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Estimating and Investigating Organic Premiums for Retail-Level Food Products

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ABSTRACT

Using 7 years of household-level scanner data, we use a hedonic pricing model to estimate the organic price premium for four retail-level food products. In each case, we find strong organic premiums of about 30% for bagged carrots, over 40% for canned soup, over 50% for coffee, and over 70% for milk. Using the estimated results from the hedonic price model, we pool the results across products, markets, and years, and then estimate a novel second-stage model where we uncover retail-level market factors associated with higher or lower premiums. For example, we find that category-level organic sales are associated with higher organic price premiums, whereas category-level nonorganic sales are associated with lower premiums. Taken collectively, our results suggest that organic price premiums are not threatened in the near term, but that several competing factors help moderate the size of the premiums. [EconLit citations: Q130]. © 2015 Wiley Periodicals, Inc.

1. INTRODUCTION

In recent years, the organic food market has been studied intensively, and several trends are now well documented. First, the organic market continues to grow dramatically faster than the overall food market. The Organic Trade Association reports organic market annual growth that averages 7.7% for 2010, and about 19% before the 2008 recession (OTA 2011). As a point of comparison, the Organic Trade Association reports total food growth of 0.6% for 2010. Second, consumers are buying an increasing portion of organic food at traditional retail outlets, such as grocery stores, supercenters, and mass merchandisers. Market research company Mintel (2011a) reports that half of surveyed shoppers now report buying natural and organic food at traditional supermarkets; half also report buying them at mass merchandisers; and half also buy them at natural food stores. Wal-Mart, at 42%, is the most common individual retailer where shoppers buy natural and organic foods (Mintel 2011b). Third, an increasing number of food retailers are offering private label (store brand) organic products. Jaenicke, Dimitri, and Oberholtzer (2011) report that surveyed food retailers claim an increase in the percentage of total gross organic food sales accounted for by private labels from almost 5% in 2005 to 17% in 2008. Fourth, while organic consumers continue to pay a substantial premium for organic food, the premium can vary widely by product. Lin, Smith, and Huang (2008) analyze organic prices for five fruits and five vegetables using 2005 data on produce purchases and find considerable variability: Among fruits, strawberries have the highest price premium (about 42%), while grapes have the lowest (20%); among vegetables, potatoes have the highest (60%), while carrots have the lowest (15%). Collectively, these four trends suggest that the organic food retail sector continues to exhibit healthy growth, and that consumers continue to pay a premium for organic food products.

*The views expressed are those of the author(s) and should not be attributed to the Economic Research Service or USDA.

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Nonetheless, industry participants, marketers, and consumers may have a number of lingering questions about the organic market's future. While Blank and Thompson (2004) suggest that these questions about the organic sector's future prospects have been considered for a long time, new data reinforce some of the concerns. Context Marketing's (2009) report "Beyond Organic" notes that 11 product claims, including "locally grown," "sustainably produced," and "natural" all out-ranked "organic" in their importance to consumers. Context Marketing (2009) also notes that while 60% of survey respondents are willing to pay 1% to 10% more for food that is "healthier, safer or produced to higher ethical standards," only 14% of respondents are willing to pay more than 10%. Since most organic products have price premiums greater than 10% (see for example Greene et al. 2009), these results may cause concern for many organic producers or manufacturers. Mintel (2011b) reports that one in five natural or organic food buyers are buying fewer of these products in 2011 than in 2009, and one in six are switching to lower-cost alternatives within the category, including private label natural or organic products. In a related report, Mintel (2011a) reports that private label products helped drive growth in the natural or organic food sector but also warns that the rate of introductions in this category has slowed since 2007.

Taken together, the well-documented trends and the lingering concerns suggest that two significant research gaps related to the organic food sector and organic pricing remain: Very little systematic documentation of organic price premiums exists for retail-level products across diverse product types. Perhaps more importantly, there is also no systematic investigation into the determinants of organic price premium levels across retail food products. This paper aims to fill these two gaps first by estimating organic price premiums for four very different retail-level products from 2004 to 2010, and second by attempting to identify market-level factors that help explain how the organic price premiums vary over time. By addressing these two research questions with two sequential econometric models, we hope to improve the understanding of what the future holds for the organic sector and organic price premiums.

After providing some more background, presenting our empirical methods, and describing our data, we will show that organic price premiums for four diverse retail products—canned soup, packaged coffee, milk, and bagged carrots—all have substantial organic price premiums of varying degrees. Part one of this paper shows that organic premiums appear to be increasing for canned soup, decreasing for coffee, fluctuating fairly widely for milk, and holding steady for bagged carrots. In part two, we pool the organic price premium results from all four products and all 7 years to investigate nonproduct specific factors associated with increasing or decreasing premiums. For example, after controlling for some cost and demand shifters, we find that the overall size of the category, as measured by total nonorganic sales, is associated with lower organic price premiums, whereas the overall size of the organic portion alone is associated with higher premiums. Additionally, we find that the share of organic sales purchased through the supercenter channel is associated with lower organic price premiums. These and other results are explained below.

2. BACKGROUND ON ORGANIC PRICE PREMIUM ESTIMATION

Ever since Rosen (1974) introduced the hedonic pricing model, which posits that in equilibrium a product's price can be decomposed into *ceteris paribus* contributions from individual product attributes, a wide range of researchers have used it to estimate the value that individual attributes of food products contribute to a product's equilibrium price. Examples include Ahmad and Anders (2012), who examine product attributes for frozen processed chicken and fish products; Stanley and Tschirhart (1991) and Stanley, Tschirhart, and Anderson (1991), who examine breakfast cereals; Ward, Lusk, and Dutton (2008), who examine retail-level ground beef; Huang and Lin (2007), who examine fresh tomatoes, and Martínez-Garmendia (2010) who examine carbonated soft drinks.

When an organic claim is treated as a product attribute, and when the market for organic products is in equilibrium, then Rosen's (1974) hedonic pricing model can be applied to estimate consumers' average marginal willingness to pay for the organic claim. There are a number of hedonic pricing model papers that do just that. For example, Lin et al. (2008) estimate hedonic models for five fresh fruits and five fresh vegetables using the 2005 Homescan data and find a 15% price premium for fresh organic carrots, a 60% premium for fresh organic potatoes, and somewhere in between for eight other fruits and vegetables. Using 2006 Homescan data, Smith, Huang, and Lin (2009), estimate hedonic-based organic price premiums ranging from 60% to 68% for private label milk, and 89% to 109% for branded milk. As part of a larger project, Kiesel and Villas-Boas (2007) estimate a hedonic model for milk prices using 2000 to 2003 Homescan data, and find organic price premiums of 39.4% and 45.8%, depending on the model specification. In a study that uses data from 2001, which pre-dates the National Organic Program's 2002 implementation of U.S. Department of Agriculture (USDA) organic standards, Maguire, Owens, and Simon (2004) estimate a hedonic model based on collected baby food prices from over 80 retail establishments in two cities and find that consumers were willing to pay a 16% to 27% premium for the organic product attribute. In another study that pre-dates the 2002 USDA standards, Boland and Schroeter (2002) estimate a hedonic model for wholesale beef prices paid by retail customers in a value-based marketing chain and find little evidence of organic pricing premiums.[1]

Another set of research papers on organic price premiums is based not on retail prices, where hedonic models have proven to be useful tools for comparing products with many attributes, but rather on farm or wholesale prices, where little product-attribute heterogeneity exists. Oberholtzer, Dimitri, and Greene (2005) rely on both wholesale and farmgate prices to compare organic and nonorganic prices for broccoli, carrots, and mesclun mix over the 2000 to 2004 period. Organic price premiums for wholesale and farmgate broccoli, and for wholesale and farmgate carrots, routinely topped 100%. The wholesale organic price premium for broccoli peaked at 223% in December 2003, and the farmgate organic price premium for carrots peaked at 202% in March 2000. On the other hand, the organic price premium for wholesale mesclun mix was quite low during the 2000 to 2004 period, often in the zero to 10% range.

Because our research relies on retail-level prices found in the Homescan data, it follows many of the papers mentioned above that estimate hedonic price equations using controls for many product attributes, including an organic claim. Our research differs, however, in at least three important ways. First, rather than examining organic price premiums in a single year or small number of years, we investigate organic price premiums over a 7-year time period, 2004 to 2010. The entire time period is well after the 2002 implementation of USDA organic standards, so any potential transition effects should have diminished by 2004. Second, we investigate four very different retail products—canned soup, coffee, milk, and bagged carrots. These products were picked for two reasons: (i) their variety of composition, where soups are highly processed, coffee is imported, milk is a livestock-based product, and bagged carrots are relatively unprocessed; and (ii) their variety in organic price premiums, where it appears as if the organic price premiums for the four products may be very different. And third, we pool the estimated organic premium results and estimate a second econometric model to identify general market-level factors common to all four products that might explain the movement of organic price premiums over the 7-year period. To our knowledge, no other researchers have undertaken this sort of second-stage analysis.

[1] Despite its prevalence in applied research, Kiesel and Vilas-Boas (2007, p. 12) recall one cautionary note from Rosen (1974), warning that estimated hedonic price models can capture average willingness to pay for a particular attribute only if preferences are homogeneous across the entire population; on the other hand, recovering average results from populations with heterogeneous preferences would require preferences to sort according to observed subpopulations.

3. FIRST-STAGE MODEL: HEDONIC ESTIMATION OF THE ORGANIC PRICE PREMIUM

Suppose we look at the supply and demand for the market for a particular product *j* at time *t*:

$$\begin{aligned} Q_{j,t}^{S} &= s\left(P_{j,t}^{S}, M_{j,t}, S_{j,t}, C_{j,t}^{S}\right) \\ Q_{j,t}^{D} &= d\left(P_{j,t}^{k}, M_{j,t}, D_{j,t}, C_{j,t}^{D}\right), \end{aligned} \tag{1}$$

where $Q_{j,t}^{S}$ and $Q_{j,t}^{D}$ are supply and demand quantities, $P_{j,t}^{S}$ and $P_{j,t}^{D}$ are supply and demand prices, $M_{j,t}$ is a vector of market identifiers, $S_{j,t}$ is a vector of supply shifters, $D_{j,t}$ is a vector of demand shifters, and $C_{j,t}^{S}$ and $C_{j,t}^{D}$ are vectors of market structure characteristics. At equilibrium, $Q_{j,t}^{S} = Q_{j,t}^{D} = Q_{j,t}^{EQ}$ and $P_{j,t}^{S} = P_{j,t}^{D} = P_{j,t}^{EQ}$.

Rosen's (1974) hedonic pricing model suggests that, within the market equilibrium, the price of retail product *j* at time *t* is a function of product attributes. If $X_{j,t}$ represents a vector of product attributes, then

$$P_{j,t}^{EQ} = f\left(X_{j,t}, M_{j,t}\right).$$

If a linear model[2] is specified in the following manner, the hedonic price equation becomes

$$P_{j,t}^{EQ} = X_{j,t}\delta_{j,t} + M_{j,t}\gamma_{j,t} + \varepsilon_{j,t}, \tag{2}$$

where $\varepsilon_{j,t}$ is an unobserved additive error, and $\delta_{j,t}$ and $\gamma_{j,t}$ are parameter vectors to be estimated. For explanatory purposes, it will be convenient to partition $X_{j,t}$ into two components, an organic product attribute component and a component with product attributes unrelated to organic, $Z_{j,t}$, so that $X_{j,t} = \left[O_{j,t}Z_{j,t}\right]$. We note that the organic component includes both a binary variable $O_{j,t}$, where $O_{j,t} = 1$ for an organic product and $O_{j,t} = 0$ for a nonorganic product, and some interaction terms between the binary organic attribute and a subset, $Z_{j,t}^{sub}$, of the elements of $Z_{j,t}$. This partitioning transforms (2) to

$$P_{j,t}^{EQ} = O_{j,t}\alpha_{j,t} + O_{j,t}Z_{j,t}^{sub}\beta_{j,t} + Z_{j,t}\gamma_{j,t} + M_{j,t}\delta_{j,t} + \varepsilon_{j,t}. \tag{3}$$

This hedonic price equation is estimated for each product, *j*, and each time period, *t*.

Once (3) is estimated the price premium due to the organic attribute can be estimated by

$$Est.\,org.\,premium = \hat{\psi}_{j,t} = \frac{\hat{P}_{j,t}^{EQ}\Big|_{O_{j,t}=1,\bar{Z}} - \hat{P}_{j,t}^{EQ}\Big|_{O_{j,t}=0,\bar{Z}}}{\hat{P}_{j,t}^{EQ}\Big|_{O_{j,t}=0,\bar{Z}}} \tag{4}$$

where $\bar{Z}$ reflects all nonorganic attributes fixed at their means, and $\hat{P}$ is the estimated price. As a function of predicted values from Equation (3), note that $\hat{\psi}_{j,t}$ itself is a random variable.[3]

[2]Note that Maguire, Owens, and Simon (2004), who estimate the organic price premium for organic baby food with a hedonic pricing model, provide a qualified defense of the linear form. Lin et al. (2008) also employ a linear model in their hedonic estimation of organic premiums for fresh fruits and vegetables.

[3]Later, after estimating (3), we use Stata's "nlcom" command, which uses the Delta method, to generate point estimates, standard errors, and confidence intervals for the estimated organic premium in (4).

4. SECOND-STAGE MODEL: ESTIMATION OF FACTORS THAT INFLUENCE THE ORGANIC PRICE PREMIUM

Based on (1) and (4), we can see that the estimated organic price premium estimated in (4) for product *j* is a function of variables in (1):

$$\hat{\psi}_{j,t} = f\left(S_{j,t}, D_{j,t}, C_{j,t}\right). \tag{5}$$

To the extent possible, the supply shifters, demand shifters, and market structure characteristics could be drawn from both the organic and nonorganic parts of the market. Assuming that (5) takes a linear form,

$$\hat{\psi}_{j,t} = C_{j,t}\theta^{C}_{j,t} + S_{j,t}\theta^{S}_{j,t} + D_{j,t}\theta^{D}_{j,t} + \mu_{j,t}, \tag{6}$$

where the θ's are parameters to be estimated, and $\mu_{j,t}$ is an error term. For each product *j*, this equation could be estimated as a time series for all t. However, Brown, and Rosen (1982) show that this model contains no additional information compared to the model in (3). We propose a different type of second-stage analysis, one based on pooled results from product-specific estimations of model (3). More specifically, we hypothesize that there are general factors across product types associated with the organic price premiums. To test this hypothesis, we pool all product-specific estimation results from (3), and estimate the following pooled version of (6) for the 2004–2010 time period:

$$\hat{\psi}_{t} = C_{t}\theta^{C}_{t} + S_{t}\theta^{S}_{t} + D_{t}\theta^{D}_{t} + \mu_{t}, \tag{7}$$

where the *j* subscript is no longer relevant. By estimating "a common underlying structure" across the four products and 7 years, we aim to follow Brown and Rosen's (1982, p. 767) advice for avoiding a "simple reproduction of the first-stage information."

5. DATA

The Nielsen Homescan panel records all food transactions by a representative sample of more than 40,000 U.S. households who purchase food products at food retailers and then re-scan them with the help of a home-scanning device.[4,5] The Homescan panel contains extensive demographic data, but because the hedonic pricing model reflects a product market in equilibrium, we generally require only the product attribute information and other transaction data for a particular market, but not the household demographic data.[6]

[4]Zhen et al. (2009) note a variety of reasons (e.g., illness, vacations, on-the-go consumption) why Homescan data might not reflect households' entire purchase information as intended. Compared to the Bureau of Labor Statistic's Consumer Expenditure Diary Survey, Zhen, Taylor, Muth, & Leibtag (2009) find differences in Homescan's unweighted demographic composition can lead to discrepancies in some results. Einav, Leibtag, and Nevo (2008) also investigate the accuracy of Homescan data, particularly focusing on price information. They find that price information is highly accurate for nonloyalty card transactions; however, loyalty-card transactions may overstate the price.

[5]Some readers may be interested to hear about the composition of the panel from year to year. Nielsen recruits households to participate using mail (30% of the panel) and Internet (70% of the panel). Once a household decides to participate, they are sent a survey in which they report their demographic characteristics. The household then enters a reserve pool where they wait for a maximum of 2 years to participate. Homescan panelists are allowed to stay on the panel for as long as they want, unless their reporting performance is subpar. Households stay in the whole panel for an average of under 5 years. When a household drops out of the panel, a replacement is selected from the reserve sample using a distance algorithm that identifies which households best match a target sample profile.

[6]One could argue that demographic information should be included in (3) to control for differences across geographic markets. Instead, we include fixed effects (dummy variables) for each geographic market. Unreported estimation results with demographic information included are highly similar to our reported results.

The data contain codes for major metropolitan market areas and eight types of retail channels where the food item was purchased. A supermarket is defined as a food retailer with over 9,000 square feet of selling space and at least $2 million in annual sales. Mass merchandisers are large department stores that sell primarily general merchandise but also limited assortments of grocery products (typically few to no perishable foods such as produce or fresh meat). Supercenters, also known as hypermarkets and superstores, are the largest channel at which consumers purchase food, in terms of both square footage and product volume. Drug stores are stores that feature prescription-based pharmacies but generate at least 20% of total sales from other categories, including general merchandise and food. Club stores, also referred to as warehouse or volume stores, are large-format outlets that specialize in selling food and selected general merchandise. This format is unique in food retailing in that consumers need paid memberships to shop at them. Convenience stores are the smallest of the major retail formats in terms of size and product offerings but they are the most numerous by a wide margin. The final category is an amalgamation of smaller formats, including dollar stores, military commissaries, and specialized department stores, online retailers, and other outlets.

The purchase data include prices paid, quantities bought, purchase dates, package sizes, brand identifiers, UPC code information, some product formulations, promotional activities, retail channel identifiers, and an organic claim code. In addition to the Homescan reported attribtes, Nielsen coded text UPC descriptions were occasionally used. For example, in the case of soup, we search this text string for the word "broth" to recover a binary variable that would reflect whether the soup purchased was broth or something else. Finally, we investigate packaged products—soup, coffee, milk, and bagged carrots—and therefore do not utilize Homescan's random weight data.

The product attributes required for the first-stage hedonic price model vary by product. Some of the products under investigation, e.g., soup, take up a large amount of supermarket shelf space, which generally reflects a wide variety of product attributes. Our general goal is to recover enough product-level attribute data from the Homescan data to sufficiently isolate the contribution that the organic claim makes to price. Table 1 summarizes the product attribute data from Homescan used in the first-stage hedonic price model, which is estimated separately for each year of data. Table 1 also notes the variable types, which correspond to the variables in equation (3), namely prices (P), the organic claim (O), the vector of product attributes (Z), and the vector of market identifiers (M). The organic attribute and its interactions with a private label attribute and quarterly dummies are included in identical fashion for each hedonic price model for the four products.[7] On the other hand, some product attribute variables vary in treatment by the product investigated. Package size is a good example of this product-specific treatment. For two of the four products under investigation (milk and carrots), we include package-size variables that are categorical dummies because of the common use of relatively standardized package sizes, but we use a continuous variable for soup and coffee because there are numerous package sizes for these products.

Before moving to the second stage we conducted a preliminary analysis on about a dozen products to ensure that we chose four products with a range of organic price premiums. This preliminary analysis was not done for all years, but it did generate estimates of organic price premiums for a wider selection of products. Based on these preliminary estimates and the criteria described above, namely, one based on variety of composition and price premium, we made the final determination to investigate the four products presented here: soup, coffee, milk, and bagged carrots.

In the second-stage analysis, the dependent variable, the estimated organic price premium described in (4), is recovered from the first-stage hedonic model applied to each of the four

[7]The organic attribute could feasibly be interacted with a wide range of other variables, including specific product attributes, store type (e.g., supermarket vs. club store), or even geographic market dummies. Instead, we choose a specification with only limited interaction to keep the model as simple as possible while still retaining reasonably strong explanatory power.

TABLE 1. Product Attribute Data from Homescan

Products	Attributes	Variable type	Definitions	Variable mean (2010)
All	Price	P	Soup: $/pint Coffee: $/pound Milk: $/gallon Carrots: $/pound	Soup: 1.360 Coffee: 5.045 Milk: 3.441 Carrots: 1.286
All	Organic	O	1 if UDA organic claim; 0 otherwise	Soup: 0.0239 Coffee: 0.0117 Milk: 0.0311 Carrots: 0.0971
All	Private label (PL)	Z	1 if PL; 0 other	Soup: 0.2060 Coffee: 0.1809 Milk: 0.7151 Carrots: 0.3388
All	PL∗Organic	$Z{*}O$	PL∗organic	Soup: 0.0041 Coffee: 0.0050 Milk: 0.0148 Carrots: 0.0364
All	Q2, Q3, Q4	M	Three quarterly dummies	
All	Q ∗ Organic	$M{*}O$	Q2, Q3, or Q4 ∗ Organic	
Soup	Diet	Z	1 if reduced calorie; 0 other	0.2929
Soup	Low sodium	Z	1 if low sodium claim; 0 other	0.0419
Soup	Microwave	Z	1 if microwavable; 0 other	0.0407
Soup	Condensed	Z	1 if condensed; 0 other	0.4246
Soup	Broth	Z	1 if broth; 0 other	0.1110
Soup	Stock	Z	1 if stock; 0 other	0.0189
Soup, Coffee	Pkg size	Z	Package size (in ounces)	Soup: 16.389 Coffee: 21.917
Coffee	Reg. flavor	Z	1 if listed as unflavored or regular flavor; 0 other	0.8860
Coffee	Bag	Z	1 if coffee package is a bag; 0 other	0.3238
Coffee	Can	Z	1 if coffee package is a can; 0 other	0.6006
Coffee	Pouch	Z	1 if coffee package is a pouch; 0 other	0.0000
Coffee	Pod	Z	1 if coffee package is a pod; 0 other	0.0041
Milk	Gal-3/4	Z	1 if milk package size is 96–97 fl oz; 0 other	0.0038
Milk	Gal	Z	1 if milk package size is gallon; 0 other	0.6349
Milk	Quart	Z	1 if milk package size = one quart; 0 other	0.0497
Milk	Quart-less	Z	1 if milk package size is < quart; 0 other	0.0113
Milk	Gallon-plus	Z	1 if milk package size > gallon; 0 other	0.0000
Milk	Low fat	Z	1 if milk fat is > 0 but < 2%; 0 other	0.1798
Milk	Reduced fat	Z	1 if milk fat = 2%; 0 other	0.3638
Milk	Whole	Z	1 if milk is whole milk; 0 other	0.1840
Milk	No lactose	Z	1 if milk is lactose free; 0 other	0.0274
Milk	Fortified	Z	1 if milk is vitamin fortified; 0 other	0.9805
Milk	Kosher	Z	1 if milk is kosher; 0 other	0.0004
Carrots	Baby cut	Z	1 if carrots are “baby cut”; 0 other	0.4276
Carrots	Other cut	Z	1 if carrots are cut but not in “baby cut”; 0 other	0.1840
Carrots	Snack size	Z	1 if carrots package is < half pound; 0 other	0.0144
Carrots	Half-pound	Z	1 if carrots package is one half pound; 0 other	0.0696
Carrots	Two-pound	Z	1 if carrots package is 2 pounds; 0 other	0.2261
Carrots	Big bag	Z	1 if carrots package is > 2 pounds; 0 other	0.0713
All	Multipack	Z	1 if product was bought as part of a mulitpack	Soup: 0.0228 Coffee: 0.0117 Milk: 0.0117 Carrots: 0.0129

TABLE 1. Continued

<table>
<tr><th>Products</th><th>Attributes</th><th>Variable type</th><th>Definitions</th><th>Variable mean (2010)</th></tr>
<tr><td>All</td><td>Discount</td><td>Z</td><td>1 if purchase price was discounted; 0 other</td><td>Soup: 0.3373
Coffee: 0.3574
Milk: 0.1729
Carrots: 0.1942</td></tr>
<tr><td>All</td><td>Store type</td><td>M</td><td>Seven binary variables for eight categories
<table>
<tr><th>Store types:</th><th>Soup</th><th>Coffee</th><th>Milk</th><th>Carrots</th></tr>
<tr><td>Grocery:</td><td>0.6877</td><td>0.5613</td><td>0.6951</td><td>0.7898</td></tr>
<tr><td>Club:</td><td>0.0155</td><td>0.0892</td><td>0.0518</td><td>0.0307</td></tr>
<tr><td>Drug:</td><td>0.0223</td><td>0.0366</td><td>0.0262</td><td>0.0024</td></tr>
<tr><td>Supercenter:</td><td>0.1817</td><td>0.1872</td><td>0.1555</td><td>0.1306</td></tr>
<tr><td>Mass:</td><td>0.0325</td><td>0.0496</td><td>0.0210</td><td>0.0006</td></tr>
<tr><td>C-store:</td><td>0.0008</td><td>0.0014</td><td>0.0171</td><td>0.0007</td></tr>
<tr><td>Health:</td><td>0.0006</td><td>0.0001</td><td>0.0003</td><td>0.0014</td></tr>
<tr><td>Other:</td><td>0.0590</td><td>0.0746</td><td>0.0330</td><td>0.0380</td></tr>
</table></td><td>See column to left</td></tr>
<tr><td>All</td><td>Market ID dummies</td><td>M</td><td>Homescan has 52 Market ID identifiers for major markets plus 9 other geographic identifiers</td><td></td></tr>
<tr><td>Soup, Coffee, Carrots</td><td>Nonorg minor brand dummies</td><td>Z</td><td>Brand dummy variables for nonorganic brand, excluding the dominant nonorganic brand</td><td></td></tr>
</table>

products. Based on (5) and (6), we hypothesize that the estimated organic price premium, once pooled across the four products, is a function of supply and demand shifters, and market-structure characteristics.[8] For supply and demand shifters, we look outside the Homescan data; for market structure characteristics, we use the Homescan data to develop variables that describe the retail structure of the underlying product category markets in the entire United States. For example, these retail market structure variables, C, include total nonorganic sales reported in Homescan of each category and the total organic sales reported in each category. Because Homescan is based on a projected sample of consumers, our estimated total sales for the United States may differ from the actual total sales. The retail market structure variables also include the share of organic sales made up by private-label products and the share sold through the supercenters. Wal-Mart's well documented entry into organic food is one impetus for including the share of organic food sold through supercenters. Both Warner (2006) and Ngobo (2011) note that Wal-Mart announced its intention to sell organic products at a 10% price premium. The Mintel report (2011b) suggests that growth in private label organic products may also lower organic price premiums. Table 2 lists and defines all the variables used in the pooled, second-stage analysis.

Because some of these retail market variables are not widely reported, we graphically present some details, using the milk category as an example. Figure 1 shows the total nonorganic milk sales and the total organic milk sales using Homecan's projection factors, which help translate figures from the sample to the entire U.S. population. Overall, total nonorganic milk sales are now almost 18 times larger than organic milk sales. But, as Figure 1 shows, organic milk sales grew much more rapidly, especially from 2004 to 2008, when organic milk sales more than tripled. Figure 2 presents the share of organic milk sales sold as private label and the share sold through supercenters. The private label share of organic milk rose steadily and dramatically through the period, from about 10% to just over 50% of all organic milk sales.

[8] By picking four products with a wide variety in organic price premiums, we can be more confident of any relationships found in the second stage. Readers should be aware, however, that no second-stage estimation was conducted prior to choosing the four products in this study. Hence, the four products studied were not picked with the second-stage results in mind.

TABLE 2. Supply, Demand, and Retail Market Variables

Dependent Variable	Definitions	Variable Means
Est. Price Premium ($\hat{\psi}$)	From Equation (4)	Soup: 0.2663 Coffee: 0.7744 Milk: 0.7100 Carrots: 0.2411
Supply Shifters (*S*)		
P-index Mktg Costs	Producer price index, total marketing cost. USDA	1455.3
P-index Electricity	Producer price index, electricity cost. USDA	637.86
P-index Ag Chemicals	Producer price index, pesticides, fertilizers, and other chem. USDA	186.82
Demand Shifter (*D*)		
U.S. Population	(x 10^{-6})	301.62
Retail Market Characteristics (*C*)		
Category sales—nonorganic	Total Homescan-reported nonorganic sales in the soup, coffee, milk, and carrots categories (quarterly, in $millions, using Homescan projection factors)	Soup: 866.491 Coffee: 734.736 Milk: 2,311.112 Carrots: 183.752
Category sales—organic	Total Homescan-reported organic sales in the soup, coffee, milk, and carrots categories (quarterly, in $millions, using Homescan projection factors)	Soup: 23.314 Coffee: 12.608 Milk: 82.200 Carrots: 22.486
PL (private label) share of organic	Expenditure share (%) of private label organic food purchases relative to total expenditure on organic (using Homescan projection factors)	Soup: 8.051 Coffee: 18.011 Milk: 31.964 Carrots: 20.051
Supercenter share of organic	Expenditure share (%) of organic food purchases in the supercenter channel relative to total expenditure on organic (using Homescan projection factors)	Soup: 4.594 Coffee: 3.116 Milk: 9.708 Carrots: 6.619
Other variables		
Year	Yearly time trend	

On the other hand, the share of organic milk sold through supercenters did not experience the same growth, though it did rise from just under 10% in the 2004–2006 period, to just over 10% in the 2007–2010 period.

To save space, we do present not similar figures for the other three products—soup, coffee, and carrots. In all cases, however, organic sales grow much more rapidly than the overall category, and the share of organic sold through supercenters does not show the same growth as the private label share of organic.

6. RESULTS

Using the variables found in Table 1, Equation (3) is estimated via generalized least squares for each of 7 years (2004–2010), and each of four products (soup, coffee, milk, and carrots). To account for possible heteroscedasticity, standard errors are estimated via a robust estimator.

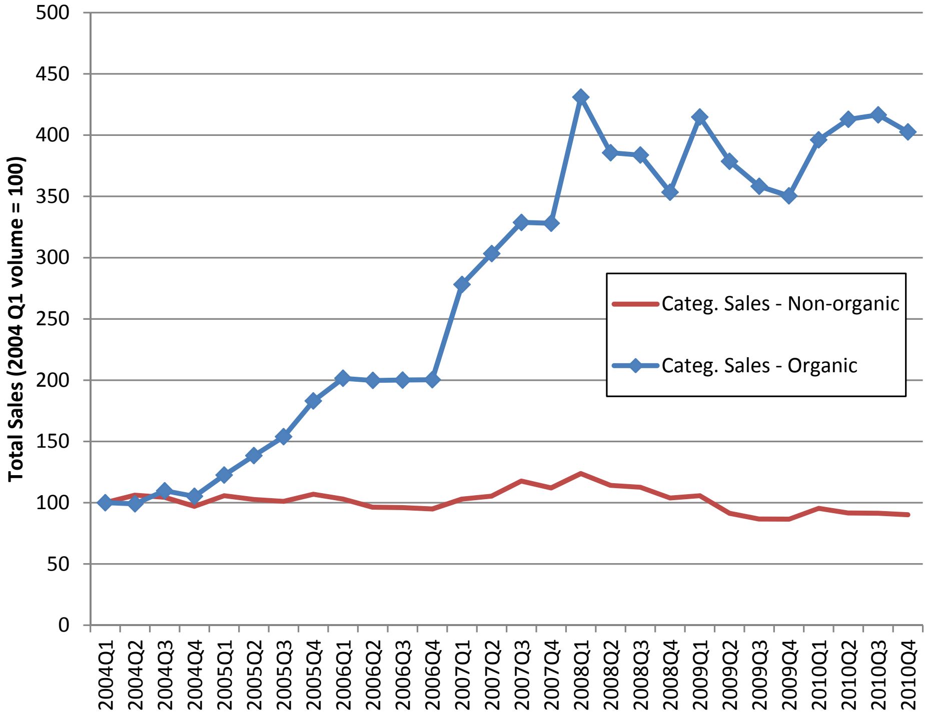

Figure 1 Total Nonorganic Sales and Total Organic Sales of Milk in the Homescan Data (Year-Quarter Counts, with Projection Factors).

The organic claim appears as a product attribute on its own as well as interacting with quarterly dummy variables and a private-label dummy variable. To save space, Table 3 presents the results from Equation (3) for just 1 year, 2010.[9] Because the variable of interest, organic claim, is interacted with other variables in the model, examination of Table 3 will not provide a direct illustration of the value of the organic claim's contribution to price. Instead we compare predicted values of the product price while the organic claim variable changes from zero to one, while fixing the other regressors at their means (using the Delta method and Stata's postestimation commands).

We will return to the discussion of the organic price premium shortly, but first we briefly discuss the hedonic impact of some other product attributes. Because the dependent variables in the hedonic models are prices, the estimated coefficients have direct economic interpretations. The estimated coefficient on a discrete "dummy" variables such as "Private Label," which equals 1 if the product is a store brand and 0 otherwise, generally reflects a lower price associated with private label products. For instance, private label soups sell for \$0.5080 less per pint, all else equal, and private label coffee sells for \$0.5829 less per pound. The estimated coefficient for a continuous variable such as "Pkg size" for soup and coffee reflects the impact on price of a one-unit increase in package size. For instance, a one-ounce increase in package size is associated with a \$0.0080 lower price for each pint of soup, and a \$0.0621 lower price for each pound of coffee, all else equal.

The soup and milk product categories both have product attributes related to reduced calories or reduced fat, and in each case—"diet" for soup, and "low fat" and "reduced fat" for milk—the hedonic models indicate a positive impact on price. On the other hand, lower sodium, included as an attribute for soup, has a negative impact on price. Apparently, consumers are willing to

[9] Interested readers may contact the authors for the full set of 28 regressions, one for each product-year combination.

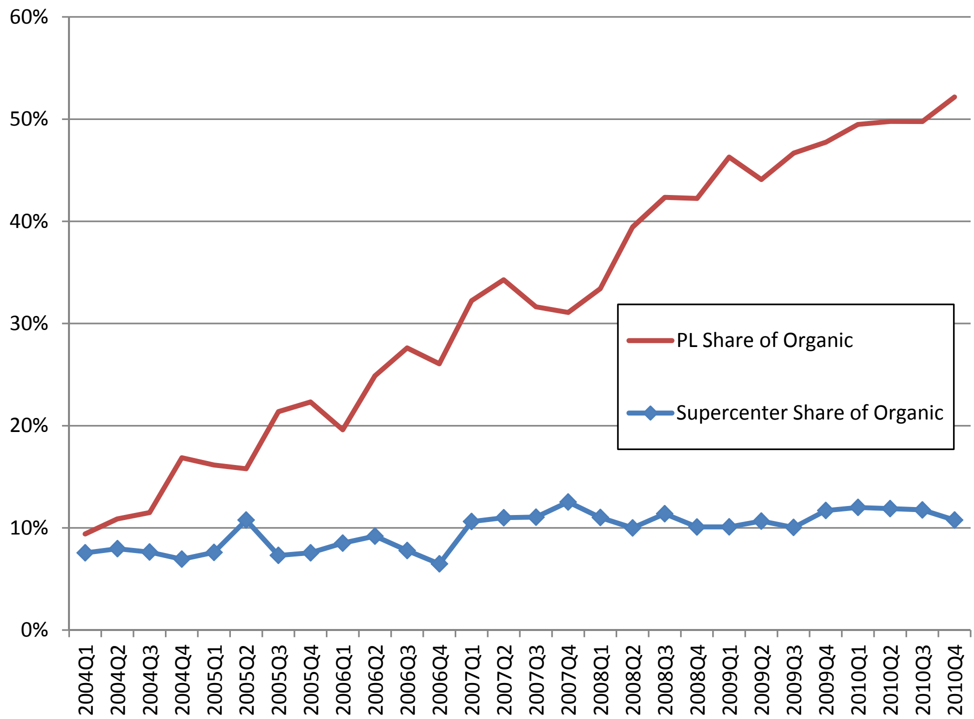

Figure 2 Private Label Share of Organic Milk and Share of Organic Milk Sold Through Supercenters (Year-Quarter Counts, with Projection Factors).

pay more for reduced calories or fat, but not for reduced sodium. Convenience attributes, such as "microwave" for soup and "baby cut" and "Snack size" for carrots, have substantial positive impacts on price. "Discount," which reflects products bought on a store or manufacturer discount, has a strong negative impact on price. "Private label" is also consistently negative as expected, meaning that consumers expect to pay less for private label products, all else equal.

All attributes related to package size have the expected signs. In the soup and coffee models, we include a continuous variable, and it is negative as expected: larger packages are sold at a lower per-unit price. For milk and carrots, which are generally sold in a small variety of standard packages sizes, we included specific dummy variables for package sizes. A half-gallon package is the base case for milk, and hence the positive signs on "Quart" and Quart-less" as well as the negative signs on "Gal" and "Gal-3/4" make sense. For carrots, a one-pound bag is the base case, so the positive sign on "Half-pound," and the negative signs on "Two-pound" and "Big bag" are also consistent with expectations. "Multi-pack" is also negative as expected.

Several product attributes reflect special packaging or special attributes. For coffee, we include product attributes that reflect the packaging. The new packaging type "Pod," which works with single-serving brewing machines, as expected has an extremely large positive impact on price. "No lactose" milk carries a substantial price premium.

A few product-attribute results in Table 3 are unexpected. According to our model, the kosher attribute in milk carries a discount rather than the expected premium. The reason for this result is unclear, but may be an empirical issue because kosher milk comprises only 0.04% of milk transactions in the data. We also find that the private label attribute carries a premium in the carrot sector. One reason for this may be related to industry structure, where two carrot companies supply about 90% of the U.S. market, including the private label market.

For each product, we include dummy variables that reflect the retail channel where the product was purchased. The base case is traditional supermarkets, so coefficient estimates

TABLE 3. Hedonic Price Estimations, 2010 (*t*-Stats Estimated with Robust Standard Errors)

	Soup $/pint		Coffee $/pound		Milk $/gallon		Carrots $/pound
Constant	1.7287 (419.0)***	Constant	6.8592 (209.4)***	Constant	4.6655 (643.0)***	Constant	0.9703 (202.8)***
Organic	0.5975 (61.3)***	Organic	2.6748 (22.0)***	Organic	2.9139 (309.6)***	Organic	0.4059 (54.4)***
Private label (PL)	−0.5080 (−351.4)***	Private label (PL)	−0.5829 (−75.0)***	Private label (PL)	−0.6092 (−318.6)***	Private label (PL)	0.0853 (42.6)***
PL*organic	−0.2226 (−22.2)***	PL*organic	−0.7173 (−7.12)***	PL*organic	−0.3036 (−35.7)***	PL*organic	−0.1783 (−26.4)***
Q2	0.0788 (45.0)***	Q2	0.0023 (0.293)	Q2	−0.0156 (−7.5)***	Q2	0.0019 (0.920)
Q3	0.0328 (19.5)***	Q3	0.1668 (20.69)***	Q3	0.0553 (26.6)***	Q3	−0.0041 (−1.95)**
Q4	−0.0674 (−48.3)***	Q4	0.2278 (27.5) ***	Q4	0.0835 (40.1)***	Q4	−0.0152 (−7.53)***
Q2*organic	0.0256 (1.67)*	Q2*organic	0.0818 (0.54)	Q2*organic	−0.0150 (−1.26)	Q2*organic	0.0201 (2.20)**
Q3*organic	0.0390 (2.69) ***	Q3*organic	0.0906 (0.64)	Q3*organic	−0.0772 (−6.51)***	Q3*organic	0.0338 (3.33)***
Q4*organic	0.0340 (2.7)***	Q4*organic	0.1284 (0.84)	Q4*organic	−0.0859 (−7.24)***	Q4*organic	0.0300 (3.33)***
Diet	0.0798 (56.2) ***	Reg. flavor	−0.6538 (−36.1)***	Gal−3/4	−0.0667 (−5.24)***	Baby cut	0.5023 (274.2)***
Low sodium	−0.0353 (12.8)***	Bag	0.9995 (36.2)***	Gal	−1.1031 (−629.0)***	Other cut	0.6001 (208.7)***
Microwave	0.5433 (151.9)***	Can	−0.5222 (−27.8)***	Quart	1.6180 (449.2)***	Snack size	2.8704 (26.7)***
Condensed	0.1892 (129.4)***	Pouch	0.4285 (12.5)***	Quart-less	4.7465 (673.6)***	Half−pound	1.0457 (157.7)***
Broth	−0.0858 (−23.8)***	Pod	5.7107 (92.5)***	Low fat	0.0415 (18.6)***	Two−pound	−0.1335 (−77.0)***
Stock	0.1416 (25.7)***			Reduced fat	0.0338 (18.1)***		
Pkg size (oz)	−0.0080(−96.9)***	Pkg size (oz)	−0.0621(−179.0)***	Gallon−plus	−1.6889(−4.25)***	Big bag	−0.2066(−71.6)***

TABLE 3. Continued

	Soup $/pint		Coffee $/pound		Milk $/gallon		Carrots $/pound
Multipack	−0.7897(−139.6)***			No lactose	2.4912(509.8)***	Multipack	−1.5620(−14.2)***
				Whole	0.1116 (49.8)***		
				Fortified	−0.2669 (−50.0)***		
				Kosher	−0.8099 (−21.7)***		
Discount	−0.3593 (−263.9)***	Discount	−1.0865 (−155.0)***	Discount	−0.5170 (−253.3)***	Discount	−0.1914 (−84.2)***
Drug stores	−0.1714 (−33.1)***	Drug stores	−0.4110 (−23.1)***	Drug stores	−0.4532 (−93.8)***	Drug stores	−0.2231 (−15.4)***
Mass merchandizers	−0.2399 (−77.0)***	Mass merchandizers	−0.1686 (−11.8)***	Mass merchandizers	−0.0204 (−3.99)***	Mass merchandizers	−0.0326 (−2.83)***
Supercenters	−0.1753 (−133.2)***	Supercenters	−0.2577 (−35.0)***	Supercenters	0.0153 (7.17)***	Supercenters	−0.0144 (−6.68)***
Club stores	0.3111 (33.9)***	Club stores	−0.0205 (−1.82)**	Club stores	−0.6289 (−180.9)***	Club stores	−0.3128 (−55.1)***
Convenience stores	0.0915 (3.37)***	Convenience stores	0.3986 (2.89)***	Convenience stores	−0.0748 (−13.1) ***	Convenience stores	0.0104 (0.24)
Other stores	−0.2592 (−97.8)***	Other stores	−0.4852 (−30.5)***	Other stores	−0.3223 (−76.3)***	Other stores	−0.2126 (−53.3)***
Health and natur. stores	0.1704 (3.65)***	Health and Natur. Stores	1.7119 (2.0)**	Health and Natur. stores	0.9499 (21.0)***	Health and Natur. Stores	−0.0796 (−3.67)**
R-squared	0.4593	*R*-squared	0.7542	*R*-squared	0.7110	*R*-squared	0.6590
Obs.	802,523	Obs.	276,494	Obs.	1,493,282	Obs.	248,887
Fixed effects		Fixed effects		Fixed effects		Fixed effects	
Market ID dummies	(52 + 9 dummies)	Market ID dummies	(52 + 9 dummies)	Market ID dummies	(52 + 9 dummies)	Market ID dummies	(52 + 9 dummies)
Nonorg minor brand dummies	(179 dummies)	Nonorg minor brand dummies	(358 dummies)			Nonorg minor brand dummies	(56 dummies)

Notes:
***,**,*Significance at 0.01 level, 0.05 level, and 0.10 level.

TABLE 4. Estimated Organic Price Premiums

		Organic price premiums (% of Conventional price)			
Year	Quarter	Soup	Coffee	Milk	Carrots
2004	1	26.29%	152.06%	76.72%	26.47%
2004	2	27.22	118.15	58.56	27.75
2004	3	24.79	124.25	60.92	29.11
2004	4	21.11	116.25	65.89	31.14
2005	1	29.18	95.23	58.29	40.28
2005	2	22.78	87.06	62.46	41.07
2005	3	19.59	81.10	66.66	39.90
2005	4	21.74	89.46	66.56	38.84
2006	1	26.64	82.74	74.12	24.67
2006	2	17.26	85.43	81.29	19.83
2006	3	25.68	92.29	84.15	19.52
2006	4	23.15	91.93	81.52	21.83
2007	1	27.10	81.02	82.53	25.87
2007	2	23.27	72.91	70.18	23.44
2007	3	23.19	72.85	47.74	20.42
2007	4	24.54	74.86	45.84	23.77
2008	1	29.36	59.55	48.50	32.33
2008	2	20.84	58.27	54.82	33.73
2008	3	27.08	56.47	55.54	32.54
2008	4	29.74	62.99	66.90	30.60
2009	1	34.74	55.69	80.50	29.79
2009	2	30.07	52.40	93.67	28.41
2009	3	33.53	44.59	98.05	28.83
2009	4	37.08	51.85	90.35	30.83
2010	1	40.86	51.78	81.07	27.53
2010	2	40.40	53.42	81.00	29.09
2010	3	42.71	51.86	77.46	30.32
2010	4	45.66	51.98	76.56	30.29

reflect average price differences relative to this case. Coefficient estimates for drug stores are unexpectedly negative for all products, and also for convenience stores in the case of milk. One possible explanation for lower prices in these instances is the potential use of some food items by drug stores and convenience stores as "loss leaders," which may attract shoppers to general merchandise items with potentially higher margins. On the other hand, the estimate for mass merchandisers is negative as expected. The supercenters variable has a negative estimate for soup, coffee, and carrots but is unexpectedly positive for milk. The club stores coefficients are negative for milk and carrots, but unexpectedly positive for soup, and not statistically different from supermarkets for coffee. Finally, health food and natural food stores, carries a strongly positive coefficient for soup, coffee, and milk, but not carrots. On average, these stores are not the places to look for bargain pricing for soup, coffee, and milk.

Turing back to our variable of interest, organic claim, we see that it is strongly positive when it appears by itself for each of the four product categories. The interaction of organic and private label is consistently negative, reflecting the fact that private label organic products are generally priced below their branded counterparts. Organic is also interacted with quarter, so the organic price premium is allowed to vary by quarter. The total effect of the organic claim on price needs to account for all the places where the organic claim appears in the hedonic price model. Following Equation (4), this total effect can be found by comparing two price estimates, one where the organic claim is present and another where it is absent, while all other variables are fixed at their means. Table 4 presents these estimates for each of the four products. While there is considerable variability across products and time, each estimate is positive. Figure 3 presents

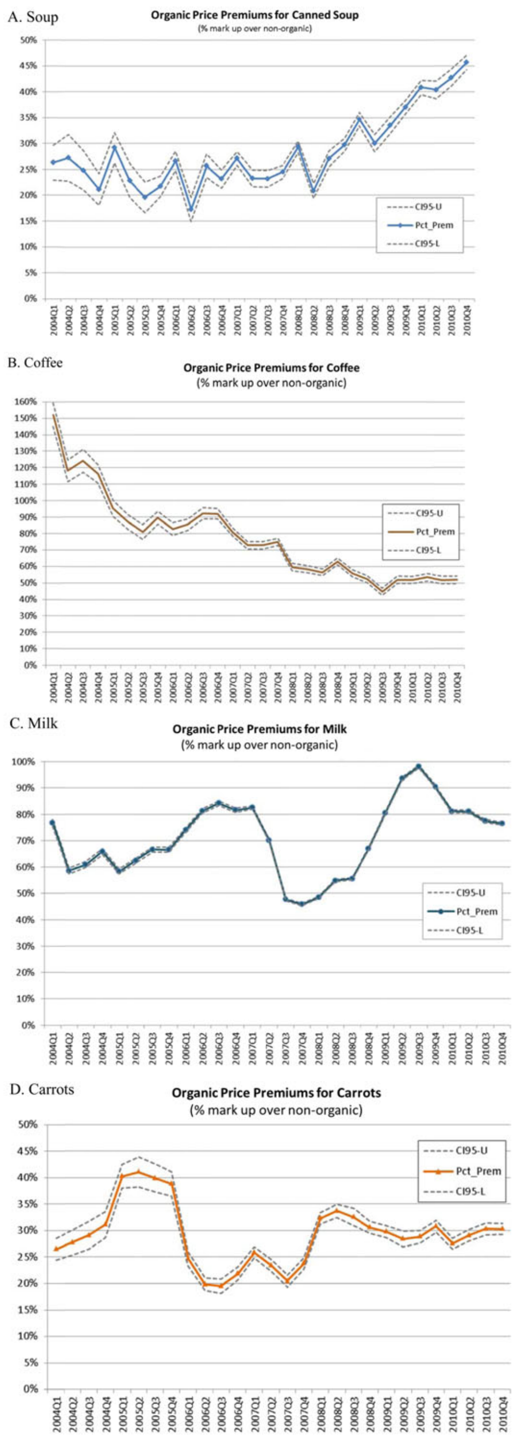

Figure 3 Organic Price Premiums (% over nonorganic), and Confidence Intervals
A, Soup; B, Coffee; C, Milk; D, Carrots.

TABLE 5. Pooled Organic Premium Estimation with Product-Specific Fixed Effects (*t*-Stats Estimated with Robust Standard Errors)

Dep Var: Estimated organic price premium (all four products)	Coeff. Est. (*t*-stat)
Category sales, nonorg ($\times 10^{-6}$)	−0.00044
	(−4.64)***
Category sales, organic ($\times 10^{-6}$)	0.00330
	(2.90)***
PL share of organic	0.18318
	(0.73)
Supercenter share of organic	−1.25849
	(−1.70)*
P-index mktg costs	−0.00519
	(−2.71)***
P-index electricity	−0.05177
	(−1.77)*
P-index Ag chemicals	0.00071
	(1.42)
U.S. population ($\times 10^{-6}$)	24.7472
	(1.63)
Year	−0.01157
	(−0.26)
Coffee dummy	0.4309
	(7.50)***
Milk dummy	0.8870
	(6.73)***
Carrots dummy	−0.2858
	(−4.10)***
Constant	20.0519
	(0.24)
Number of obs.	112
Prob > *F*	0.0000
R-squared	0.8151

Note:
***,**,*Significance at 0.01 level, 0.05 level, and 0.10 level.

a graphic depiction of the organic price premium for each product in separate panels, along with the lower and upper bounds of a 95% confidence interval around the estimate. The organic price premium is generally rising for soup (panel A), generally decreasing for coffee (panel B), and fluctuating widely for milk (panel C) and more narrowly for carrots (panel D). Looking at the end-of-the-period premiums in Table 4, we see that milk has the highest organic premium (76.6%), followed by coffee (52.0%), soup (45.7), and carrots (30.3%). Based on Table 4 and Figure 3, it does not appear as if the organic price premium is in any immediate danger of disappearing, even for coffee which has been decreasing but appears to be flattening out around the 50% premium level.

Table 5 presents the second-stage estimation results of Equation (6), where the estimated organic price premiums found in Table 4 are pooled and then regressed on the variables listed in Table 2 after including product-specific dummy variables to account for fixed effects. All *t*-statistics in Table 2 are calculated with robust standard errors. This pooled, second-stage model appears to work very well.

The retail structure variables provide the most interesting results in Table 5. The first four variables listed Table 5 can be thought of as two sets of paired variables. The first pair of variables reflects category sales—first total nonorganic sales and then total organic sales. Results show that higher total nonorganic sales correspond to a lower organic price premium, whereas higher organic sales correspond to a higher organic price premium. These results suggest that a growing nonorganic market, by far the larger of the two markets, can expect lower organic price premiums. But if organic sales outpace nonorganic sales, then the organic price premium might increase. The second pair of variables reflects two types of organic shares—first, the share of organic sold as private label products and, second, the share of organic sold through the supercenter channel. Here, conventional wisdom might suggest that stronger presence of organic private-label and/or supercenter-based organic products can lower organic price premiums. However, the results in Table 5 show that this is true only for the share of organic sold through supercenters: a higher share of organic sold through supercenters is associated with a (slightly) statistically significant lower organic price premium. These results confirm the importance of Wal-Mart's (and other supercenter retailers') increasing influence in the organic market that market followers anticipated back when Wal-Mart first entered the market (Warner 2006). For the private label share of organic sales, however, the impact on organic price premiums is not significantly different from zero.

Economic interpretation of the magnitude of Table 5's estimated coefficients is not necessarily straightforward. Because the dependent variable in each model is the estimated organic price premium, and because it is measured as the ratio of the organic price premium to the nonorganic price, the estimated coefficients reflect the change in this ratio for a one unit increase of an independent variable. For example, a $1 million increase in organic sales increases the price premium ratio by 0.0033. However, the economic interpretation of these retail market results can be made much clearer by considering some simple empirical scenarios, where most variables are fixed at their mean values. First, consider the potentially conflicting influence of an increase in both the nonorganic and organic market size. We find that a $100 million increase in total nonorganic sales results in a 4.39% lower organic price premium; however, an $13.3 million increase in total organic sales leads to a 4.39% higher organic price premium, which could exactly offset the decrease. In addition, a 5% increase in the share of organic sold through supercenters results in a 6.3% lower organic price premium. Monitoring the relative growth in the organic and nonorganic portions of the market, and the share of organic sold through supercenters, may therefore help organic producers, manufacturers, and retailers stay informed about the prospects for the organic premium.

The next three variables in Table 5—the price indexes for all marketing costs, electricity, and agricultural chemicals—are considered to be supply shifters. We would expect these input cost-related variables to have a negative effect on supply, but the overall impact on the price premium depends on whether they affect the supply of organic products differently than the supply of nonorganic products. The coefficient estimates for the marketing and electricity cost variables are both negative and statistically different from zero. Thus, the overall negative effect suggests that any increases in these cost factors may increase the nonorganic price in a stronger fashion than the organic price. In other words, it might be that the organic price is less sensitive to marketing and electricity cost increases. The coefficient estimate for the cost of agricultural chemicals is positive but not statistically different from zero.

The next variable in Table 5—the U.S. population—is a demand shifter. Its coefficient estimate is positive, but not statistically significant estimate. Lastly, Table 5 shows that a yearly time trend is not significant, but product-specific dummy variables are all significant.

7. CONCLUSIONS

This paper addresses three gaps on the literature on organic price premiums. First it estimates the organic price premium for a variety or retail-level organic products, and finds that these premiums are still substantial, and there is little or no evidence of them disappearing. The organic price premium is rising to about 45% for canned soups, a highly processed product; decreasing to about 50% for coffee, an import; fluctuating greatly around an average of about 70% for milk, a livestock-based product; and fluctuating narrowly around an average of about 30% for bagged carrots, a product with little processing. Second, it examines organic price premium over a fairly long time period, 28 quarters from 2004 to 2010. This period represents the post-USDA label era in organic foods, and coincides with strong market growth, even accounting for the 2008 recession. And third, it investigates a second-stage analysis of the how the estimated organic price premiums are influenced by retail-level characteristics of market structure and supply and demand shifters.

This second-stage analysis of the organic price premium is novel, and it provides some key insights into the organic market more generally. First, we find that the growing size of the organic market, when examined alone, is associated with higher organic price premiums. However, we find the opposite effect when the (larger) nonorganic market is growing. Our calculations show that these two opposite effects approximately neutralize each other if for every \$10 in nonorganic market growth the organic market grows by \$1.33. We also find that an increased organic presence by supercenters can lower organic price premiums. For the four products we investigate, however, the earliest years of data showed strong growth in the share of organic sold through supercenters for coffee, and to some extent soup. However, for the middle and later years in the period, none of the four products show dramatic growth in the supercenter share of organic.

Taken collectively, our results provide some general insight into near-term prospects of organic market, which may be potentially valuable information for organic producers, consumers, retailers, and policy makers. By suggesting that the organic price premium is in no way disappearing, these prospects seem strong from the organic producer's point of view. Even after the strong market growth in the post-USDA regulation era, the organic price premium is still growing for products such as soup, still holding for carrots and coffee, and still very high for milk. Consumers might also take comfort from these results by finding moderating factors and potentially lower priced organic products.

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