National Demand for Organic and Conventional Baby Food

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Future growth of organic production methods in the United States is linked to the rate at which consumer demand for organic foods continues to expand. While retail sales of organic foods have grown at around 20 percent annually during the 1990's, the market share of organic foods has remained small at less than 3 percent. Whether organic foods will expand beyond this niche market to account for more than 5 or 10 percent of retail food sales remains uncertain. A growing variety of organic foods has become increasingly available at mainstream supermarkets as traditional food manufacturers have acquired organic food companies and promoted their own organic lines of products. But high prices of many organic foods relative to conventional counterparts have inhibited growth in organic market share.

Consumers have many reasons for buying organic food products. Environmental and social concerns motivate some consumers to buy organic foods. Concerns about personal and family health stimulate others to purchase organic foods as a way to reduce their dietary exposure to pesticides and other agricultural chemicals. Scientific studies documenting the health impacts of dietary exposure to pesticides are relatively limited (e.g. Juhler et al.) But since the early 1990's, the concern about dietary exposure of infants and young children to pesticides has grown (National Research Council; Environmental Working Group, 1995). Consistent with this concern for children's health, the Food Quality Protection Act of 1996 mandated that the Environmental Protection Agency should take a conservative approach to pesticide regulation by requiring a ten-fold margin reduction of pesticides tolerances in food when scientific evidence on toxicity is inconclusive. The Pesticide Data Program (PDP) administered by the Agricultural Marketing Service now collects data on pesticide residues in foods most likely consumed by infants and children (U.S. Department of Agriculture, 2001).

Consumer and environmental groups have analyzed PDP data to make their own inferences about safety of food for infants and children among others (Consumers Union; Environmental Working Group, 1998). The continued public policy and scientific concern over dietary exposure of infants and young children to pesticides suggests consumers may be more concerned about what their babies and toddlers ingest than what they as adults ingest.

An important question is whether growing concerns about dietary exposure of infants to pesticides translate into observable market behavior In particular, do organic baby foods exhibit marked growth in sales and expanding market shares relative to conventional baby foods? Circumstantial evidence suggests organic baby foods have gained prominence during the 1990's. Market share of organic baby foods was estimated at 2.5% in 1995 (Harris) while market shares of many other organic foods was less than 1 percent. In 1999, sales of organic baby cereals and teething biscuits grew at 60.5% while sales of organic baby juice gained by 202.1% (Berman). Mainstream food manufacturers have recognized this growth potential: H.J. Heinz acquired *Earth's Best* baby food in March 1996 and Gerber introduced its *Tender Harvest* line of organic baby foods in October 1997 (Groves). Yet the evidence about growth in organic baby foods remains piecemeal and anecdotal.

The purpose of this paper is to analyze the trends in consumption of organic and conventional baby food during the 1990's by estimating a demand system to calculate key price elasticities. We employ two distinct samples drawn from separate sources of national scanner data. These data and econometric modeling permit us to make inferences about substitution between organic and conventional baby foods at the national level as well as own-price response of selected baby food categories.

Changes in the Organic Food Industry

The value of organic food sales in 2000 has been estimated at $7.8 billion, a 20% increase over 1999 sales of $6.5 billion (Myers and Rorie). This recent growth has been propelled by the enhanced availability of organic food items in mainstream supermarkets, and by the entrance of traditional food manufacturers such as General Mills, Kellogg Co., Mars, Inc., H.J. Heinz Co, and Gerber into organic food markets. In 2000, nearly half (49%) of all organic foods were purchased at mainstream supermarkets with another 20% bought at two natural food chains, Wild Oats and Whole Foods (Myers & Rorie). The manufacture, distribution, and promotion of organic foods by traditional manufactures in mainstream supermarkets is an important development because it signals an increase in shelf space and prominence of organic food items in venues where the majority of consumers shop regularly.

Growth in baby food sales and consumption has paralleled the evolution of all organic food sales. The first processor of organic baby foods, *Earth's Best*, began as a small firm in 1988 selling its products mainly in health food stores (Harris). Recognizing the growth potential of organic baby food, H.J. Heinz, Inc. acquired *Earth's Best* and its 46 SKU's (stock keeping units) in March 1996. Prior to this acquisition, many traditional food manufacturers were reticent to promote organic lines of their products lest they imply that their conventional lines of the same products were unsafe or contaminated. Gerber, the single largest manufacturer of baby food in the United States with a market share of 65%, introduced its own line of 10 organic baby food items under the *Tender Harvest* brand name in October 1997 (Groves). *Tender Harvest* has expanded its line to include 22 flavors of baby food in 4 oz. jars.

The entrance of Gerber into the organic baby food market nearly guarantees national exposure for *Tender Harvest* because Gerber's products are available in 90% of U.S.

supermarkets. Gerber's main competitors, Beech-Nut and Heinz distribute nationally with market shares 17.4% and 15.4%, respectively, but each firm has smaller shares in some regional markets. As one of the most trusted national brands of food, Gerber enjoys secure shelf space in most supermarkets. Beech-Nut and Heinz, on the other hand, pay slotting and pay-to-stay fees in order to maintain shelf space (U.S. Court of Appeals).

Scanner Data and Baby Food Categories

The growing availability and purchase of organic foods at mainstream supermarkets makes the use of scanner data increasingly appropriate for estimating trends in organic baby food consumption. We use two separate sources of scanner data: ACNeilsen and Information Resources, Inc. (IRI). Both firms purchase scanner data from grocery stores with annual sales of $2 million or more. Their coverage of supermarkets throughout the United States differs: ACNeilsen encompassed 3,000 stores while IRI collected data form 13,000 supermarkets. While the types of sales information both collect are similar—universal product code (UPC), dollar sales, unit prices, and volume sold—the information about product attributes differs between ACNeilsen and IRI. The ACNeilsen data are available monthly from April 1988 to December 1996 while the IRI data are reported at four-week intervals from August 1996 through December 1999. Due to the differences in national coverage, information available on product attributes, and reporting intervals, splicing the two data sets together is not feasible. As a result, in the following analysis, two separate samples were employed.

Because scanner data report minute details about different aspects of a product such as container type and size, flavors, manufacturer, brand, and various other attributes, decisions about what products to group into categories for analysis must be made. Baby foods are typically targeted towards infants and toddlers by age and stage of development. All three conventional brands—Gerber, Beech-Nut, and Heinz—segment their products according to three stages. Single ingredient wet cereals, vegetables, and fruits in 2.5 ounce jars are marketed as "first" foods. As quantities of food consumed by infants increase and tastes for multiple ingredients develop, larger jars with multiple ingredients including meats, pasta, and other ingredients are promoted as "stage II" foods. The third stage foods targeting toddlers usually have chunks of food and come in larger size jars or plastic tubs. These three stages of baby food constitute distinct market segments.

For defining product categories relevant to organic baby foods, we chose to exclude all products that were not shelf stable. Frozen baby foods are a growing organic category but sales are relatively small with few manufacturers competing. Dry cereals, teething biscuits, cookies and the like were also excluded because not all manufacturers selling these dry items also sell baby food in jars. Dry cereals require a modicum of preparation whereas wet cereals in jars are ready to eat. Although teething biscuits are edible, their main purpose is to assuage teething pain. Hence, the products examined were limited to those ready-to-eat foods sold in jars.

The size of jars available can usefully be divided into three categories: smaller than 4 oz.; 4 to less than 6 oz.; and 6 oz. and larger. Interestingly, only one organic baby food manufacturer has consistently offered items in each of these three size categories. The majority of the other manufacturers' organic baby food items have been available only in 4 or 4.5 oz. jars. As table 1 indicates, about 90% or more of organic baby foods were sold in 4 or 4.5 oz. jars. Conventional baby foods, by contrast, are available in a larger array of sizes, with 4 or 4.5 oz. jars accounting for just over half of sales. Hence, for subsequent analysis of organic and conventional baby foods, data corresponding to sales in jars from 4 to less than 6 oz. size are employed.

Having identified the relevant container size for organic baby foods, the categories of types and flavors of foods must also be chosen. Most baby food manufacturers divide their offerings into the following broad categories: dinners, fruits and deserts, vegetables, wet cereals, and juices. As mentioned before, single-ingredient foods are often promoted as appropriate for an infant's first foods but infants and toddlers of any age may also consume these foods. Instead of trying to segment the categories by number of ingredients and flavors, we aggregated all items falling into the five categories mentioned. Wet cereals in 4 or 4.5 oz. jars were not available during the first sample periods so we are unable to include wet cereals in the ACNeilsen sample.

Market Shares of Organic Baby Food

Only ACNeilsen scanner data contain information on the percentage of stores carrying items in a given month. Table 2 displays annual average availability of the categories of organic baby food selected. From the late 1980's through the mid-1990's organic baby food became steadily more available, reaching as many as a quarter of supermarkets nationally. This availability is remarkable because it occurred before the two traditional food manufacturers, H.J. Heinz and Gerber, entered the organic baby food market. The percentage of supermarkets carrying organic baby foods is also much higher than that carrying organic fluid milk, an organic product that experienced substantial growth in the mid-1990's (Glaser and Thompson).

Although availability of baby foods at mainstream supermarkets is probably necessary for growth beyond a niche category, it does not guarantee larger market shares if organic prices are substantially higher than those of conventional baby foods. Table 3 displays annual average price premiums for the five categories chosen. When first introduced in 1988, most baby foods were twice as expensive as conventional items. By about 1995, price premiums for dinners and fruits had declined to approximately half again as expensive as conventional counterparts.

Vegetables and juices remained relatively more expensive until 1998 and 1999. During the last three years of the 1990's, which coincide with the IRI scanner sample, organic price premiums for each of the four categories declined.[3] These declining premiums are not inconsistent with more competition between traditional baby food manufacturers having entered the organic market or with enhanced economies of scale on the part of traditional manufacturers.

Although the causes are not evident, the declining price premiums of organic baby food were due in large measure to more rapid increases in nominal prices of conventional baby food. In figure 1 the increasing trend in the nominal price of conventional baby food dinners generally exceeds the trend in nominal organic prices. Similar trends in relative price increases were found for fruits, vegetables, and, to a lesser extent, juices. In general, the temporal decline in organic price premiums has occurred as organic prices have not increased as rapidly as those of conventional baby foods.

Analysts familiar with scanner data might suggest that the percentage of products sold at reduced price due to, say, sales and coupons could affect the price comparisons between organic and conventional baby foods. ACNeilsen and IRI data did not contain useful evidence for judging the volume of organic and conventional baby foods sold with at discounted prices. We do note, however, that Hosken, Matsa, and Reiffen found baby foods were one of the categories least likely to be placed on sale among various food items and categories studied at retail. Hence, the price series from ACNeilsen and IRI likely represent the nominal retail prices the majority of consumers faced over the sample periods.

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[3] One-tailed t-tests for differences in organic versus conventional prices were calculated using both ACNeilsen and IRI samples. In every case, average organic prices were found to exceed their conventional counterparts with statistical significance. Space considerations preclude us from reporting the full results here.

Market shares of organic baby foods have climbed steadily since their introduction in 1988. Market shares displayed in table 3 were calculated using volume sold. In value terms, organic market shares are even higher because their unit prices are higher than those of conventional items. Organic baby food dinners have captured the largest market share measured in volume terms of 13 % in 1999. Organic vegetables and fruits have smaller shares, around 5% while juices accounted for less than 2.5% of volume in 1999. The small market share of juices is likely due to more limited availability at supermarkets. The smaller shares of vegetables and fruits compared to dinners are apparently not due to differences in availability or price premiums across these organic categories. Dinners likely embody more convenience because of multiple ingredients often including meats and carbohydrates in a single jar. Parents may be more likely to prepare fruits and vegetables at home because cooking and pureeing a single fruit or vegetable is relatively easy compared to preparing a dinner. Unfortunately, we have no household data to test this hypothesis of relative convenience.

Econometric Analysis

The foregoing descriptive analysis suggests that while organic baby foods have gained considerable market share during the 1990's, there are differences in the rates at which sales of organic baby foods have grown relative to conventional ones. In this context, an econometric model of demand can be used to estimate aggregate consumer responsiveness to changes in prices and expenditures. To that end, we chose the quadratic almost ideal demand system (QUAIDS) developed by Banks, Blundell, and Lewbel. The QUAIDS model has a number of theoretically desirable characteristics: it is a rank three demand system capable of generating nonlinear Engel curves and it nests the popular almost ideal demand system of Deaton and Muellbauer.

For exposition of the QUAIDS model, our notational conventions are as follows: at time period *t*, define the unit price and quantity of the i[th] good as p_{it} and q_{it}, respectively, with expenditure on all *m* goods considered given as $x_t \equiv \sum_{i=1}^{m} p_{it} q_{it}$. The expenditure share of any particular good is $w_{it} \equiv \frac{p_{it} q_{it}}{x_t}$. The QUAIDS model we estimate is

$$(1) \qquad w_{it} = \alpha_i + \sum_j \gamma_{ij} \ln p_{jt} + \beta_i \ln\left[\frac{x_t}{a(p_t)}\right] + \frac{\tau_i}{b(p_t)}\left\{\ln\left[\frac{x_t}{a(p_t)}\right]\right\}^2 + \varepsilon_{it} \quad i = 1,\ldots,m$$

where $\ln a(p_t) = \alpha_0 + \sum_j \gamma_{ij} \ln p_{jt} + 1/2 \sum_i \sum_j \gamma_{ij} \ln p_{it} \ln p_{jt}$ and $b(p_t) = \prod_j p_{jt}^{\beta_j}$. The system is nonlinear in the parameters $\alpha_i, \beta_i, \gamma_{ij}$, and τ_i but is conditionally linear given values of $\ln a(p_t)$ and $b(p_t)$. Blundell and Robin (1999) have developed an estimator which exploits this conditional linearity without having to use some index for $\ln a(p_t)$ or $b(p_t)$. For estimation purposes, the parameter α_0 was set at a value slightly less than the minimum the log of real expenditure in the samples (Banks, Blundell, and Lewbel; Deaton and Muellbauer). Note that if $\tau_i = 0 \ \forall i$, (1) reduces to the familiar AIDS model. The following parameter restrictions may be tested and imposed.

Symmetry: $\gamma_{ij} = \gamma_{ji} \ \forall i, j$

Homogeneity: $\sum_j \gamma_{ij} = 0 \ \forall i$

Adding-Up: $\sum_i \alpha_i = 1, \ \sum_i \gamma_{ij} = \sum_i \beta_i = \sum_i \tau_i = 0$

A few observations about the specification of the QUAIDS model in (1) are in order. First, the model does not embody any habit-persistence mechanisms because the duration of an infant's consumption is relatively short lived. Hence, a static formulation should be adequate to capture parents' preferences for baby food purchases. Second, prices of baby food are taken as weakly exogenous or predetermined because baby food manufacturers and supermarkets establish the prices at which consumers must decide to buy baby foods. Given that the scanner data measure actual retail prices and are reported at relatively short intervals—months or 4-week periods—the assumption of predetermined or weakly exogenous prices appears reasonable and obviates the need to consider an inverse demand system. Third, total expenditure, x_t, would likely be endogenous, suggesting that a suitable estimation procedure would account for the endogeneity. Last, the error terms, ε_{it} , may not be normally distributed, and given the time-series nature of the data, serial correlation is likely present. Accordingly, we choose a generalized method of moments (GMM) estimator to account for the potential endogeneity of expenditures, and nonnormality and serial correlation of the errors (Blundell and Robin (2000); Banks, Blundell, and Lewbel).

We assume weak separability of the five categories of goods consumed. While we might consider more elaborate separability structures, for this analysis of ten aggregate baby food categories—five food categories for each organic and conventional—there appears to be little to gain from applying latent separability, for example (Blundell and Robin (2000)).

Estimation of a demand system with organic wet cereals was precluded with the ACNeilsen sample because organic wet cereals did not become available until October 1994. There was also a gap in availability of organic juices from February 1989 through January 1990. Expenditure shares for a few of the other categories of organic baby food were miniscule in the early sample period, smaller than 1 x 10^{-5}. Given these characteristics of the early sample period, estimation of the (1) was conducted with 60 observations from January 1992 through

December 1996. All quantities of baby food were expressed in per capita terms using the population of infants younger than two years of age (see table 1).

Some own-price elasticities resulted positive at sample means when vegetables or juices were included in the ACNeilsen sample. A small number of own-price elasticities were also positive when dinners were included using the IRI sample. The results reported hereafter include the following categories of baby food: dinners and fruits/desserts in the ACNeilsen sample; and fruits/desserts, vegetables, juices, and wet cereals in the IRI sample. Positive own-price elasticities for a subset of goods indicate violations of concavity at some sample points. Concavity could be imposed for the nested AIDS model (Moschini) but imposition of concavity in the more general QUAIDS model has yet to be developed.

Symmetry and homogeneity were tested in both samples while maintaining additivity. The test results reported in table 4 suggest that when the number of parameters estimated is small relative the length of the time series as in the ACNeilsen sample, homogeneity is not be rejected at the 1% significance level. Using the small sample corrections due to Pudney, symmetry would not be rejected either. However, jointly symmetry and homogeneity are rejected. When the number of parameters estimated is large relative to the length of the time series as in the IRI sample, all three hypotheses are rejected at the 1% level even when small sample adjustments are made. Despite the rejection of the joint hypothesis of symmetry and homogeneity in both samples, these two sets of restrictions are imposed for consistency with consumer theory and for purposes of comparison across the two samples.

As the AIDS model is nested within the QAIDS model, tests of the null hypotheses $\tau_i = 0 \; \forall i$ in (1) with symmetry, homogeneity and adding-up imposed were performed in both ACNeilsen and IRI samples. In both samples, the majority of the individual estimated parameters $\hat{\tau}_i$ exhibited low asymptotic t-statistics. In the ACNeilsen sample, the null hypothesis of the AIDS model could not be rejected ($\chi^2_{(3)} = 3.017$, p-value = 0.389). In the IRI sample, however, the null of the AIDS was rejected at typical levels ($\chi^2_{(7)} = 21.221$, p-value = 0.003) although with Pudney's small sample adjustments the null would not be rejected ($\chi^2_{(7)} = 12.691$, p-value = 0.199). In these two samples, the empirical evidence in favor of the QUAIDS over the AIDS model is not especially compelling. Nevertheless, the following analysis is based on estimates of the QUIADS model with symmetry, homogeneity and adding-up imposed

Parameter estimates are not reported due to space considerations. Instead, own- and cross-price as well as expenditure elasticities and their respective standard errors are displayed in tables 5 and 6.

Own-price elasticities exhibit a number of regularities. Purchases of organic baby foods are highly own-price sensitive. In most cases, the absolute value of own-price elasticities has declined over time as price premiums have diminished and market shares have increased (figures 2 and 3). The absolute magnitude of the elasticities is not especially large compared to elasticities estimated from scanner data at the product level or the store level. For national data, however, the own-price elasticities are large in absolute value, suggesting that any reductions in retail price—whether due to retail competition, economies of scale in manufacture and distribution, or reduced raw product costs are organic yields increase and unit production costs decline—will elicit sizable increases in organic baby food purchases. The declining absolute value of own-price elasticities over the sample periods emphasizes the fact that as market shares of organic baby foods increase, reductions retail price will have relatively less effect on aggregate purchases.

Purchases of conventional baby foods, by contrast, display little if any sensitivity to own-price changes. The absolute value of own-price elasticities that are distinguishable from zero range from around 0.75—vegetables in the IRI sample—to as low as 0.15—fruits/desserts in the ACNeilsen sample. The lack of precision in some of the elasticity estimates for conventional baby food categories makes it impossible to distinguish them from zero, suggesting no discernable change in consumption as own-prices change. The near lack of own-price response for purchases of conventional baby foods has two plausible explanations: (i) nominal prices exhibit relatively small variations over time which is consistent with very infrequent discounted prices due to sales or coupons (Hosken, Matsa, and Reiffen); and (ii) once parents identify particular baby foods their infants like, parents appear likely to continue purchasing those items despite the infrequent price fluctuations. Although shelf-stable baby foods can be bought in large quantities and stored when retail prices are reduced, there is no evidence at the national level of stockpiling behavior.

One parenthetical remark about the magnitudes of the elasticities across the two samples is worth making. Although the two samples could not be spliced for various reasons, it is perhaps surprising that some of the estimated elasticities coincide as closely as they do. In figure 4, for example, the own-price elasticities estimated for fruits and desserts track very closely with one another through time. Not all other elasticities coincided as closely but the results in figure 4 at least provide some evidence that despite differing samples and hypothesis test results, essentially compatible information can be estimated from the two samples.

The magnitudes of cross-price elasticities from both samples display distinct patterns. Within a given category of baby food, say, dinners, the quantity purchased of the organic item is highly sensitive to a change in the price of the conventional counterpart. Conversely, however, purchases of the conventional item are relatively insensitive to changes in the price of the organic counterpart. In all but one case—vegetables in the IRI sample—the signs of the elasticities statistically different from zero suggest that pairs of conventional and organic items are substitutes.

The asymmetry in the magnitudes of the cross-price elasticities for pairs of conventional and organic baby foods reflects asymmetries found in cross-price elasticities for other conventional and organic foods (Glaser and Thompson 2000, 1999). One reason for the asymmetry in elasticity values is due to the fact that the elasticity formulae contain expenditure shares in the denominator, namely, $e_{ijt} = \left[\partial w_{it} / \partial \ln p_{jt}\right] / w_{it} \;\; i \neq j;\; t = 1, 2, \ldots, T$ (see Banks, Blundell, and Lewbel for the details of the derivative $\partial w_{it} / \partial \ln p_{jt}$). In cases where w_{it} is quite small (e.g. 0.0001 for organic items) while w_{jt} is correspondingly large (e.g. 0.45 for conventional items), as occurs in both samples, one elasticity of the pair is very large compared to the other. As the expenditure share values of organic foods increase through the sample period, the values of cross-price elasticities tend to decline slightly towards the end of the sample.

An heuristic interpretation of the asymmetry in the values of the cross-price elasticities could be that because organic prices are high relative to conventional prices, a given percentage increase in the organic price has little effect on the majority of consumers who already view organic prices as high. The same percentage increase in the organic price elicits little reaction from the minority of consumers who have decided to purchase organic products despite their relatively high prices. Presumably, the small minority who are repeat purchasers of organic items either face less constraining budgets or their preferences are such that organic items confer significantly higher utility than conventional counterparts. Conversely, percentage increases in conventional prices tend to elicit rather large increases in organic purchases. The asymmetry in cross-price elasticities can be stated succinctly as follows: price increases of organic baby foods do little “drive away’ current purchasers of organic products while increases in the prices of conventional baby foods have sizable effects in spurring consumers to purchase organic baby foods.

The estimated values of expenditure elasticities tend to vary erratically across the baby food items in both samples, from –4.768 to 5.444. Perhaps the only regularity displayed by the expenditure elasticities is that nearly all are statistically indistinguishable from zero. Hence, the apparently large negative and positive estimates of the expenditure elasticities are better viewed as simply too imprecise to be different from zero. Given the nature of baby food purchases, zero expenditure elasticities seem plausible. Allocation of a larger portion of a household budget to baby food expenditures likely has little effect on the purchase of individual baby food categories because infants tend to have distinct preferences for particular food items. Also, parents are generally concerned about providing their infants with a nutritious, balanced diet which would preclude purchasing more items in one food category like dinners or juices as total baby food expenditures increase. Finally, all items contained in each of the baby food categories are ready-to-eat foods so there is little scope for introducing “luxury” items as total baby food expenditures grow.

Summary and Conclusions

National scanner data from two commercial sources were uses to assemble samples of conventional and organic baby foods. Given the dizzying array of baby food products, shelf-stable foods sold in mid-size jars—4 or 4.5 ounce—were selected because over 90% of organic baby foods were sold in those jars during the sample periods. Particular baby food items were aggregated into five broad categories of foods: dinners; fruits and desserts; vegetables; wet cereals; and juices.

Descriptive analysis of the two samples indicates market shares of baby food dinners have grown more rapidly than all other categories. Even so, most baby food categories have attained market shares vis-à-vis conventional baby foods that exceed market shares of nearly all other organic foods sold at retail. The relatively large market shares attained by baby foods at the end of the decade of the 1990's provide indirect evidence that consumers apparently are willing to pay more for reducing the dietary exposure of infants to pesticides than for the dietary exposure of adults.

Elasticity estimates for a quadratic almost-ideal system of expenditure shares of organic and conventional baby foods revealed distinct patterns in consumer reactions to prices. Future decreases in organic baby foods could result in large increases in organic baby food purchases, yet decreases in conventional baby food prices will likely have almost no effect on conventional baby food purchases. These own-price elasticity results suggest that any source of reductions in retail prices or organic baby foods—increased competition between baby food manufacturers, scale economies achieved in manufacture, distribution, and marketing, or lower costs of raw food products due to cost-reducing innovations in organic crop and livestock production—will likely result in noticeable increases of organic market shares. By contrast, any decreases in conventional baby food prices will have little observable effect on conventional market shares. This lack of own-price effects is perhaps surprising for consideration of branded products at retail. However, given the level of aggregation across brands used in this study, the lack of own-price effects likely occurs because consumption of baby foods by infants is short lived and baby foods are seldom placed on sale or sold with coupons.

The cross-price elasticity estimates suggest, on the other hand, that reductions in organic prices will elicit limited substitution away from conventional products. However, as market shares grow over time the substitution effects can be expected to increase. Any increases in conventional baby food prices will, however, tend to boost purchases of organic baby foods by a relatively larger amount.

Finally, the expenditure elasticity estimates suggest no observable impact of increase baby food expenditures on specific categories of baby foods like dinners, fruits, or vegetables. These results likely occurred because regardless of income level and the level of the food budget allocated to baby foods, parents tend to maintain balanced diets for their infants. Also, all the baby foods considered are ready-to-eat products embodying convenience and portability. There are no "luxury" baby foods in this regard.

Although per capita consumption of baby foods is obviously small compared to per capita quantities of foods consumed by adults, the baby food market represents the fastest growing market among all organic foods sold at retail. Consumer demand for organic baby foods will likely be sufficient to support a small but growing derived demand for organic raw inputs such as meats, grains, fruits, and vegetables. The apparent concern expressed by some parents about reducing the dietary exposure of their infants to pesticides has indeed translated into observable consumer behavior. Agricultural producers, manufactures, distributors, and retailers of organic baby foods have reason to be optimistic about future growth of demand for their products.

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Table 1. Selected Characteristics of Baby Food Sales and Consumption[a]

Calendar Year	U.S. Population, Under 2 Years of Age (Millions)[b]	Volume of Baby Food Sold (Million Pounds)[c]	Baby Food Sales, Nominal Dollars (Millions)	"Per Capita" Baby Food Consumption (lb./person)	Organic Baby Food Sold in 4-<6 oz. Jars (%)	Conventional Baby Food Sold in 4-<6 oz. Jars (%)
1988[d]	7.39	428.6	499.6	58.02	100.0	71.4
1989	7.53	572.1	737.7	75.98	100.0	57.0
1990	7.78	583.4	793.4	74.96	100.0	56.8
1991	7.95	584.2	836.5	73.46	100.0	55.3
1992	7.95	572.9	863.3	72.05	100.0	54.6
1993	7.86	561.5	886.3	71.48	100.0	53.7
1994	7.74	555.5	888.0	71.77	99.7	54.0
1995	7.64	538.6	889.9	70.49	93.4	52.9
1996	7.56	508.8	847.5	67.29	90.0	53.8
1997	7.52	466.6	813.3	62.02	89.0	53.7
1998	7.54	439.4	809.8	58.31	93.3	52.0
1999	7.58	428.7		56.55	95.4	52.8

[a] Volume and sales for 1988 through 1992 are from ACNielsen. Volume and sales for 1993 to 1999 are from Information Resources, Inc..

[b] United States Department of Commerce. U. S. Census Bureau, *U.S. Population Estimates by Age, Sex, Race, and Hispanic Origin: 1980 to 1999*

[c] All frozen, dry (crackers, biscuits, cookies, etc) and private label (only 3-5 upc's in both Nielsen and IRI) products were excluded. Within the shelf-stable foods, jars/tubs, assorted and meat items were excluded, leaving dinners, fruit, desserts, vegetables, juices, and wet cereals.

[d] Volume and sales figures are for April through December 1988 only.

Table 2. Availability of Organic Baby Food in Mainstream Supermarkets, All Size Jars[a]

Year	Dinners	Fruits	Vegetables	Juices
1988	0.0%	0.5%	0.5%	0.0%
1989	0.5%	2.2%	2.2%	0.0%
1990	4.5%	8.3%	8.3%	7.7%
1991	7.8%	12.4%	12.4%	13.0%
1992	13.9%	14.6%	14.6%	8.1%
1993	19.1%	18.0%	18.0%	5.2%
1994	21.6%	19.7%	19.7%	3.4%
1995	24.7%	22.3%	22.3%	7.3%
1996	27.4%	24.7%	24.7%	6.6%

[a] Percentage of supermarkets in the ACNeilsen sample carrying any kind of organic baby food in jars.

Table 3. Price Premiums and Market Shares of Organic Baby Food, 4 - <6 oz. Jars

Year	Dinners	Fruits	Vegetables	Juices
	Organic Prices as a % of Conventional Price,			
1988	123.4%	98.1%	106.5%	134.9%
1989	88.3%	71.6%	83.1%	132.7%
1990	76.3%	61.3%	69.6%	67.5%
1991	69.2%	59.2%	69.0%	60.8%
1992	58.2%	52.0%	60.0%	63.4%
1993	52.9%	49.0%	56.6%	65.3%
1994	51.1%	49.7%	56.8%	72.6%
1995	48.3%	47.5%	56.0%	72.8%
1996	51.3%	51.5%	61.7%	59.6%
1997	56.8%	68.7%	69.2%	64.3%
1998	54.8%	58.0%	57.8%	39.5%
1999	51.1%	53.3%	51.8%	35.0%
	Organic Market Shares by Volume			
1988	0.01%	0.03%	0.04%	0.001%
1989	0.2%	0.2%	0.2%	0.0001%
1990	1.4%	0.9%	0.8%	0.4%
1991	2.5%	1.3%	1.6%	0.8%
1992	4.2%	1.7%	2.2%	0.4%
1993	5.6%	2.0%	2.3%	0.3%
1994	6.9%	2.4%	2.8%	0.2%
1995	7.5%	2.7%	3.3%	0.2%
1996	7.8%	2.8%	3.6%	0.3%
1997	5.7%	3.0%	4.3%	1.0%
1998	12.5%	4.6%	6.3%	2.9%
1999	13.0%	4.5%	6.7%	2.3%

Table 4. Consumer Hypotheses Test Results

Sample/Null Hypothesis	χ^2 Value	Degrees of Freedom	p-value	Adjusted[a] χ^2 Value	Adjusted p-value
ACNeilsen Sample (n=3, T=60)					
Symmetry	25.93	6	0.0002	18.87	0.0213
Homogeneity	9.61	4	0.0475	4.87	0.4013
Symmetry/Homogeneity	51.90	10	0.0000	40.29	0.0008
IRI Sample (n=7, T=45)					
Symmetry	111.15	26	0.0000	76.12	0.0129
Homogeneity	72.19	6	0.0000	63.75	0.0000
Symmetry/Homogeneity	241.99	34	0.0000	196.92	0.0000

[a] Adjustments to χ^2 and p-values were made using Pudney's (p. 575) small sample corrections. The adjusted p-value is calculated using Pudney's k_2 factor.

Table 5. Uncompensated Elasticities at Sample Mean, ACNeilsen Data, 1992-1996

	Organic Dinners	Conventional Dinners	Organic Fruits/ Desserts	Conventional Fruits/ Desserts	Expenditures
Organic Dinners	**-2.489** (.000)[a]	**1.913** (.048)	0.245 (.702)	-2.248 (.138)	2.579 (.255)
Conventional Dinners	**0.143** (.004)	-0.154 (.377)	0.003 (.943)	**-1.722** (.000)	**1.730** (.000)
Organic Fruits/Desserts	-0.212 (.850)	0.588 (.702)	**-3.110** (.002)	0.588 (.702)	2.416 (.293)
Conventional Fruits/Desserts	**-0.029** (.000)	**-0.436** (.000)	**0.039** (.000)	**-0.165** (.000)	**0.590** (.000)

[a] P-values for test of elasticity being different from zero. Standard errors for the test were calculated by the delta method. Bold face elasticities are statistically distinguishable from zero at conventional levels of significance.

Table 6. Uncompensated Elasticities at Sample Mean, IRI Data, 4-Week Periods Ending from 08/18/96 to 1/2/00.

	Org. Fruit	Conv. Fruit	Org. Veg.[a]	Conv. Veg.	Org Juice	Conv. Juice	Org. Cereal	Conv. Cereal	Expenditure
Organic Fruit	**-2.543**	4.434							-4.768
	(.000)[b]	(.234)							(.454)
Conventional Fruit	0.065	-0.026							0.490
	(.234)	(.939)							(.451)
Organic Vegetables			**-1.584**	**-1.930**					5.444
			(.000)	(.080)					(.243)
Conventional Vegetables			-0.064	**-0.735**					1.960
			(.139)	(.045)					(.231)
Organic Juice					**-5.161**	1.471			-1.156
					(.000)	(.670)			(.961)
Conventional Juice					0.011	-0.362			3.188
					(.772)	(.379)			(.285)
Organic Cereal							0.296	**3.295**	5.294
							(.623)	(.000)	(.375)
Conventional Cereal							**0.524**	-0.171	-3.070
							(.000)	(.823)	(.361)

[a] Selected cross-price elasticities have been omitted for the sake of clarity.
[b] P-values for test of elasticity being different from zero. Standard errors for the test were calculated by the delta method. Bold face elasticities are statistically distinguishable from zero at conventional levels of significance

Figure 1. Weighted Average Prices, Organic & Conventional Dinners, 4 - < 6 oz. Jars

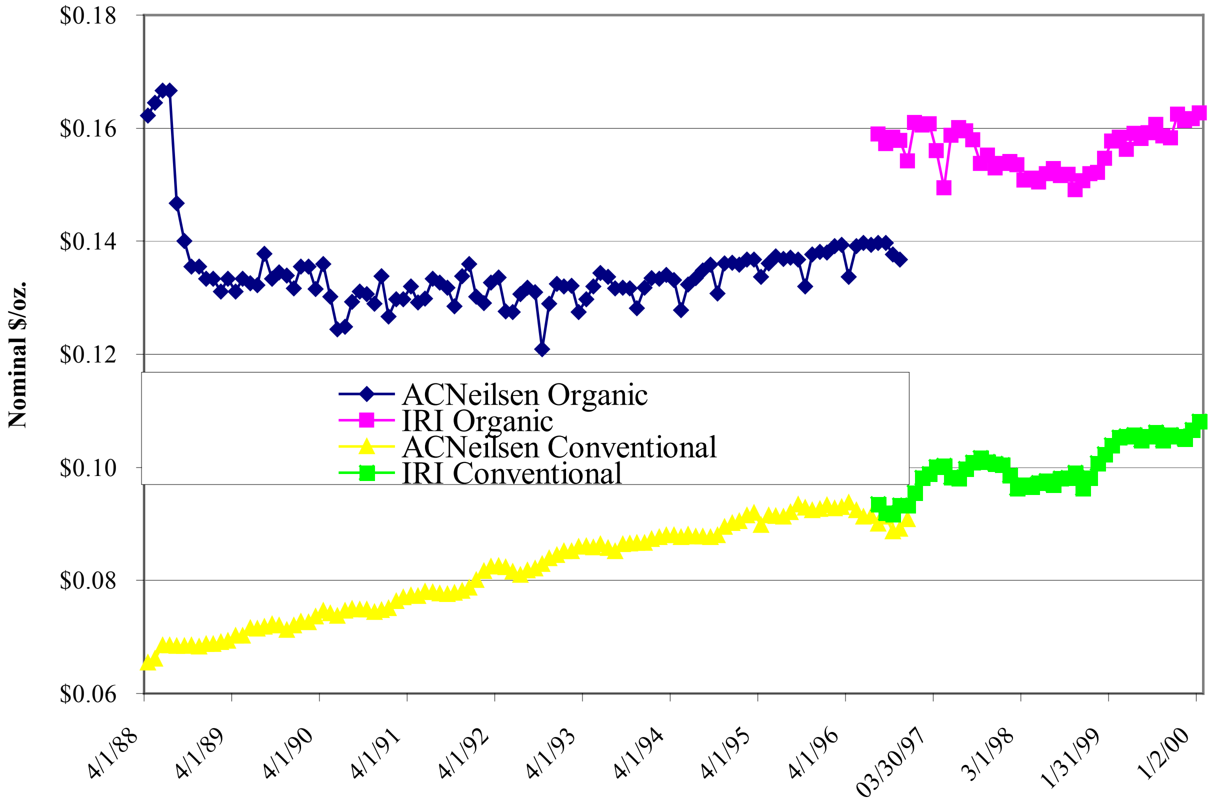
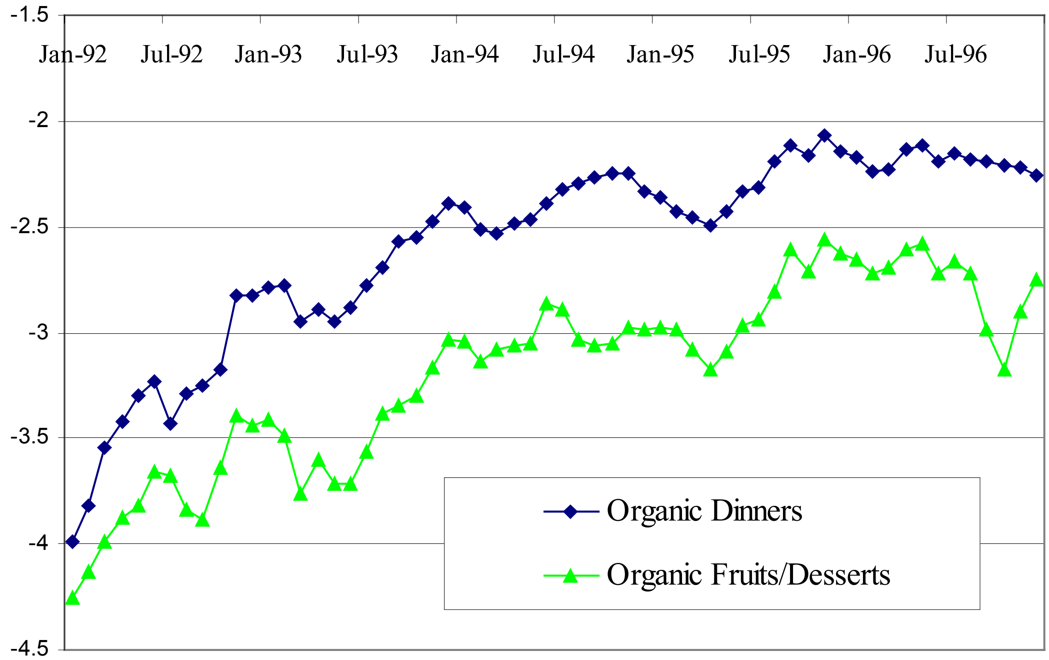


Figure 2.Uncompensated Own-Price Elasticities, ACNeilsen Data, 1992-1996



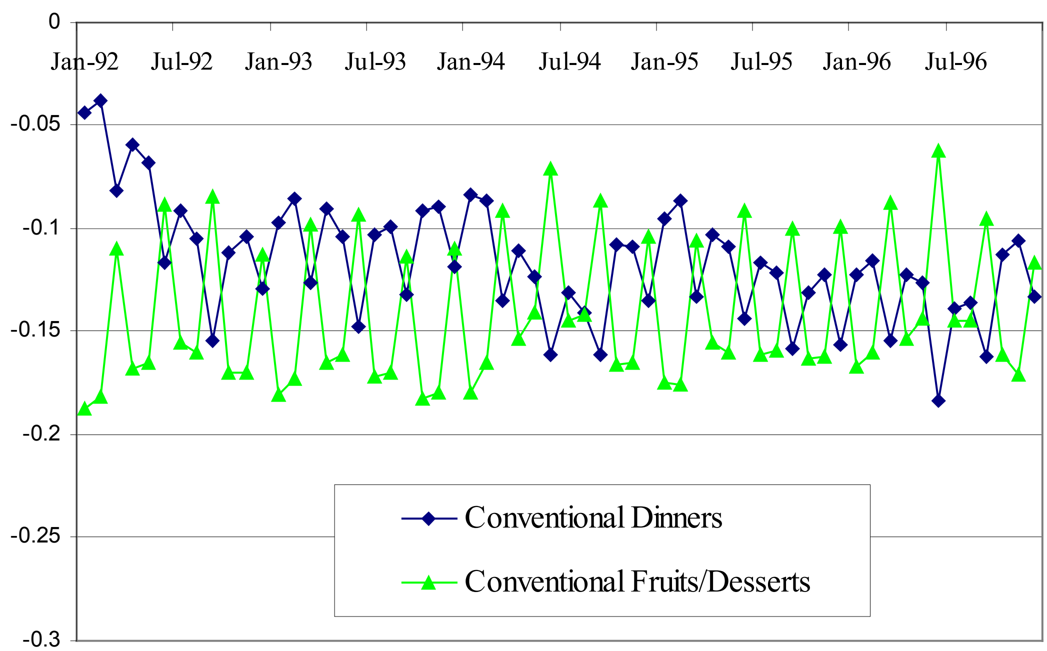


Figure 3. Uncompensated Own-Price Elasticities, IRI Data, 8/18/96-1/03/00

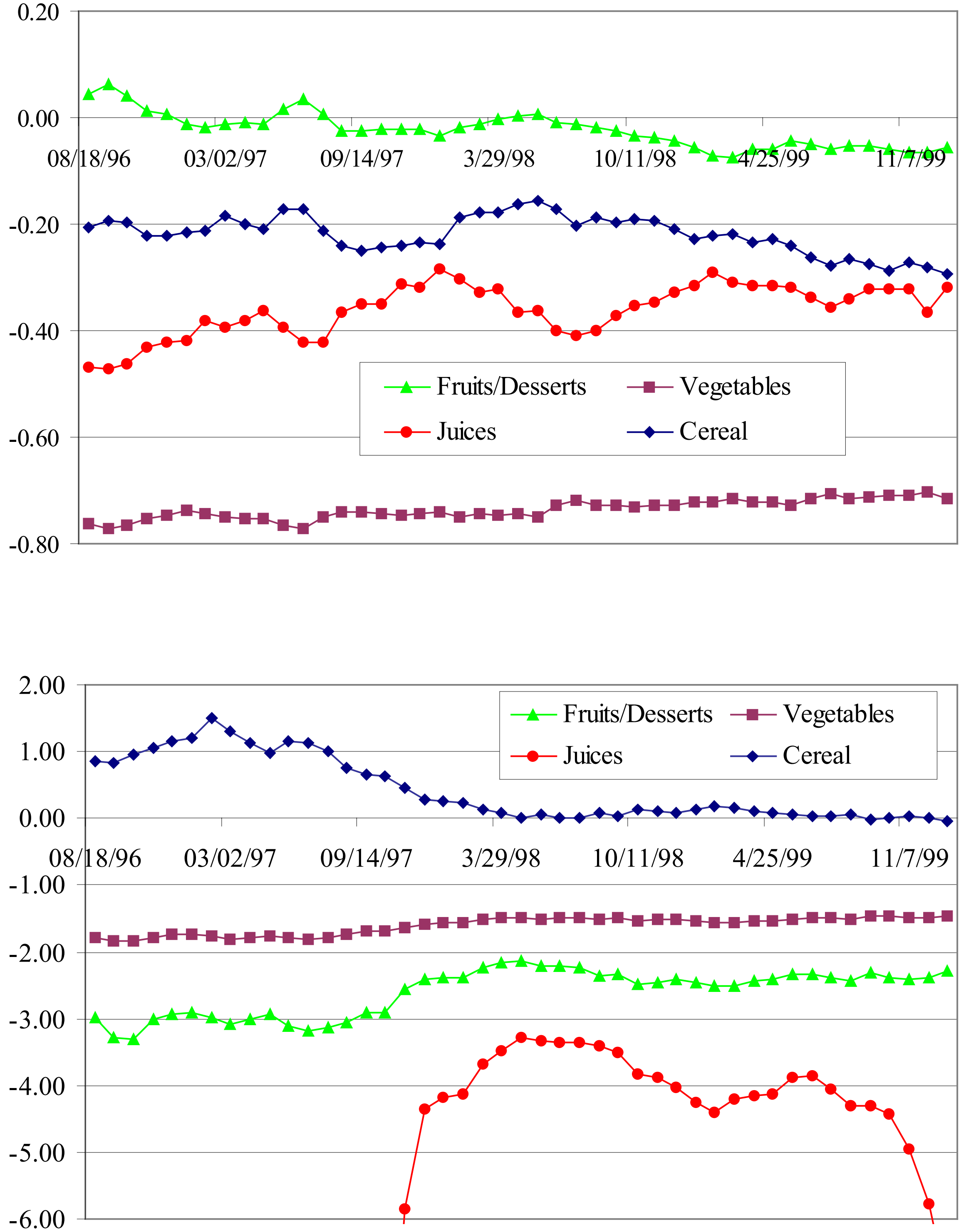


Figure 4. Comparison of Own-Price Elasticities, Organic Baby Foods, ACNeilsen and IRI Samples.