How much are Consumers Paying for Organic Baby Food?

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Abstract

Using retail purchase data, price premiums and discounts associated with household demographics, market factors, and product attributes (focusing on the organic attribute for strained baby food) are estimated using a hedonic pricing model. Results suggest that the organic premium ranges from about 12 to 49 percent in 2004 and from 30 to 52 percent in 2006. Tests for significant changes relative to product attributes show that while the price of conventional baby food has stayed relatively the same, the premium for organic baby food has increased.

Key words: organic baby food, hedonic price, market factors, product attributes, Nielsen Homescan, organic premium

Introduction

Increased consumer interest in organic foods over the past decade has turned a growing niche market into a multibillion dollar a year industry. In fact, the United States organic food industry's sales have grown from just over $1 billion in 1990 to almost $19 billion in 2007, up 17 percent from the previous year (Dimitri and Greene, 2002; *NBJ*, 2008). The use of organics by consumers is related to personal health concerns such as the absence of pesticides, growth hormones and genetically modified foods, as well as, generally being safer for one's health (Hartman Group, 2006). Additionally, some consumers identify organic foods with an increased nutritional value over conventionally grown foods (Hay, 1989). These issues are of particular concern for baby food consumers—parents of infants and young children—who wish to pay a price premium to mitigate perceived risks associated with conventionally produced foods. The focus of this study is to estimate the organic premiums parents are paying in the marketplace to find out how they value and assess risk reductions.

Consumer awareness and knowledge of what constitutes an organic food, and what it means for a food to be organic, impacts the consumer's attitudes towards organic foods and their willingness to pay. Complete awareness and knowledge about organic foods does not necessarily mean a consumer will purchase the food due to other barriers such as price or skepticism of perceived attributes (Yiridoe et al., 2005; Hartman Group, 2006). Although high price premiums can encourage production of organic foods, premiums may also discourage non-users from entering the organic market and keep current users from purchasing more organics.

Traditionally, studies on organic foods have measured consumers' attitudes and willingness to pay an organic price premium through the contingent valuation method rather than using actual purchase choices. A comprehensive review of literature on consumer perceptions

and preferences of organic foods by Yiridoe et al. (2005) suggested that caution should be exercised when drawing any conclusions from earlier studies with such limited short-term time-series data on willingness to pay a price premium. Although findings from the literature confirm that organic foods command a price premium (Thompson and Kidwell, 1998; Wolf, 2002; O'Donavan and McCarthy, 2002; Thompson and Glaser, 2001; Huang and Lin, 2007), discrepancies in the magnitude vary across products and location. For example, using survey data, Wolf (2002) found that 30 percent of respondents in California were willing to pay a 50 percent premium for organically grown grapes, while O'Donavan and McCarthy (2002) found that about 70 percent of Irish consumers were not willing to pay more than a 10 percent premium for organic meat.

Increased demand for organic baby food is most noted by the sector's 16 percent growth in sales over the previous year resulting in total sales of about $268 million for 2007 (*NBJ*, 2008). Few empirical studies have investigated the organic price premiums consumers are paying for baby food (e.g., see Harris, 1997; Thompson and Glaser, 2000; and Maguire et al., 2004). Thompson and Glaser, as well as Harris, estimated price premiums for strained baby food at the national level using supermarket scanner data, while Maguire and colleagues collected sticker price information from all types of stores in two US cities. Because the two scanner data studies use information only from large supermarket chains, they are potentially missing other major outlets for organic foods. In fact, two-thirds of organic foods occurred in natural and specialty food stores in 1998 (*NBJ*, 2006). Although Maguire et al. (2004) collected price information from all store types, not just grocery chains, their data is limited in the sense that it only represents a small portion of the US population and doesn't necessarily reflect the price consumers are actually paying. The objective of the study is to estimate price premiums and

discounts associated with household characteristics, market factors, and product attributes with an emphasis on the organic attribute for strained baby food using actual retail purchases from a nationally representative data set. The years 2004 and 2006 are analyzed to test for significant price movements among each characteristic.

Data Source

The data source of this study is the 2004 and 2006 Nielsen Homescan data. The panel consists of representative U.S. households that provide food purchase data for at-home consumption. Total enrollment for both years was over 37,000 households, but to avoid would-be data problems resulting from incomplete reporting, only those households that reported purchases for at least 10 months in the given year were included. Each purchase records the date, the quantity purchased, expenditure for that quantity, promotional information including whether or not the item is on sale, and detailed product characteristics. In addition to product characteristics and sales information, detailed socio-demographic information of each household is included. Only those households that purchased strained baby food of interest are considered in the study.

Panelists report total expenditure and the quantity purchased. Prices for organic and conventional baby food are derived as unit values – the ratio of reported expenditures to the reported quantities for each purchase record, net of any promotional and sale discounts. In order to avoid potential problems stemming from inadvertent reporting errors, derived unit values greater than the sample mean plus three standard deviations are considered outliers and thus excluded from the sample.

Each purchase record is identified by type (organic or conventional), contents (fruit, vegetable, or dinner), stage of baby food (which in analogous to the container size), and store

format at which the purchase was made (supermarket, discount, convenience or other type of store). Table 1 provides a list of variables constructed from the data to be used in the empirical estimation.

Table 2 shows the percentage of purchases across product and selected market characteristics for conventional and organic baby food. In both 2004 and 2006, conventional and organic baby food was sold predominantly in stage 2 containers, although organic sales were clearly much more skewed than conventional sales. Stage 1 baby food is finely puréed, generally offered in 2.5 ounce containers and is one of the first solid foods babies eat. Babies then move to stage 2 foods that generally come in 4-ounce sizes. Finally, babies eat stage 3 baby foods (6 ounces) that have more texture and small chunks of food to promote chewing.

A relatively smoother distribution among the content types (dinner, vegetable and fruit) is observed across both conventional and organic for both years. Sales of conventional baby food decreased in supermarkets over the three year period mainly to purchases in discount and other types of stores. On the other hand, sales of organic baby food slightly increased in supermarkets and were almost proportionally cut in half in discount stores. Sales of organic baby food in 'other' stores (which can include small natural and specialty stores or on-line sales) increased substantially. It is also interesting to note that sales of organic baby food in multi-packs constitute nearly 13 percent of organic purchases in 2006 compared to nearly zero in 2004. In response to increased consumer demand, new bulk packaging efforts by leading organic baby food companies have been introduced in the marketplace over the three year period.

Methodology

A limitation of the neoclassical theory of consumer demand is its inability to explain why consumers derive utility from commodities as well as its inability to predict demand for new

products. Realizing the weaknesses of the neoclassical approach, Lancaster (1966) proposed the characteristics theory to address some of the inherent limitations found in the neoclassical demand theory. The characteristics theory assumes that consumers derive utility from the characteristics or attributes inherent in a good or service. It is the intrinsic properties of a particular good that make it different from other goods that, in some instances, may be quite similar. The model developed by Lancaster (1966) makes several modest assumptions. It is not the good itself that gives rise in utility to the consumer, but the characteristics within the good. In general, it is assumed that a good possess more than one characteristic and that many characteristics will be shared by more than one good. And finally, goods in combination may create characteristics completely different than those pertaining to the goods separately.

Economists have expanded Lancaster's theory to develop hedonic approaches that model price as a function of quality attributes to estimate the implicit values of product characteristics (Rosen, 1974; Ladd and Martin, 1976; Ladd and Suvannunt, 1976). Hedonic modeling relies on the assumption that the price of a product must be low enough relative to the prices of other products to be represented on the efficiency frontier (Lancaster, 1966). The theory states that the price of a product is a function of all its associated attributes *z*,

$$p(z) = (z_1, z_2, ..., z_n),$$

so that the marginal implicit values of the product's attributes sum up to the price paid by the consumer (Ladd and Suvannunt, 1976). The amount of attributes demanded by the consumer must be met by the amount supplied by the producer (Rosen, 1974). This implies that both consumers and producers distinguish product attributes approximately the same way and that the decisions made by each group leads to an equilibrium condition (Huang and Lin, 2007).

Given the nature of Homescan data that may contain multiple observations from the same household, the error terms are likely clustered-correlated and not independently distributed. Thus, the covariance estimates obtained from applying the standard ordinary least squares estimation are likely biased, which would yield inappropriate standard errors and misleading tests of statistical significance (Brogan, 1997). The error terms in the hedonic price equation are assumed to be cluster-correlated. To estimate the hedonic equation, Stata's commands designed for survey data are used (StataCorp, 2005). The regression procedure uses weighted least squares for survey data, so that the price of baby food, P_i, in the hedonic model is specified as

$$P_{it} = \alpha_0 + \sum_{n=1}^{15} \alpha_n SOC_{nit} + \sum_{r=1}^{15} \beta_r MKT_{rit} + \sum_{s=1}^{6} \gamma_s PRO_{sit} + \delta_1 ORG_{it} + \sum_{v=2}^{7} \delta_v ORG_{it} \times PRO_{vit} + e_{it}$$

in which P_{it} is the price of baby food paid by the i-th household in time t for each year; SOC_{it} represents a set of household socio-demographic characteristics; MKT_{it} represents a set of market factors such as type of store, promotional sale occasion, region, and urbanization of purchase; PRO_{it} represents product attributes such as the stage of baby food (container size) and contents; ORG_{it} represents the organic attribute of baby food; and e_{it} is the error term. Interactive terms between organic purchases and product attributes are included to allow for price differentiation among the different types of baby food. Finally, the data are stacked and a dummy for 2006 ('Year06') is included and allowed to interact with all explanatory variables to test for significant price movement.

The hedonic price model represents a reduced-form equation reflecting both the supply and demand influences simultaneously. Unfortunately, there is no rule-of-thumb for choosing the appropriate functional form *a priori* in regression analysis. Thus, the choice of the functional form remains an empirical issue. Due to its ease of interpretation and previous application to

hedonic pricing structures for organic foods (Lin et al, 2008; Maguire et al 2004), the linear functional form is chosen.

Results

This study estimates a linear hedonic model for the price[1] of baby food as a function of household characteristics, market factors, and products attributes (Table 3). The R^2, a measure of goodness-of-fit, for the pricing models ranges from 21 to 26 percent. Given that cross-sectional data are used, the R^2 is deemed satisfactory. The constant term reflects strained baby food sold as a dinner in the southern region during the winter in the most popular container (stage 2) in a supermarket and not sold under a promotion or in a multi-pack. Overall, the estimated coefficients appear to be reasonable in magnitude and satisfactory in terms of statistical significance.

Household characteristics exert little influence on the price of baby food in terms of both statistical significance and magnitude relative to market factors and product attributes in both 2004 and 2006 (Table 3). The insignificant demographic variables mean they do not, in general, affect prices paid, other things being equal. For example, prices of baby foods do not vary between supermarkets shopped by people with different demographic profiles. However, higher income households in 2004 had a higher willingness to pay for baby food, possibly due to the correlation between income status and the quality of shopping venue and product offering. Our finding is consistent with Thompson and Kidwell (1998) who found that higher household income increases the probability that a household will choose to shop at a specialty grocery store, which tend to maintain higher prices on average.

[1] All prices were computed as a unit value paid by dividing total expenditure, net of any promotional and sales discounts, by the total quantity purchased.

Regarding markets factors, the quarterly price of baby food, as measured by seasonal variation, is relatively constant throughout both 2004 and 2006. Due to baby food's low perishability, we would expect prices to show little change throughout the year given fairly stable input and operating costs. In addition, baby foods are mostly jarred; so unlike fresh organic foods such as produce and milk (e.g., see Lin et a.l, 2008 and Smith et al., 2009), baby food prices are quite stable across time and geography. The price of baby food is generally at its lowest in the Southern region of the US, and at its highest in the West and Northeast although the estimated price differences are small—less than one cent per ounce.

Price discounts and premiums across store format, packaging and promotional offerings are more evident. Relative to prices in a supermarket, baby food tends to be priced higher in a convenience store. Baby food sold at a discount store (i.e., supercenter or club warehouse) was priced one cent per ounce lower than when sold through a supermarket[2]. Moreover, baby food sold under a promotion (i.e., store feature or coupon use) was discounted substantially below the regular price—more than 2 cents per ounce in both years.

All product attributes resulted in significant price differences at the 1-percent significance level. For both years, vegetable baby food maintained the lowest price, while baby food sold as dinners commanded the highest price. Not surprisingly, due to its direct correlation to container size, stage 1 baby food had significantly higher prices than stage 2 baby food. It is interesting to note that stage 3 baby food, although sold in the largest sizes, was priced slightly higher than baby food sold as stage 2. One possible explanation is that stage 3 baby food generally is made with diced or chunks of 'regular' food, thereby possibly increasing production costs relative to

[2] Specialty chain grocery stores (i.e., Whole Foods) are recorded in the same category as all other grocery stores in Homescan

the other two stages of baby food that mainly differ in packaging size. Additionally, stage 3 baby foods are likely to have the most substitutes (i.e., table food).

The variable of most interest ‘Organic’ reflects the premium paid for organic dinners over conventional dinners. Allowing ‘organic’ to interact with the two other types of baby food enables us to test for significant price differences among the organic products. The positive coefficients for ‘Organic×Vegetable’ and ‘Organic×Fruit’ implies that the premium margin is the lowest for organic dinner among the three types of baby foods.

The transition column in Table 3 reflects the significant differences in estimated nominal price premiums and discounts for each of the variables. No significant price changes were observed for any of the household characteristics or market factors with the exception of baby food sold in multi-packs. The relatively large price increase for bulk packaged baby food implies that consumers did not enjoy such large price discounts in 2006 as in 2004.

Significant changes in price corresponding to product attributes are more apparent. The insignificance of the variable ‘Year06’ suggests that the price of conventional baby foods in general did not change, although the price of conventional vegetable and fruit baby food increased relative to dinners over the three year period. Stage 1 baby foods showed a slight decrease in price relative to stage 2, while stage 3 baby foods exhibited a rather larger increase in price. The price premium of organic dinners more than doubled to about 3.5 cents per ounce in 2006, while fruits and vegetables showed a more modest increase of about one-half to one cent per ounce, respectively.

The remainder of the discussion will focus on stage 2 baby food since organic baby food is predominantly sold (70 to 77 percent) in this container for both years. Holding household characteristics and market factors constant, the organic premium in absolute value is calculated

by adding the relevant estimated product attribute coefficients for organic baby food found in Table 3. For example, the organic premium for fruit sold as stage 2 is 5.84 cents per ounce or 23.4 cents per jar. Previous studies using the contingent valuation approach typically report organic price premiums as a percent above conventional prices instead of absolute dollars and cents in order for respondents to report their willingness to pay for organic food in relative terms. To be consistent with the literature for comparison, the premium as a percentage above the average actual prices of conventional baby food found in Table 4 are reported in Figure 1. Therefore, the 23.4 cents per jar premium is about 52 percent above the average price paid for its conventional counterpart in 2006 as compared to its 49 percent premium in 2004. Note that all price increases are significant at least at the 5 percent level (Table 3).

Figure 1 clearly depicts the price of organic baby food increasing relative to conventional prices. As shown in Table 4, the ratio of organic purchases relative to conventional purchases, organic market share, has decreased over the three year period for all three types of baby food. Assuming the hedonic framework holds, which balances the supply and demand conditions, the results suggest that the organic supply squeeze noted in the literature and popular press may be driving organic premiums up—the demand for organic baby food is outpacing its supply.

Conclusions

This study estimated a hedonic pricing model to investigate price premiums and discounts associated with household characteristics, market factors, and product attributes for baby food. Most notably, the organic attribute carried a large and significant premium. Furthermore, additional price variation associated with content types and stages was found for organic baby food over its conventional counterpart. Parents of infants and small children may be willing to

pay such premiums to mitigate perceived risks associated with conventional baby foods (i.e., pesticide residue and presence of genetically modified foods).

Results suggest that the organic premium for stage 2 baby food ranges from about 12 to 49 percent in 2004 and from 30 to 52 percent in 2006. A recent study of ten selected organic fresh produce found premiums to be under 30 percent (with the exception of peppers and strawberries) and organic market shares ranging from 0.5 to 5 percent (Lin et al., 2008). Given that baby food is predominantly made with fruits and vegetables, the higher organic market shares for baby food reported in Table 4 may be reflected in the premiums for baby food and could contribute to the difference.

As compared to previous research of organic baby food, our results suggest a slightly higher premium as compared to that of Maguire et al. (2004) who found premiums to be approximately 16 to 27 percent in 2001 for San Jose, CA and Raleigh, NC in particular. Although we may expect premiums to decline in general as more producers enter the market, their results, as noted by the authors, can not be applied to the entire United States. In fact, Thompson and Glaser's (2001) study showed a clear downward trend in premiums from 1988 to 1999 estimating that vegetable baby food price premiums declined from 107 percent in 1988 to 52 percent in 1999. However, their study only reflects supermarket prices and does not include other popular outlets for organic foods such as specialty and natural food stores, which in general maintain higher prices. Therefore their premiums only reflect those in supermarkets and not necessarily premiums in the baby food market in general. A rise in premiums for organic baby food may be due to an organic supply squeeze causing increased demand to outpace supply.

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Table 1. Variables Included in the Hedonic Model.

Variable	Definition
Dependent Variable	
Price	= unit value of baby food (expenditure net of any promotions divided by the corresponding quantity), cents per ounce
Independent Variables	
HOUSEHOLD DEMOGAPHICS	
Income	= the ratio of household income over the federal poverty level; where household income is the midpoint of the income class
Marital status	=1 if household has a specific marital status (married with both employed, married with one employed, or single[a]), = 0 otherwise
Education	= 1 if household head has a specific education (high school diploma or less, some college, college degree and beyond[a]), = 0 otherwise
Age	= 1 if household head's age is in a specific group (< 40, 40–64, 65 or older[a]) , = 0 otherwise
Race/ethnicity	= 1 if the household head is a particular race/ethnicity (African-, Hispanic-, Asian-, other-American, white[a]), = 0 otherwise
MARKET FACTORS	
Season	= 1 if purchase made in a specific season (Spring, Summer, Fall, Winter[a]), = 0 otherwise
Region	= 1 if the household resides in a specific region (Northeast, Central, West, South[a]), = 0 otherwise
Urban	= 1 if the household resides in an urban area
Store format	= 1 if purchase made in a specific type of store (supermarket[a], discount, convenience, other store), = 0 otherwise
Promotion	= 1 if purchase made on sale or under promotion, = 0 otherwise
Multi-pack	= 1 if purchase was made in a bulk package, = 0 otherwise
PRODUCT ATTRIBUTES	
Organic	= 1 if organic baby food purchase, = 0 otherwise
Stage	= 1 if specific stage of baby food (1, 2, 3[a]), = 0 otherwise
Type	= 1 if specific contents (fruit, vegetable, dinner[a]), = 0 otherwise

Source: Nielson Homescan Data, 2004 & 2006.

[a] Reference category.

Table 2. Percent of purchases by product and market characteristics, 2004 – 2006.

	Conventional		Organic	
Characteristic	**2004**	**2006**	**2004**	**2006**
	---------- **Percent** ----------			
Stage1	24.8	26.5	11.8	21.0
Stage2	47.1	45.0	77.0	70.8
Stage3	29.1	28.5	11.2	8.1
Dinner	36.7	37.8	37.0	32.7
Vegetable	30.0	27.9	22.9	25.5
Fruit	35.3	34.2	39.1	41.8
Supermarket	71.1	64.3	82.2	83.1
Discount store	21.1	24.6	11.8	6.8
Convenience store	0.7	1.0	0.2	0.4
Other store	7.1	10.0	5.8	9.7
Promotional sale	26.5	24.7	25.3	29.6
Multi-pack	16.4	23.7	0.5	12.9

Source: Nielson Homescan Data, 2004 & 2006.

Table 3. Hedonic Pricing Results for Strained Baby Food, 2004 and 2006

	2004		2006		Transition	
Variable	Coefficient	Std. Err.	Coefficient	Std. Err.	Coefficient	Std. Err.
Constant	13.67**	0.44	12.88**	0.52	13.67**	0.44
Year06	--		--		-0.80	0.68
Household Characteristics						
Income	0.12**	0.04	0.05	0.04	-0.07	0.06
Married (employed)	-0.24	0.24	-0.26	0.29	-0.02	0.38
Married (at-home)	-0.22	0.22	-0.11	0.29	0.11	0.37
High school or less	0.08	0.22	0.08	0.29	0.01	0.36
Some college	0.23	0.21	0.19	0.22	-0.03	0.30
Age less than 40	0.51	0.27	0.28	0.29	-0.24	0.40
Age between 40 – 64	0.05	0.26	0.34	0.21	0.29	0.34
African-American	0.28	0.25	0.47	0.27	0.19	0.37
Hispanic-American	-0.03	0.22	0.21	0.24	0.24	0.32
Asian-American	-0.01	0.47	-0.22	0.34	-0.21	0.58
Others	0.06	0.38	-0.15	0.49	-0.20	0.62
Market Factors						
Spring	-0.08	0.17	0.30*	0.15	0.38	0.23
Summer	-0.01	0.15	0.10	0.14	0.11	0.21
Fall	-0.20	0.13	0.14	0.13	0.35	0.19
Northeast	0.65*	0.28	0.72**	0.27	0.06	0.39
Midwest	0.60**	0.21	0.18	0.26	-0.42	0.33
West	0.82**	0.21	0.53*	0.26	-0.30	0.34
Urban	-0.01	0.19	-0.16	0.24	-0.15	0.31
Convenience store	1.59**	0.56	2.68**	0.59	1.09	0.81
Discount store	-0.86**	0.18	-0.98**	0.21	-0.12	0.28
Other store	-1.23**	0.28	-0.87**	0.27	0.36	0.39
Multi-pack	-2.13**	0.20	-0.31	0.21	1.81**	0.29
Promotion	-2.48**	0.13	-2.25**	0.14	0.23	0.19
Product Attributes						
Vegetable	-2.70**	0.19	-1.62**	0.15	1.08**	0.24
Fruit	-3.38**	0.18	-2.38**	0.17	0.99**	0.25
Stage1	5.88**	0.19	5.10**	0.24	-0.78**	0.30
Stage3	0.59*	0.17	2.44**	0.21	1.85**	0.27
Organic	1.64**	0.42	3.49**	0.30	1.85**	0.52
Organic×Vegetable	2.83**	0.30	1.96**	0.25	-0.87*	0.39
Organic×Fruit	3.75**	0.35	2.35**	0.31	-1.39**	0.47
Organic×Stage1	-2.25**	0.39	-1.19**	0.39	1.06	0.55
Organic×Stage3	-1.07**	0.46	-2.23**	0.44	-1.16	0.64
R^2	0.213		0.262		0.234	
No. observations	78,329		62,890		141,219	

Note: ** and * indicate the estimated coefficients are significantly different from zero at least at the 1 percent and 5 percent significance level, respectively.

Table 4. Average prices and associated premiums in cents per stage 2 baby food (4 oz.), 2004 & 2006.

	Conventional		Organic	
Content	**2004**	**2006**	**2004**	**2006**
	---------- Average Prices[a] ----------			
Dinner	53.40	46.93	61.61	65.64
Vegetable	44.88	44.66	62.34	65.31
Fruit	44.35	47.72	62.84	65.75
			-------- Market Shares[b] --------	
Dinner			11.04	8.53
Vegetable			6.57	6.23
Fruit			15.11	13.72
			----- Estimated Premiums[c] -----	
Dinner			6.56	13.96
Vegetable			17.87	21.78
Fruit			21.55	23.37

[a] All prices are in cents per stage two (4 ounce) container. Average prices were constructed using the Nielsen projection factor.
[b] Organic market shares are in percent—ratio of the quantity of organic baby food relative to the purchase of conventional baby food.
[c] Premiums (cents per 4 ounce jar) are calculated using estimated coefficients from Table 3 and inflated by 4 ounces.
Source: Nielsen Homescan, 2004 and 2006.

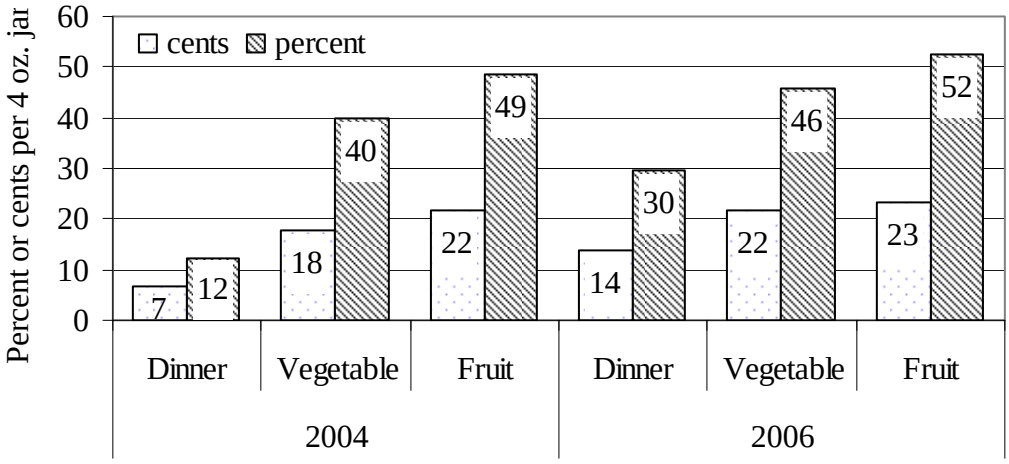

Figure 1. Organic price premiums: Stage 2 (4 ounces) strained baby food.
Note: Premiums reflect the percent above their respective average actual conventional baby food prices within each food content category found in Table 4.
Source: Nielsen Homescan, 2004 and 2006.