin A (%DV)	18	-100+10X	80.0	.03	2.2
Vitamin C (%DV)	11	-100+10X	10.0	.02	.2
Calcium (%DV)	6	-100+10X	0	.04	0
Iron (%DV)	21	-100+10X	100.0	.00005	0
∑ Weighted points = Index value	NA	NA	NA	NA	9.4

g = Grams, mg = Milligrams, %DV = Percent of daily value.
NA = Not applicable.

1994-97 or 1995-97. The alternative of covering the entire period from 1992 through 1997 but using only products with complete information may have created a bias in the quality change analysis. This bias could be serious because products with no information or limited information on their nutritional profiles in the early years might have reformulated more than labeled products.

The food categories included under highly formulated products are entrees (including frozen entrees/single-serving dinners, frozen entrees/family pack, shelf-stable entrees, and frozen pizza) and soup. Categories included under medium formulated products are salted snacks (crackers, potato chips, corn chips, and other salted snacks), cookies, and processed meats and bacon. Highly formulated products are defined as those with contents that vary greatly. For example, such products can contain vegetables, meats, cheese, or pasta. The nutritional profiles of those products also vary greatly. Medium formulated products are those with contents and nutritional profiles that are more uniform.

This analysis uses Padberg's index and nutrient-by-nutrient analysis to represent changes in the average nutritional quality of product offerings in each food product category. To indicate the quality of goods that were actually purchased in the market place, the Padberg index was weighted by national sales data. The national sales data used in this study contain information on brands, sales, package size, nutrient content claims, and health claims from a large sample of supermarket scanner data nationwide. These data do not provide information on the amounts of nutrients in food products. Therefore, they cannot be used by themselves for the analysis of nutritional quality change. Instead, information on brand sales from the scanner data must be matched with information on the nutritional quality of the respective brands from the University of Massachusetts supermarket data.

Table 3—Value of U.S. retail scanner-tracked sales for selected food categories, 1996

Food category	Sales	Share of total sales
	Million dollars	*Percent*
Entrees	3,609.0	4.8
Soup	3,157.9	4.2
Salted snacks	2,406.0	3.2
Cookies	2,105.3	2.8
Processed meats and bacon	9,377.5	6.9
Total for food category	20,655.7	21.9
Total national sales	133,462.0	100.0

Source: U.S. National Scanner Data for 1996.

Table 4—Number of products in selected food categories from supermarket data set

	Products in food categories									
	1992		1993		1994		1995		1997	
Food category	Total	Usable	Total	Usable	Total	Usable	Total	Usable	Total	Usable
					Number					
Entrees	—	—	—	—	93	55	92	80	87	75
Frozen entrees/dinners[1]	—	—	—	—	47	30	41	36	41	37
Frozen entrees[2]	—	—	—	—	21	12	24	19	24	17
Shelf-stable entrees	—	—	—	—	11	6	13	12	12	11
Frozen pizza	—	—	—	—	14	7	14	13	10	10
Soup	—	—	—	—	—	—	59	55	69	69
Salted snacks	—	—	—	—	92	81	93	91	107	104
Crackers	—	—	—	—	34	28	32	31	51	50
Potato chips	—	—	—	—	27	26	25	24	21	20
Corn chips	—	—	—	—	14	12	19	19	18	18
Other salted snacks	—	—	—	—	17	15	17	17	17	16
Cookies	—	—	—	—	54	48	51	50	57	57
Processed meats and bacon	67	49	57	51	58	53	54	53	53	52

— = Not available.
[1]Single-serving products.
[2]Multiple-serving products.

Table 5 summarizes the extent of the data match between the two sources. The process of matching information was difficult. The scanner data set includes hundreds of records for every record in the supermarket data set because the scanner data contain records on products in all possible package sizes, flavors, and kinds. Further, although the scanner data set is based on a large sample of stores, it does not encompass the entire population of food products. As a result, specific private-label products that appear in the supermarket data set are missing in the scanner data set and cannot be included in the analysis. Another difficulty arises from the fact that the number of observations in the scanner data is always the same in each year because it is based on the number of brands recorded in the last year the data were collected (in our case 1996). For example, if a product exited the market in 1996, its record will be missing not only in 1996 but also in the earlier years. Approximately 25 percent of the brands from the supermarket data were not in the scanner data.

While the degree of match shown in table 5 is relatively low, we believe our approach yields interesting preliminary insights into the quality of products purchased in the years studied.

Table 5—Summary of supermarket scanner data for selected food categories

	Scanner data					
		Products matched to supermarket data				
Food category	Products, 1992-96[1]	1992	1993	1994	1995	1996[2]
	Number					
Entrees	639	—	—	30	30	32
Soup	518	—	—	—	44	56
Salted snacks	927	—	—	64	67	73
Cookies	707	—	—	28	31	34
Processed meats and bacon	2,006	39	40	40	42	43

— = Not available.

[1]Same each year.

[2]Due to the lack of availability of 1997 data, 1996 scanner data are matched to the 1997 supermarket data.