United States Department of Agriculture

Economic Research Service

Economic Research Report Number 209

May 2016

Changes in Retail Organic Price Premiums from 2004 to 2010

Andrea Carlson and Edward Jaenicke

United States Department of Agriculture

Economic Research Service
www.ers.usda.gov

Access this report online:
www.ers.usda.gov/publications/err-economic-research-report/err209

Download the charts contained in this report:

- Go to the report's index page www.ers.usda.gov/publications/err-economic-research-report/err209
- Click on the bulleted item "Download err209zip"
- Open the chart you want, then save it to your computer

Recommended citation format for this publication:

Carlson, Andrea and Edward Jaenicke. *Changes in Retail Organic Price Premiums from 2004 to 2010*, ERR-209, U.S. Department of Agriculture, Economic Research Service, May 2016.

Cover images: Shutterstock and USDA logo.

United States Department of Agriculture

Economic Research Service

Economic Research Report Number 209

May 2016

Changes in Retail Organic Price Premiums from 2004 to 2010

Andrea Carlson and Edward Jaenicke

Abstract

Organic foods are one of the most rapidly growing sectors of the retail food market. This study applies a hedonic model to 2004-10 Nielsen Homescan data to estimate the organic price premiums for 17 products. Eggs and dairy products generally have the highest premiums, while fresh produce has the widest spread of premiums (ranging from 7 percent of the nonorganic price for spinach to 60 percent for salad mix). Processed food premiums range from 22 percent for granola to 54 percent for canned beans. The strong organic premiums, combined with increased sales, suggest that there is continued room for growth in the organic supply.

Keywords: organic food, organic price premiums, organic label, Homescan data, fruit and vegetable prices, milk prices, egg prices, processed food prices, hedonic price model, organic consumers

Acknowledgments

The authors thank Catherine Greene, Diansheng Dong, and Hayden Stewart of USDA's Economic Research Service (ERS) for their comments. We also thank Betsy Rakola, Organic Policy Advisor of USDA's Agricultural Marketing Service, and Terry Long of USDA's Specialty Crops Market News, AMS, for their comments, as well as peer reviewers Ilya Rahkovsky of ERS, Travis Smith of the University of Georgia, Carolyn Dimitri of New York University, and Mark Bradley of USDA's Agricultural Marketing Service, National Organic Program. We also thank ERS editor Susmita Pendurthi and ERS designer Cynthia A. Ray.

About the Authors

Andrea Carlson is an economist at the USDA's Economic Research Service. Edward Jaenicke is an Associate Professor of Agricultural Economics at Penn State University.

Contents

Summary . . . . . **iii**

Introduction **1**

Background **2**

Methods **6**

Model 6

Data 9

Results **14**

Store Type, Season, and Geographic Market 18

Eggs and Dairy 20

Fresh Fruits and Vegetables 23

Processed Foods 27

Conclusion **32**

References **34**

Appendix Tables—Regression Results **38**

United States Department of Agriculture

A report summary from the Economic Research Service May 2016

Find the full report at *www.ers.usda.gov/publications/err-economic-research-report/err209*

Changes in Retail Organic Price Premiums from 2004 to 2010

Andrea Carlson and Edward Jaenicke

What Is the Issue?

The organic food sector has been one of the fastest growing parts of the food industry since the U.S. Department of Agriculture (USDA) began regulating organic labels on food in 2002. It even grew during the Great Recession (December 2007-June 2009), as organic products became available in more retail outlets. Bringing organic products to retail incurs costs at every level—from farmers and ranchers who must follow the USDA organic regulations (including avoiding synthetic fertilizers, sewage sludge, irradiation, or genetic engineering), to food processors and retailers who must ensure that organic and nonorganic products are not comingled by their transporters or within their facilities. In order to earn a return on these costs, all participants in the organic food supply chain must receive a higher price (ordinary price plus a premium) for the product. While the wholesale price premium can be determined by comparing the prices of organic and nonorganic agricultural products, the products available at the retail level are more diverse, and therefore the price premium cannot be determined by a simple price comparison.

What Did the Study Find?

Retail-level organic price premiums were more than 20 percent of the nonorganic price for all but 1 (spinach) of the 17 products analyzed in this study. Between 2004 and 2010, most premiums fluctuated—i.e., they did not steadily increase or decrease. Only three products demonstrated a steady decrease in their premiums (spinach, canned beans, and coffee), and only the yogurt premium steadily increased throughout the entire study period.

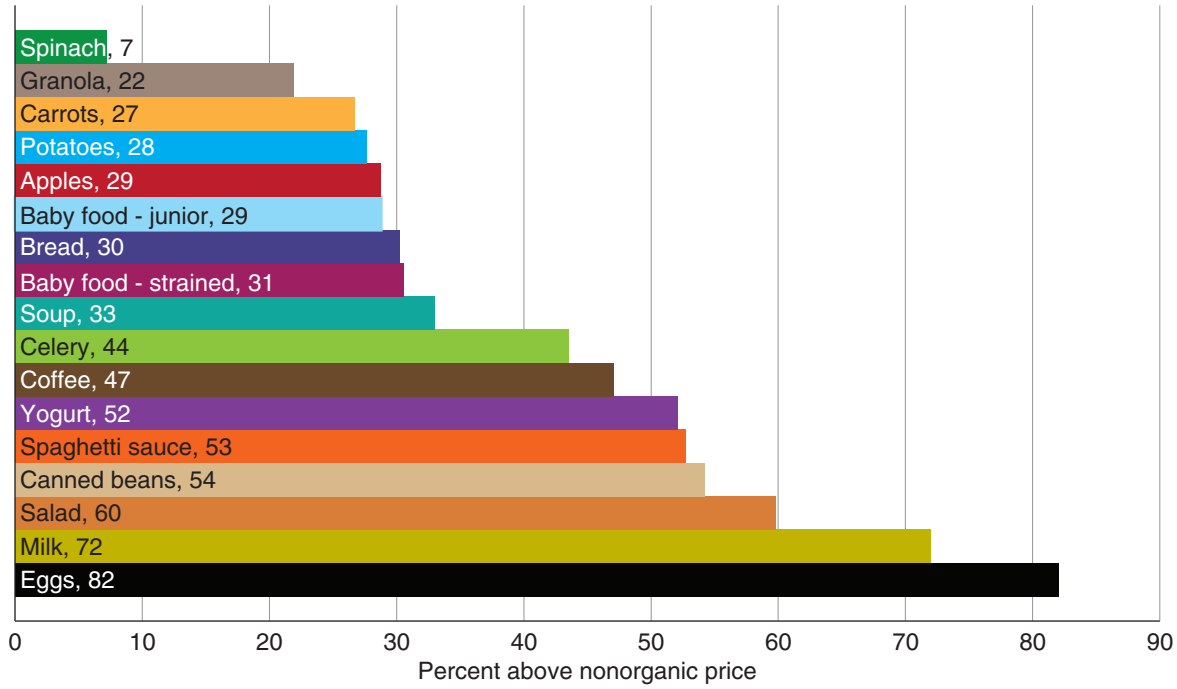
Eggs and dairy had the highest premiums in 2010, ranging from 52 percent of the nonorganic price for yogurt to 82 percent for eggs. Fresh fruits and vegetables, generally recognized as the largest part of the organic market, had the widest spread of premiums (ranging from 7 percent for spinach to 60 percent for salad mix). Processed food premiums ranged from 22 percent for granola to 54 percent for canned beans.

The share of organic product sold (of the total market) increased steadily for all products studied. Sales in 2010 were generally higher for the organic products with lower premiums (e.g., spinach, granola, and carrots); sales were also higher for foods frequently fed to children (such as baby food).

How Was the Study Conducted?

The analysis was based on data from Nielsen's Homescan data for 2004-10. The participating Homescan households used a barcode scanner to record all food purchases from stores, including grocery stores, supercenters, club stores, drug stores, convenience, and health food stores. The authors used a hedonic price-estimation model to isolate the organic price premium from the other attributes of the various products, such as package size, level of convenience, type of package, or the variety of the product (e.g., salad mix with spring greens versus a cabbage mix). Other factors that affected price were the type of store, month of the year, region of the country, and whether or not the product was sold under a brand name or a private label (store brand).

Organic price premiums, 2010



Notes: Bars depict the size of the relative price premium for each product in 2010.
Source: USDA, Economic Research Service estimates from Nielsen Homescan data (2010).

Changes in Retail Organic Price Premiums from 2004 to 2010

Introduction

Organic food sales have risen rapidly since the U.S. Department of Agriculture (USDA) introduced the USDA organic seal and started regulating organic labels in 2002. Although some studies find that consumers feel the higher price for organic food is a barrier to purchasing it, the organic market continued to expand even during the Great Recession.[1] As more consumers demanded organic products, retailers responded by making organic foods available well beyond health food stores and food co-ops. Most major food retailers have also introduced their own private-label organic line, in addition to carrying major organic brands.

The increased demand for organic products put a strain on the supply and led to the inclusion of a goal in the USDA strategic plan to increase the number of certified organic operations (USDA, 2014). One key factor to achieving this goal is whether farmers know that they will receive a sufficient economic return if they switch to organic farming. McBride et al. (2015) find that the economic return on organic field crops is higher than for nonorganic field crops. This is primarily due to the higher price premium that organic farmers receive for their crops. Organic field crops are also used as feed for organic animals and ingredients in organic food sold to consumers.

While field-crop farmers can determine their organic premium by examining prices at the wholesale terminal-market[2] level, retailers and investment firms need to know the retail-level organic price premium—i.e., the extra cost consumers pay for purchasing certified organic foods. For farmers who use direct marketing (generally not used for field crops), studies find that prices are set based on local demand and supply (King et al., 2010) and these farmers can compete with grocery stores, particularly in rural areas (Valpiani et al., 2015). Knowledge of the organic price premium at the retail level can assist these farmers in setting prices for the direct-sale market.[3] In addition, consumers may be interested in knowing whether the extra price they pay for organic food is because it is organic, or because of some other factor (such as the flavor or some level of processing desired by the consumer).

This report estimates the organic price premium for 17 products (including eggs and dairy products, fresh fruits and vegetables, and processed foods) for 2004-10, using Nielsen Homescan consumer panel data to determine the major trends in organic price premiums.

[1]The National Bureau of Economic Research defines the Great Recession as an 18-month downturn in the economy, lasting from December 2007 through June 2009.

[2]A terminal market is a central hub where agricultural commodities are brought for sale to food manufacturers and retailers.

[3]This statement is based on personal correspondence with Terry Long of USDA's Specialty Crops Market News regarding unpublished results from the USDA, Agricultural Marketing Service's 2014 Survey of Organic Producers (March 31, 2015).

Background

In order to sell an organic product in the United States, there are specific rules at each stage of the food supply chain—from the farmers and livestock producers, through the food processors and transporters, to the food retailers (see box, "What Does It Mean To Be Organic?"). Producers and handlers must maintain a current organic certification through a USDA-accredited third party, as well as take steps to ensure that organic products are not comingled with nonorganic ingredients (including ensuring that the transportation services they employ do not allow comingling) or contaminated with prohibited substances. Although retailers are not required to maintain a certification, some choose to maintain a single certification at the retail level for their private-label products. Retailers also incur additional costs to keep organic and nonorganic products separated in the store. All these extra costs are reflected in the higher price of organic products. The best current estimates of the higher costs of organic food are at the wholesale level through USDA's Market News. The retail price premiums listed for fresh produce are based on store flyers and are for very specific products (such as Fuji apples in a 3-pound bag)—these are not necessarily representative of the entire retail market.

Despite higher costs, organic food is the fastest growing sector in retail food today. According to the National Business Journal, total sales for organic food were just under $11.5 billion in 2004, climbing to $35.9 billion in 2014 (Organic Trade Association, 2015c). Some of this growth occurred during the Great Recession, as evidenced by Mintel Group's 2011 description of organic as "one of the few bright spots in a generally dreary consumer economy" during the last recession. The positive growth trend continued after the recession—from 2011 to 2012, organic food sales grew 10.2 percent, compared with only a 3.7-percent growth rate for all food sales (Organic Trade Association, 2013a); they also grew 11.3 percent from 2013 to 2014 (Organic Trade Association, 2015c).

In 2012, 75 percent of all consumers bought organic food at least occasionally, up from 66 percent in the early 2000s (Hartman Group, 2010). Additionally, 24 percent of all organic consumers today are considered core shoppers, meaning that they look for both the USDA organic seal and seek relationships with the farmer. An additional 24 percent purchase organic foods on a regular basis; the remaining organic consumers are occasional purchasers with a range of understanding of what it means for a food to be labeled organic (Hartman Group, 2010).

Although once believed to be a sector for the high-income consumer, organic consumers have always been fairly diverse in terms of income, race, and ethnicity (Dimitri and Oberholtzer, 2009; Lin et al., 2008; Organic Trade Association, 2015b; Organic Trade Association, 2015c; Smith et al., 2009; Stevens-Garmon et al., 2007). However, while organic consumers come from all income groups, studies indicate that price may continue to be a barrier for some consumers purchasing organic products during economic hardships. In a 2010 study of consumers, the main reason cited by consumers who reduced their organic purchases from one year to the next was a change in their financial situation (Hartman Group, 2010).

Additionally, organic food purchases are also strong among families with at least one child under age 18 living in the home: 81 percent of these families chose organic foods at least some of the time in 2013 (Organic Trade Association, 2013b). The Organic Trade Association further notes that organic shoppers with children tend to visit more stores per week than consumers with children who do not purchase any organic products (Organic Trade Association, 2013b).

What Does It Mean To Be Organic?

When an agricultural product sold in the United States has the word organic somewhere on the package or is otherwise represented as organic, the product has been produced through approved methods and is regulated by the U.S. Department of Agriculture's Agricultural Marketing Service's National Organic Program. The main goal of the program is to ensure the integrity of products marketed in the United States as organic. The organic label requires that foods and other agricultural products be produced and handled "through approved methods that integrate cultural, biological, and mechanical practices that foster cycling of resources, promote ecological balance, and conserve biodiversity. Synthetic fertilizers, sewage sludge, irradiation, and genetic engineering may not be used" (USDA, National Organic Program, 2011, p. 2). Once a product leaves the farm, the transporters, food processors, and retailers must guarantee that the organic products are not comingled with nonorganic products or contaminated with substances prohibited by the National Organic Program to ensure transparency and verification throughout the entire supply chain. (While we mention consumer preferences about the health and safety of organic foods, the USDA organic regulations do not address these topics.)

In order to maintain the integrity of the organic label, USDA's National Organic Program regulates all organic crops, livestock, and agricultural products. Farmers, ranchers, processors, and handlers must maintain a current organic certificate through a USDA-accredited third party (also known as a certifier). Both producers and handlers must keep accurate records which verify that they used only approved organic methods, including the use of organic ingredients in processed food. Certifiers inspect all certified operations at least once each year to verify that all USDA organic regulations are being followed in the growing or raising, transporting, and processing of organic products. In addition, USDA conducts audits and investigations using both monitoring and enforcement to ensure that all products labeled organic actually meet the USDA organic regulations.

If a product carries the USDA organic seal, that product must be both certified organic and have 95 percent or more organic content. However, products do not need to display the USDA organic seal to fall under the regulation. Some food processors may choose not to put the seal on their package; other products are labeled "made with organic ____," which indicates that the ingredients listed as organic meet the USDA organic standards, and that the product contains at least 70 percent organic ingredients. "Made with organic ___" products must also be certified, but they may not carry the seal. If the seller represents the product as organic and/or the word *organic* appears on the package, then it must follow the USDA organic regulations.

In this study, we chose to define a product as organic if it made any organic claim on the principle display panel (including products that contain at least 70 percent organic ingredients)—we cannot infer a product's organic status from brand names, ingredient lists, or other indicators due to data limitations. For more information on USDA's National Organic Program, visit the USDA Agricultural Marketing Service's National Organic Program website at http://www.ams.usda.gov/about-ams/programs-offices/national-organic-program.

The growing consumer base has increased organic's share of total food sales—the total is nearly 5 percent of total food sales, and it is significantly higher for some categories (such as fresh fruits and vegetables) (Organic Trade Association, 2015c). The fresh fruits and vegetables category continues to be the largest segment of organic food, occupying about 35 percent of all organic sales in 2012 (Organic Trade Association, 2013a). This is down slightly from earlier in the decade as snacks, packaged goods, condiments, meat, poultry, and fish occupy a slightly larger share than they did in the early 2000s (Dimitri and Oberholtzer, 2009).

Another trend affecting both organic and nonorganic produce is the rise of prepackaged produce items. In the past, consumers selected produce items from a bin and placed them in a bag themselves. Most produce items are now available in prewrapped packages, allowing for an expansion in national brands and private-label offerings (also called store brands). Prepackaged produce allows for an even greater diversity within each produce item as different levels of processing are available (e.g., prewashed, chopped, and microwave-ready bags).

Another trend that has contributed to the growing organic market share is the increase in the number of retail chains that offer both national- and regional-brand organic and private-label organic products. In 2000, only Whole Foods offered an organic private label; however, all major chains had an organic private label, and organic foods were available in most major grocery stores by 2008 (Dimitri and Oberholtzer, 2009). Organic snacks saw the largest growth in private-label sales in 2012, followed by dairy, breads, and grains (Organic Trade Association, 2013a). As private-label brands spread beyond the natural food stores, consumers are purchasing organic food from a broader spectrum of food outlets. About 58 percent of organic food was purchased in stores that were not health or natural food stores in 2012. Club stores were a small, but rapidly growing outlet for organic products in 2011 (Organic Trade Association, 2013a); in 2015, Costco was the largest seller of organic products in the United States (Ledbetter, 2015).

These changes to the organic sector led Dimitri and Oberholtzer (2009) to conclude that the market had shifted from supply driven (where farmers had trouble finding customers) to a demand-driven market with inadequate supply. The increased sales in the sector and previous estimates of organic price premiums suggest that consumers are willing to pay more for organic foods for certain products, particularly those like milk or baby food that are frequently fed to children. However, the number of dairy cows in the organic herds has not grown as rapidly as the demand for milk, mainly due to shortages in organic feed as well as the 3-year transition period required to convert nonorganic pastureland to organic pastureland (Greene, 2014; Greene, 2015). This may lead to higher organic price premiums in the future for milk.

USDA's Agricultural Market Service currently estimates the prices of organic products at the wholesale terminal market level, and at the retail level based on store flyers (USDA Market News), but there is not a complete retail estimate of price premiums. Consumers are clearly willing to pay for the extra costs of producing organic food but estimating how much more they are actually paying for organic is no small feat, even for a relatively simple product like carrots (let alone for more complex products, such as soup or bread). For example, carrots come in several different size packages, can be purchased with or without the tops, as baby carrots, or prechopped. While it is possible to compare the price of an organic and nonorganic, 1-pound bag of baby carrots sold under the same label, this would leave out chopped, shredded, and whole carrots, as well as other bag sizes. This method would also not allow researchers to capture any brand differences that the consumer may perceive. Likewise, soup and bread have multiple varieties, and soup can come in different types of packages. Thus, we cannot determine the organic price premium by simply comparing the

difference in price between an organic product and a nonorganic product at the broad retail-product category. The organic product may be more expensive simply because it has some additional level of processing or flavor desired by the consumer. Additionally, the organic premium would be underestimated if nonorganic products are in a more expensive package, such as a microwave-ready container, than the organic products.

Previous USDA research estimated price premiums for several produce items in 2005 and 2006 (Greene et al., 2009; Lin et al., 2008; Smith et al., 2009). These premiums ranged from about 15 percent for onions and carrots to about 109 percent for skim milk. These studies also note that products with the lowest organic premiums also had the highest organic market share (although organic milk has a high market share despite its high premium). However, these studies were not able to examine trends in organic price premiums.

In 2010, the Hartman group said that consumers believe that the price gap between organic and conventional food was getting smaller (Hartman Group, 2010). The Hartman Group further reports that many consumers are not willing to pay more than about 30 percent more for organic food. If the retail organic price premium is shrinking, then it may not be sufficient to offset the additional costs of production, leading farmers, ranchers, and handlers to exit the organic market. In this study, we test whether the organic price premium is getting smaller over time by estimating the premium for 17 products from 2004 to 2010, including milk and eggs, fresh fruits and vegetables, and processed foods.

Methods

We used Nielsen Homescan data to estimate a hedonic price model, which incorporated both demand and supply factors in one equation. Results from the estimated model allowed us to estimate the organic price premium over all specific products in a category, allowing us to estimate the organic price premium for an entire category (such as soup or bread) even though specific products come in a wide variety of flavors, packages, sizes, and health attributes. This model allowed us to control for these product characteristics.

Model

We use the concept of *product differentiation* to determine the trends in the organic price premium for 17 products. For organic food products to sustain a higher price than their nonorganic counterparts, consumers and producers must believe that that the two product versions are fundamentally different (see box, "The Organic Price Premium Depends On Product Differentiation").

We defined the organic price premium as the difference between the organic price and the nonorganic price when all other factors are equal. For example, to determine the premium for carrots, we could have defined carrots as whole carrots sold in 1-pound bags, where all carrots in the organic and conventional bag are of a similar size and taste. Unfortunately, this premium would have left out baby or prechopped carrots, larger and smaller bag sizes, and different levels of quality. While the taste and freshness of the carrots are not observable in most data containing prices, the brand is observable and some consumers may use the brand as a measure of quality. In other words, we need to be able to control for these factors to isolate the organic price premium.

The hedonic model was developed from a model introduced by Lancaster (1966) as an alternative to the neoclassical demand theory where consumers choose products available on the market or bundles of products. Instead, under Lancaster's model, consumers choose characteristics, such as flavor, nutritional value, color, package size, or level of convenience. The assumption was that each of these product attributes has a separate value and, therefore, an implicit price. Rosen (1974) augmented the theory by combining supply and demand into a single equation, assuming that each characteristic carried costs from the supply equation and willingness to pay from the demand equation. Rosen (1974) showed that, when a product market is in equilibrium, a product's price can be framed as a function of individual product attributes, and this function can be estimated with observable data. Underlying assumptions included the neoclassical assumption of perfect competition, and two additional assumptions: that the attributes can be separated, and that the product attribute space is continuous. Ladd and Suvannunt (1976) presented the combined equation and empirically tested it with prices of meat, dairy, and poultry items and the nutritional characteristics of each. Other studies used hedonic models to estimate the marginal price of characteristics of frozen meat and seafood (Ahmad and Anders, 2011), the treatment of laying hens and the price of eggs (Chang et al., 2010), and the price premium for organic food (He and Bernard, 2011; Kiesel and Villas-Boas, 2007; Lin et al., 2008; Smith et al., 2009). However, this study is the first to estimate the organic price premium over a broad range of products and years. In examining results over several years, we were able to identify additional attributes to include in our model; these were not identified in previous work, which generally covered a short timespan.

In our model, consumers purchase and stores supply a general product that can be decomposed into a collection of product characteristics, such as organic, taste, flavor, nutritional characteristics,

The Organic Price Premium Depends On Product Differentiation

Product differentiation occurs when both consumers and producers accept that the organic and nonorganic products are fundamentally different. Economic theory requires product differentiation to exist in order for producers to charge more, and for consumers to be willing to pay more for one product than the other.

On the producer side, a large part of the organic certification process focuses on rules and requirements that (a) describe how organic production is different from nonorganic production and (b) document those differences via detailed farm records. For example, the certification process requires organic farmers to avoid materials that are commonly used in nonorganic production, such as synthetic fertilizers and pesticides in crop production and the use of antibiotics and hormones in livestock production.

On the consumer side, the U.S. Department of Agriculture's (USDA) organic labeling requirements guarantee that the differences established by certified organic producers are maintained in the market place. Only products that meet production certification requirements can use the term *organic* or carry the USDA organic seal. Thus, a consumer knows that *USDA Organic* is intrinsically linked to the production practices specified by the USDA's National Organic Program.

With production and market differentiation firmly established by the USDA organic standards and labeling requirements, the price of organic products is determined by supply and demand factors. Because of the additional requirements and restrictions, organic crops and foods can have higher production costs than nonorganic crops and foods. At the same time, some consumers may have a higher willingness to pay for organic products than nonorganic products. These two factors (i.e., potentially higher production costs and willingness to pay) are the supply and demand forces that support a significant organic price premium; however, it is the establishment of product differentiation via the USDA standards and labels that allows the price premium to be sustained in the market.

and the package size and type. In equilibrium, the product price is influenced by both the cost of supplying these attributes and the demand for them. The model is:

$$(1)\quad p = \beta_0 + \beta_1(organic) + \beta_2(private\ label) + \beta_3(organic * private\ label) + \sum_{k=1}^{61}\delta_k(market)_k + \sum_{l=1}^{8}\zeta_l(retail\ channel)_l + \sum_{j=1}^{J}\gamma_j(product\ char)_j + e,$$

where p is the price paid in the purchase observation, *organic* is an indicator variable for whether or not the product claims to be organic on the package, *private label* indicates whether the product is sold under a store's private label brand, *product char* is a set of product characteristics that affects both the supply and the demand of the product, *market* is a set of binary indicators for the retail market, *retail channel* indicates the type of store (grocery, health food store, supercenter, mass merchandiser, etc.), β_i, δ_k, ζ_l, and γ_j are estimable parameters, and e is the error term. The product characteristics include the package size, flavor, type of product, purchase month, and indicators of quality (e.g., brand). Each of these impacts the supply and the demand of the product. For example, growing and producing organic food has a different set of costs than nonorganic food does, which affects supply (Greene et al., 2009; McBride et al., 2015; Slattery et al., 2011). At the same time, some consumers are willing to pay more for organic than they would for conventional food, which

impacts demand. When the market is in equilibrium, the organic attribute variable can accurately represent the combined contribution that organic makes to the product price.

A number of other product attributes, besides organic, will impact the price of the product. For example, many stores now sell organic products under their own private label. Because stores typically contract with other manufacturers to make the product, the supply chain for private label is different than for branded products (where the company which owns the brand also owns the processing facility). For consumers, it may also be less convenient to purchase some private labels because, unlike the potential presence of multiple national or regional brands, only one private label is generally available in any one store.

The season of the year also affects the price. For example, hot soup is not very appealing on a hot summer day in August, so consumers are not as likely to purchase soup in August as they are in November. Likewise, some fruits and vegetables can only be produced and harvested at certain times of the year, and must be stored (if possible) for other times. Additionally, stores sometimes reduce the price of some products when they are in high demand (Chevalier et al., 2003). The retail channel also affects the price since different channels represent different levels of retail services, and various retail services are appealing to different consumers at different levels (and have various levels of costs for the retailer). Technically, the retail channel is a general indication for a bundle of attributes (e.g., onsite bank, in-store bakery, range of fresh produce, only organic produce, or availability of nonfood items); these characteristics were beyond the scope of this paper, so we used a simple set of indicator variables for the retail channel to represent them.

The hedonic price model is typically estimated for one specific geographic market. Since we have national data and are interested in a national organic premium, we included indicator variables for each of the 61 geographic markets in the Nielsen Homescan data and the four nonmetro market regions. Other researchers using the same data included demographic factors instead of markets (Chang et al., 2010; He and Bernard, 2011; Lin et al., 2008). Chang et al. (2010) treated the demographics as willingness to pay and used the information to learn more about organic consumers. When we included these factors with the geographic markets, we found that much of the demographic differences were captured in the market indicator variables; hence, we used the market variables rather than consumer demographic variables when estimating the organic price premium.

The final set of attributes in the model is unique to each product. For example, for canned soup, we included whether the product is sold in a microwave-ready container, a can, a carton, or pouch. We also controlled for whether it is sold as condensed soup. Following Ahmad and Anders (2011), we included an indication of brand, which could reflect unobservable quality differences. We used a separate binary variable for each of the nonorganic brands except the variable(s) for the major nonorganic brand(s), which were omitted from the estimation to prevent perfect multicolinarity. The appendix tables list the attributes used for each product, along with the results from the model.

This model states that the price of a general product is a function of a long list of product attributes, one of which is organic. Since the model interacts the organic and private-label indicators, the organic price premium must be estimated by comparing the predicted general price under two cases: one where the product is nonorganic (i.e., where organic = 0) and one where the product is organic (i.e., where organic = 1). After estimating the parameters in equation (1), we estimated the organic premium by evaluating equation (1) with organic = 1 and organic = 0 and all other variables held at the mean, and taking the difference.

Many food industry analysts identify the organic premium as a relative premium, where the premium is described as the organic product's price as a percentage of the nonorganic price. In our notation, this relative premium was defined as:

$$(2) \qquad Org\ premium(\%) = \frac{100\left(E(p)\Big|_{organic=1,\,all\ else=mean} - E(p)\Big|_{organic=0,\,all\ else=mean}\right)}{E(p)\Big|_{organic=0,\,all\ else=mean}}.$$

Note that both the estimate of the actual premium and the relative premium (equation 2) are functions of the estimated parameters in equation (1). In order to calculate the variance of the organic premium, we used the delta method, which uses a Taylor's series expansion to estimate the variance (Cameron and Trivedi, 2010). That is, if γ is a function of all estimated parameters, θ, then we can write the variance as:

$$(3) \qquad s^2 = \left(\frac{\partial\gamma}{\partial\theta}\Big|\hat{\theta}\right)\left(\hat{V}(\hat{\theta})\right)\left(\frac{\partial\gamma}{\partial\theta'}\Big|\hat{\theta}\right),$$

where V is the covariance matrix of the parameters.

Data

The Nielsen Homescan data is an annual, nationally representative panel of households' retail food purchases (Einav et al., 2008; Zhen et al., 2009). During the early years of our study (2004-06), the panel included approximately 40,000 households. For the remaining years (2007-10), the panel was expanded to approximately 60,000 households. Nielsen's major customers are food manufacturers and vendors, but the wealth of information in the data is also useful to researchers. For each product-purchase observation, the data included the Universal Product Code (UPC), the price paid, the amount purchased, the type of retail channel (grocery store, supercenter, mass merchandiser, club, convenience store, drug store, natural food store, or other store), and various attributes of the product. Additional information was determined by reviewing the UPC description.

A participating household was asked to use a handheld scanner to enter each of its food purchases when the food was brought into the home. Participants were also asked to enter products purchased at stores, but consumed away from home, as well as the store where the food was purchased. When available, Nielsen used the store's scanner data to enter the price of the product; for other stores, the consumer was asked to enter the price. For products that did not carry a UPC, such as produce sold loose and bagged by the consumer, only the total purchase price and broad category (fruits and vegetables, bakery, meat, etc.) were recorded after 2006. For this reason, we could only determine the price per pound for products that were sold with a UPC. While this may seem like a limiting factor to examine the price premium of organic produce, many commonly consumed produce items were sold in standard size bags with a UPC during the study period. However, we were not able to examine the organic price premium for meat and poultry, which is predominantly sold by the pound and without a UPC.

The data also included the retail market area where the consumer resides. Recorded purchases were assumed to be made in this market area. For consumers residing in rural areas, ERS created market areas for each of the nine census divisions. Household demographic data were also included in the sample, but not used in estimating the model.[4]

Nielsen started coding whether the product was organic in 2004. Since the certification period began in 2002, this data set allowed us to examine the price premium from very close to the beginning of the USDA National Organic Program. Nielsen also included several codes for organic: one indicated whether the product carried the actual USDA organic seal, and another indicated whether the product made any organic claim on the package (including displaying the organic seal). This latter set included products that were made with organic ingredients, but did not qualify for the organic seal. Since a product cannot be sold as organic in the United States if it does not meet the standards of the USDA National Organic Program (Federal Code of Regulation, 2015), we include all products that Nielsen designated as organic or made with organic ingredients. Note that we only included products which made an explicit organic claim on the package. If the manufacturer only implies organic by brand name, including organic on the ingredient list or other mechanism of signaling to the consumer that the product is organic, Nielsen does not indicate that the product is organic.[5]

The statistical properties of the Homescan data were validated by two studies: Einav et al., 2008 and Zhen et al., 2009. Einav et al. (2008) matched Homescan purchase observations to data from a consumer-loyalty card program and found that quantity data is more accurately reported than price data. This is likely a result of the fact that Nielsen imputed prices by using store-level prices, averaged over a short period of time, instead of the actual price paid by the consumer. Zhen et al. (2009) compared the total expenditures of food purchases reported in Homescan with those in the Consumer Expenditure (CE) Study (a survey of U.S. consumers collected by the U.S. Bureau of Labor Statistics). They found that households that purchased more food (such as larger households) or those with a higher opportunity cost (such as higher income or more educated female heads of household) tended to underreport expenditures compared to the CE. While the price imputation and underreporting of purchases could cause biases in economic demand estimations, estimates of price differences are less susceptible to this bias where demographic information does not enter into the estimate itself. Since we compared the prices paid for organic versus nonorganic products, these limitations are less likely to affect results in our study.

One econometric issue does arise from the fact that the data are a panel (multiple purchases of a product are made by the same household in a given year). Because households tend to stick to similar shopping patterns and have unique tastes and preferences, it is reasonable to assume that the purchase observations made by the same household are correlated with each other. Many of these

[4]Demographic variables are not typically included in a hedonic price model, though a variation of the hedonic model has been used to understand demographic factors that may affect the willingness to pay for organic products. In this study, we are interested in the premium that is currently being paid by all consumers, so it is not appropriate to include demographic variables. As a sensitivity check, we did include demographic variables in early estimates of the model and the results did not significantly differ from the results presented here.

[5]The National Organic Program requires that any type of organic claim made on the package must comply with the organic regulations. However, our data do not allow us to identify claims beyond the front of package labels.

effects are not observable in our data, so we use a random-effects model to control for them.[6] This assumes that the households are randomly selected from a large population, and the set of unobserved effects associated with each household is also only one draw from a large population of unobserved effects. For the random-effects model, equation 1 becomes:

$$(4) \quad p_{it} = \beta_0 + \beta_1(organic)_{it} + \beta_2(private\ label)_{it} + \beta_3(organic * private\ label)_{it} + \sum_{k=1}^{61} \delta_k(market)_{ik} + \sum_{l=1}^{8}(retail\ channel)_{lit} + \sum_{j=1}^{J} \gamma_j(product\ char)_{jit} + (e_{it} + \alpha_i),$$

where the *i* subscript indicates the observation for household *i*, and the subscript *t* indicates the date of purchase. The time variable, *t*, also allows for multiple purchases in one day. The error term ($e_{it} + \alpha_i$) is now split into two parts: the random error, e_{it}, and the unobserved household effects, α_i. This model allows us to control for the unobserved household effects in both the estimation of the price premium and the standard error of this estimate (Cameron and Trivedi, 2010; Greene, 2000). When estimating this equation with these data, we must adjust the standard errors to reflect potential heteroscedasticity in the data caused by the unobserved household effects.

We selected products from three categories (fresh fruits and vegetables, eggs and dairy, and processed foods) to capture a broad spectrum of organic products with different sets of supply chains and consumer preferences. Within each category, we selected the foods that had the highest percentage of organic sales, purchase quantity, or purchase observations in 2010, based on the Homescan data—i.e., we ranked each product by percent of organic sales, percent of organic purchase quantity (weight or fluid ounces), and percent of organic transactions (table 1). We selected products that were ranked within the top 20 of at least one of these rankings. For fresh fruits and vegetables, we augmented our list with produce listed by the Environmental Working Group as having *high pesticide use* (Environmental Working Group, 2015) because we believed this was one source consumers would have consulted when making decisions about which products to purchase as organic.[7]

Of the products we studied, spinach had the highest organic share in our data—about 40 percent of all spinach sales, 30 percent of all purchases, and 28 percent of the total pounds sold in 2010 were organic. Although fresh fruits and vegetables are generally touted as the leaders in organic sales, granola and strained baby food both had greater market penetration than the next produce item (carrots). After fresh produce, dairy and bread are considered gateway organic items (Hartman Group, 2010). We found only a small percentage of bread sales were organic, but milk and yogurt both had a modest penetration rate (around 5 percent of total sales).

Other studies have also used these data to estimate organic price premiums (Greene et al., 2009; Lin et al., 2008; Smith et al., 2009; Zhang et al., 2009; Zhang et al., 2008), but those studies tended to cover a shorter time period and did not include as many individual product attributes.

---

[6]A fixed-effect model may appear to be more appropriate because of the possible endogenous relationship between the price and the error term. The benefit from a fixed-effect model comes from fully utilizing information on repeat purchases by the same household throughout a calendar year. Thus, any household characteristics that might be unobserved to the researcher but affect purchase behavior would be accounted for in a fixed-effect model. However, the drawback of a fixed-effect model would be the loss of information from households that only had a single purchase over the course of a year. For our study, the ignored transactions would approach 20 percent of the total transactions for a single product. More specifically, for the 14 of the 17 products, over 10 percent of the households that purchased the product recorded only 1 purchase, and 6 products had over 30 percent. For our study, we feel the drawbacks outweigh the benefits and, for this reason, we use a random-effects model that accommodates the single-purchase information.

[7]The USDA National Organic Program does not discuss the health impacts of organic versus nonorganic products.

Table 1

Organic sales, quantities, and purchase observations, 2004-10

Product		2004	2005	2006	2007	2008	2009	2010
Eggs and Dairy								
Eggs	Organic share of total sales of eggs (%)	0.75	1.35	1.81	1.97	2.16	2.65	3.42
	Organic share of total number of eggs (%)	0.27	0.38	0.56	0.82	1.03	1.05	1.44
	Organic share of total number of egg purchases (%)	0.41	0.62	0.80	1.14	1.33	1.37	1.67
Milk	Organic share of total sales of milk (%)	1.31	1.84	2.62	3.56	4.28	5.04	5.46
	Organic share of total gallons of milk (%)	0.63	0.88	1.16	1.89	2.37	2.29	2.62
	Organic share of total number of milk purchases (%)	0.94	1.27	1.70	2.57	3.19	3.05	3.43
Yogurt	Organic share of total sales of yogurt (%)	2.53	2.67	3.38	4.69	4.57	4.52	5.17
	Organic share of total pints of yogurt (%)	1.95	1.95	2.35	3.37	3.35	3.23	3.57
	Organic share of total number of yogurt purchases (%)	1.58	1.69	1.95	3.25	3.15	3.10	3.52
Fresh fruits and vegetables								
Apple	Organic share of total sales of apples(%)	1.39	1.97	3.52	3.44	3.93	5.26	6.58
	Organic share of total pounds of apples (%)	0.76	1.23	2.15	2.41	2.66	3.99	4.88
	Organic share of total number of apple purchases (%)	1.10	1.55	2.71	2.83	3.24	4.34	5.00
Carrot	Organic share of total sales of carrots (%)	3.55	5.22	11.39	12.03	14.42	14.67	14.69
	Organic share of total pounds of carrots (%)	2.99	4.70	10.38	10.94	14.27	15.12	14.84
	Organic share of total number of carrot purchases (%)	3.32	4.30	8.39	8.58	9.92	10.13	10.14
Celery	Organic share of total sales of celery (%)	0.70	0.81	1.44	2.33	1.77	1.97	2.22
	Organic share of total bunches of celery (%)	0.53	0.56	1.00	1.83	1.20	1.43	1.59
	Organic share of total number of celery purchases (%)	0.53	0.58	1.04	1.91	1.26	1.50	1.68
Potato	Organic share of total sales of potatoes (%)	0.39	0.51	0.84	1.09	1.29	1.30	1.57
	Organic share of total pounds of potatoes (%)	0.19	0.27	0.45	0.60	0.78	0.71	0.72
	Organic share of total number of potatoe purchases (%)	0.27	0.39	0.72	0.94	1.20	1.18	1.26
Salad	Organic share of total sales of salad (%)	4.93	5.49	6.65	6.54	7.33	8.83	10.82
	Organic share of total pounds of salad (%)	2.09	2.06	2.87	2.84	3.14	4.02	5.01
	Organic share of total number of salad purchases (%)	3.50	3.76	4.57	4.59	4.90	5.73	7.25
Spinach	Organic share of total sales of spinach (%)	5.90	5.66	19.23	25.41	31.93	31.94	40.06
	Organic share of total pounds of spinach (%)	1.70	2.13	10.50	14.19	19.92	21.25	28.00
	Organic share of total number of spinach purchases (%)	4.74	4.32	14.07	19.48	24.17	24.20	30.68
Single-ingredient processed food								
Canned beans	Organic share of total sales of canned beans(%)	0.74	1.77	2.97	3.89	4.12	3.86	3.89
	Organic share of total pounds of canned beans (%)	0.34	0.95	1.68	2.26	2.63	2.61	2.65
	Organic share of total number of canned bean purchases (%)	0.47	1.16	1.96	2.76	3.32	3.11	3.13
Coffee	Organic share of total sales of coffee (%)	0.43	0.82	1.42	1.52	1.81	2.06	2.90
	Organic share of total pounds of coffee (%)	0.20	0.39	0.71	0.74	0.82	0.72	0.80
	Organic share of total number of coffee purchases (%)	0.24	0.50	0.86	1.05	1.32	1.32	1.73

Continued—

Table 1

Organic sales, quantities, and purchase observations, 2004-10—continued

Product		2004	2005	2006	2007	2008	2009	2010
Multi-ingredient processed food								
Bread	Organic share of total sales of bread (%)	0.49	0.57	0.95	1.18	1.25	1.07	1.29
	Organic share of total pounds of bread (%)	0.27	0.34	0.58	0.78	0.83	0.67	0.80
	Organic share of total number of bread purchases (%)	0.29	0.33	0.55	0.74	0.71	0.58	0.66
Granola	Organic share of total sales of granola (%)	4.93	14.92	22.57	25.06	27.47	31.23	29.51
	Organic share of total pounds of granola (%)	3.24	9.24	15.32	21.07	22.92	26.04	25.20
	Organic share of total number of granola purchases (%)	4.47	10.90	17.62	22.96	25.19	27.55	25.23
Soup	Organic share of total sales of soup (%)	0.68	1.35	2.09	3.00	3.38	3.58	4.01
	Organic share of total pints of soup (%)	0.48	1.07	1.78	2.73	3.16	3.10	3.40
	Organic share of total number of soup purchases (%)	0.47	0.86	1.31	1.87	2.06	2.20	2.42
Spaghetti sauce	Organic share of total sales of spaghetti sauce (%)	0.55	2.12	3.24	3.43	3.13	2.63	2.45
	Organic share of total pints of spaghetti sauce (%)	0.28	1.45	2.16	2.27	1.99	1.64	1.46
	Organic share of total number of spaghetti sauce purchases (%)	0.35	1.74	2.54	2.60	2.17	1.78	1.67
Baby food								
Baby food - junior	Organic share of total sales of jr baby food (%)	0.86	0.71	1.38	3.29	4.86	4.63	6.80
	Organic share of total ounces of jr baby food (%)	0.45	0.41	1.24	3.08	4.59	4.49	7.57
	Organic share of total number of jr baby food purchases (%)	0.49	0.35	0.72	3.07	4.35	4.13	5.76
Baby food - strained	Organic share of total sales of strained baby food (%)	13.16	14.24	17.00	22.38	21.63	21.27	18.80
	Organic share of total ounces of strained baby food (%)	12.19	12.80	15.22	20.07	20.03	19.51	17.76
	Organic share of total number of strained baby food purchases (%)	9.79	11.14	10.95	13.39	13.32	13.05	14.13

Note: The organic sales of the number of purchases is the number of sales transactions of the product that were organic divided by the total number of transactions of that product. A transaction can be one or several units of the product. For example, if a Homescan participant purchases two packages of 1 dozen eggs at the same time, this is one sales transaction.

Source: USDA, Economic Research Service estimates using Nielsen Homescan Data, 2004-10.

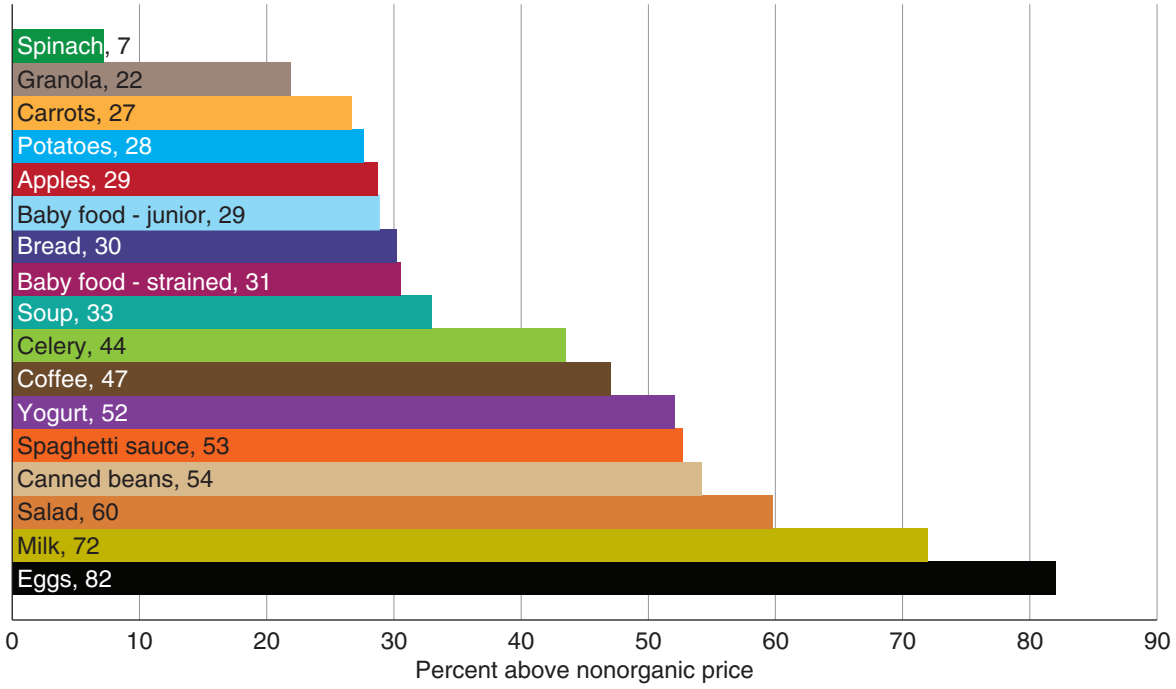
Results

We estimated equation 4 for each product and each year using STATA 14, xtreg with cluster robust standard errors. After estimating the premium, we used equation 2 to estimate the percent of the nonorganic price (or relative price) and equation 3 to estimate the delta method variance of both estimates, using STATA 14 nlcom command. Each year is run separately for each product to facilitate estimation with very large numbers of observations.

Organic price premiums as a percent of the nonorganic price for 2010 are in figure 1. In 2010, all premiums were positive—i.e., the organic price was higher than the conventional price after controlling for attributes that may affect the product's demand and supply. Dairy and eggs generally had the highest retail-level premiums, ranging from 52 percent of the nonorganic price for yogurt to 82 percent for eggs. Fresh fruits and vegetables (generally considered the largest part of the organic market) also had the widest spread of premiums, ranging from 7 percent for spinach to 60 percent for salad mix. Among processed foods, relative organic premiums ranged from 22 percent for granola to 54 percent for canned beans.

For the most part, price premiums exhibited the most volatility in the early years before 2007 (when the USDA National Organic Program was relatively new) (table 2). While some product price premiums did increase or decrease over the entire study period, most fluctuated from year to year. In order to check which changes were statistically significant, we regressed the premium as a percent of the conventional price on time, with one observation for each year. If time was significant, then we defined the premium as either increasing (positive coefficient on time) or decreasing (negative

Figure 1
Organic price premiums, 2010



Notes: Bars depict the size of the relative price premium for each product in 2010.
Source: USDA, Economic Research Service estimates from Nielsen Homescan data (2010).

Table 2

Organic price premiums, 2004-10

	2004	2005	2006	2007	2008	2009	2010	Trend
Eggs and Dairy								
Eggs								
Percent of conventional price	118.98	172.96	152.37	94.91	66.16	90.20	82.02	Undetermined
Variance	0.001	0.001	0.001	0.000	0.000	0.000	0.000	
Premium ($/dozen)	1.53	1.83	1.73	1.47	1.18	1.31	1.23	Decrease
Variance	0.002	0.001	0.001	0.000	0.000	0.000	0.000	
Milk								
Percent of conventional price	55.09	55.57	68.81	52.71	50.34	80.62	71.96	Undetermined
Variance	0.000	0.000	0.000	0.000	0.000	0.000	0.000	
Premium ($/gallon)	1.85	1.87	2.27	1.96	1.98	2.60	2.43	Undetermined
Variance	0.003	0.002	0.002	0.001	0.001	0.001	0.001	
Yogurt								
Percent of conventional price	25.49	28.44	42.17	42.02	35.11	40.24	52.05	Increase
Variance	0.000	0.000	0.000	0.000	0.000	0.000	0.000	
Premium ($/8oz)	0.18	0.20	0.30	0.31	0.27	0.32	0.43	Increase
Variance	0.000	0.000	0.000	0.000	0.000	0.000	0.000	
Fresh fruits and vegetables								
Apples								
Percent of conventional price	32.98	34.48	43.86	35.66	30.27	24.60	28.70	Undetermined
Variance	0.001	0.001	0.000	0.000	0.000	0.000	0.000	
Premium ($/pound)	0.26	0.28	0.39	0.35	0.33	0.24	0.29	Undetermined
Variance	0.001	0.000	0.000	0.000	0.000	0.000	0.000	
Carrots								
Percent of conventional price	21.12	24.86	19.87	22.23	24.59	25.35	26.66	Undetermined
Variance	0.000	0.000	0.000	0.000	0.000	0.000	0.000	
Premium ($/pound)	0.25	0.30	0.24	0.29	0.32	0.32	0.34	Increase
Variance	0.000	0.000	0.000	0.000	0.000	0.000	0.000	
Celery								
Percent of conventional price	41.44	47.57	40.34	28.91	45.86	36.80	43.54	Undetermined
Variance	0.000	0.000	0.000	0.000	0.001	0.000	0.000	
Premium ($/bunch)	0.51	0.61	0.51	0.40	0.63	0.50	0.60	Undetermined
Variance	0.001	0.001	0.000	0.000	0.001	0.000	0.000	
Potatoes								
Percent of conventional price	36.19	36.75	19.85	10.94	15.00	19.55	27.67	Undetermined
Variance	0.001	0.002	0.001	0.000	0.000	0.000	0.000	
Premium ($/pound)	0.15	0.16	0.10	0.06	0.09	0.11	0.16	Undetermined
Variance	0.000	0.000	0.000	0.000	0.000	0.000	0.000	

Continued—

Table 2

Organic price premiums, 2004-10—continued

	2004	2005	2006	2007	2008	2009	2010	Trend
Salad								
Percent of conventional price	38.62	61.30	46.11	49.52	59.24	61.97	59.78	Undetermined
Variance	0.000	0.000	0.000	0.000	0.000	0.000	0.000	
Premium ($/pound)	1.23	1.97	1.53	1.65	2.06	2.18	2.17	Increase
Variance	0.002	0.002	0.002	0.001	0.002	0.001	0.001	
Spinach								
Percent of conventional price	57.47	37.82	17.44	11.48	13.54	6.11	7.21	Decrease
Variance	0.004	0.001	0.001	0.002	0.000	0.002	0.000	
Premium ($/pound)	1.78	1.40	0.77	0.55	0.70	0.31	0.38	Decrease
Variance	0.036	0.020	0.017	0.059	0.007	0.040	0.010	
Single-ingredient processed food								
Canned beans								
Percent of conventional price	99.12	90.22	70.98	71.48	56.90	49.42	54.18	Decrease
Variance	0.001	0.006	0.000	0.001	0.000	0.000	0.000	
Premium ($/pound)	0.62	0.58	0.49	0.50	0.44	0.43	0.49	Decrease
Variance	0.000	0.003	0.000	0.000	0.000	0.000	0.000	
Coffee								
Percent of conventional price	105.60	75.85	76.00	65.58	49.47	47.65	47.07	Decrease
Variance	0.004	0.002	0.001	0.000	0.000	0.000	0.000	
Premium ($/pound)	3.97	3.22	3.34	3.03	2.44	2.35	2.36	Decrease
Variance	0.059	0.029	0.014	0.009	0.007	0.009	0.010	
Multi-ingredient processed food								
Bread								
Percent of conventional price	30.08	46.15	28.58	27.18	25.16	30.96	30.21	Undetermined
Variance	0.000	0.009	0.000	0.000	0.000	0.000	0.000	
Premium ($/pound)	0.42	0.66	0.43	0.43	0.43	0.53	0.52	Undetermined
Variance	0.001	0.017	0.000	0.000	0.000	0.000	0.001	
Granola								
Percent of conventional price	38.91	33.12	37.69	35.60	33.39	27.84	21.88	Decrease
Variance	0.019	0.001	0.002	0.000	0.000	0.000	0.000	
Premium ($/pound)	0.91	0.80	0.94	0.93	0.91	0.79	0.62	Undetermined
Variance	0.102	0.006	0.011	0.001	0.001	0.001	0.002	
Soup								
Percent of conventional price	21.30	18.28	16.20	16.73	19.21	24.96	32.98	Undetermined
Variance	0.000	0.000	0.000	0.000	0.000	0.000	0.000	
Premium ($/pint)	0.26	0.23	0.21	0.22	0.26	0.35	0.44	Undetermined
Variance	0.000	0.000	0.000	0.000	0.000	0.000	0.000	

Continued—

Table 2
Organic price premiums, 2004-10—continued

	2004	2005	2006	2007	2008	2009	2010	Trend
Spaghetti sauce								
Percent of conventional price	72.13	34.84	34.67	41.33	44.17	34.73	52.74	Undetermined
Variance	0.001	0.000	0.000	0.000	0.000	0.000	0.000	
Premium ($/pint)	0.77	0.37	0.38	0.45	0.52	0.42	0.64	Undetermined
Variance	0.001	0.000	0.000	0.000	0.000	0.000	0.000	
Baby food								
Baby food - junior								
Percent of conventional price	29.32	52.98	46.50	31.84	29.38	35.74	28.79	Undetermined
Variance	0.044	0.012	0.007	0.000	0.000	0.004	0.000	
Premium ($/6oz)	0.32	0.59	0.53	0.36	0.36	0.43	0.34	Undetermined
Variance	0.054	0.015	0.009	0.000	0.000	0.005	0.000	
Baby food - strained								
Percent of conventional price	18.20	17.79	22.08	26.19	23.72	27.78	30.51	Increase
Variance	0.000	0.000	0.000	0.000	0.000	0.000	0.000	
Premium ($/4oz)	0.11	0.11	0.13	0.16	0.16	0.19	0.22	Increase
Variance	0.000	0.000	0.000	0.000	0.000	0.000	0.000	

Source: USDA, Economic Research Service.

coefficient); other products had premiums which we defined as fluctuating. For example, the retail organic price premium for spinach dropped from 57 percent of the nonorganic price in 2004 (or $1.78 per pound more for organic spinach) to about 7 percent in 2010 (or 38 cents per pound more for organic). Both the actual price premium and the relative premium for yogurt rose during the study period, while the organic price premium for bread did not exhibit a clear trend.

Retail food prices were susceptible to price shocks and fluctuations based on agricultural commodities during 2004-10. From late 2007 through 2008, food prices experienced a major price spike after remaining steady for the previous years included in this study; prices spiked again in late 2010 and in 2011. Price spikes are caused by both supply factors (e.g., weather, energy prices, and changes in the major producers or growers) and demand (e.g., food-safety scares, media stories, and trends in food choices). In some cases, price fluctuations affecting organic food production may coincide with those affecting nonorganic food production—in these cases, the organic price premium may be unaffected by underlying price shocks. However, we might also expect that the organic food prices in a mature market may fluctuate in a way that is different than nonorganic food prices. For example, organic food producers tend to sign more contracts for ingredients than conventional producers due to difficulties obtaining organic commodities. The risk-reducing nature of these contracts will cause organic prices to spike about a year after the conventional spikes that are caused by things like weather or input prices. Thus, fluctuations in the organic price premium could be due to differences in supply and demand shocks for organic and nonorganic food.

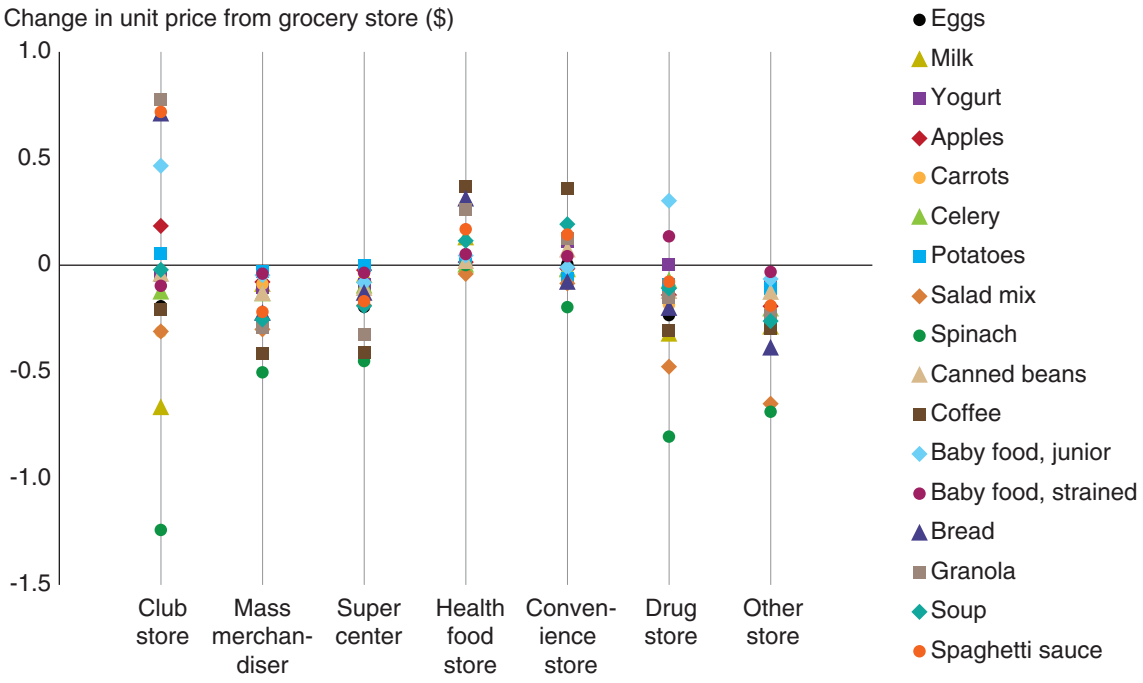
The detailed regressions results (appendix tables) show factors that affect demand and supply of all products, as well as attributes unique to each product.

Store Type, Season, and Geographic Market

Store type. All coefficients are compared to grocery stores in figure 2—a negative number indicates that the product is less expensive (on average) at the store type compared to grocery stores, while a positive number indicates it costs more. Mass merchandisers, supercenters, and other stores are generally less expensive than grocery stores (these differences are for all UPCs in the product, not just the organic or nonorganic one). Drug stores were also generally less expensive than grocery stores for items other than salad mix and strained baby food (although the number of observations for some products—particularly produce items—is lower than in the stores where food is more commonly purchased). On the other hand, convenience stores are generally more expensive (except for bread, milk, and spinach). Convenience stores may use bread and milk as *loss leaders* (i.e., selling commonly purchased items at less than their cost in order to bring people into the store in the hope that they will purchase other higher priced items). Club stores are mixed—about half of the products studied are more expensive and about half are less. Health food stores were not added to the data until 2007 (and for some products, not until 2010)—our results suggest that health food stores are more expensive.

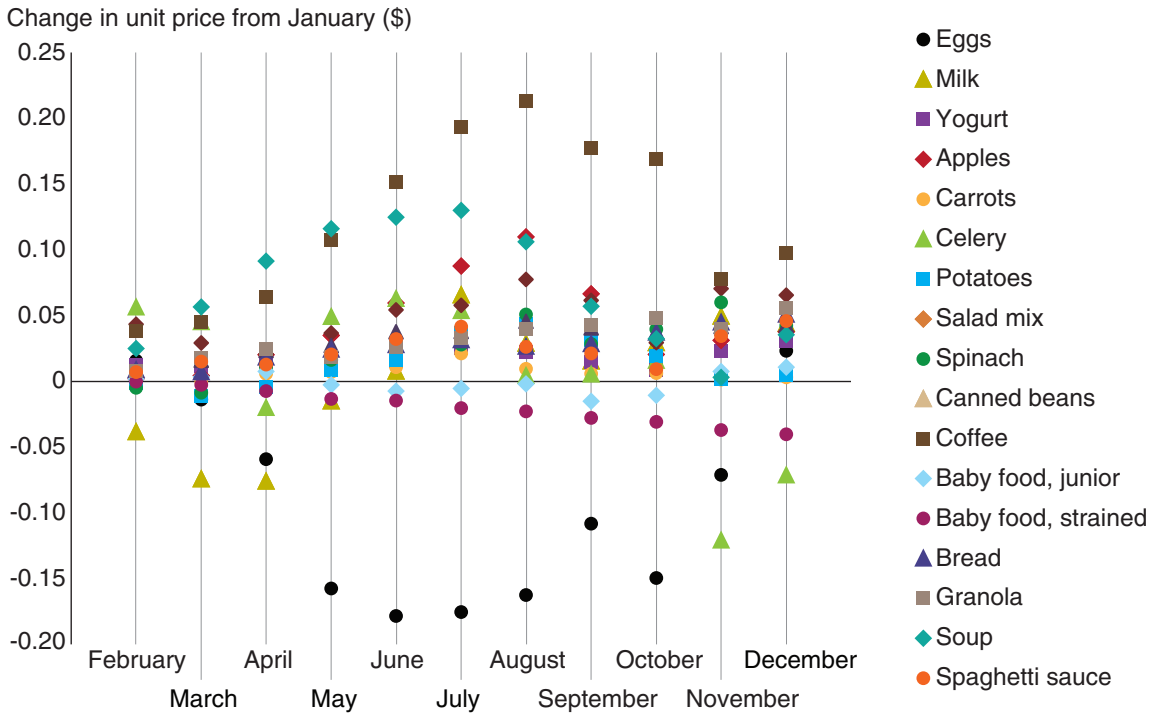
Month of the year. Many products have a seasonal fluctuation in prices—i.e., they are more expensive during certain months of the year. In order to appropriately study seasonality, we would need to run the models over several years and use a fixed effect for season. However, this approach would make it difficult to estimate the organic price premium in each year. The changes shown in figure 3 are changes in the unit price from January of that year, and represent changes in both supply and

Figure 2
Impact of store type on unit price



Notes: Each dot represents the average change in price for that product, compared to grocery stores. For example, granola costs about $0.77 per 8 ounces more at club stores than at grocery stores. This estimate is an average of 2004-10 for every item in the product category, not just the organic items.
Source: USDA, Economic Research Service estimates from Nielsen Homescan data (2004-10).

Figure 3
Impact of month on unit price

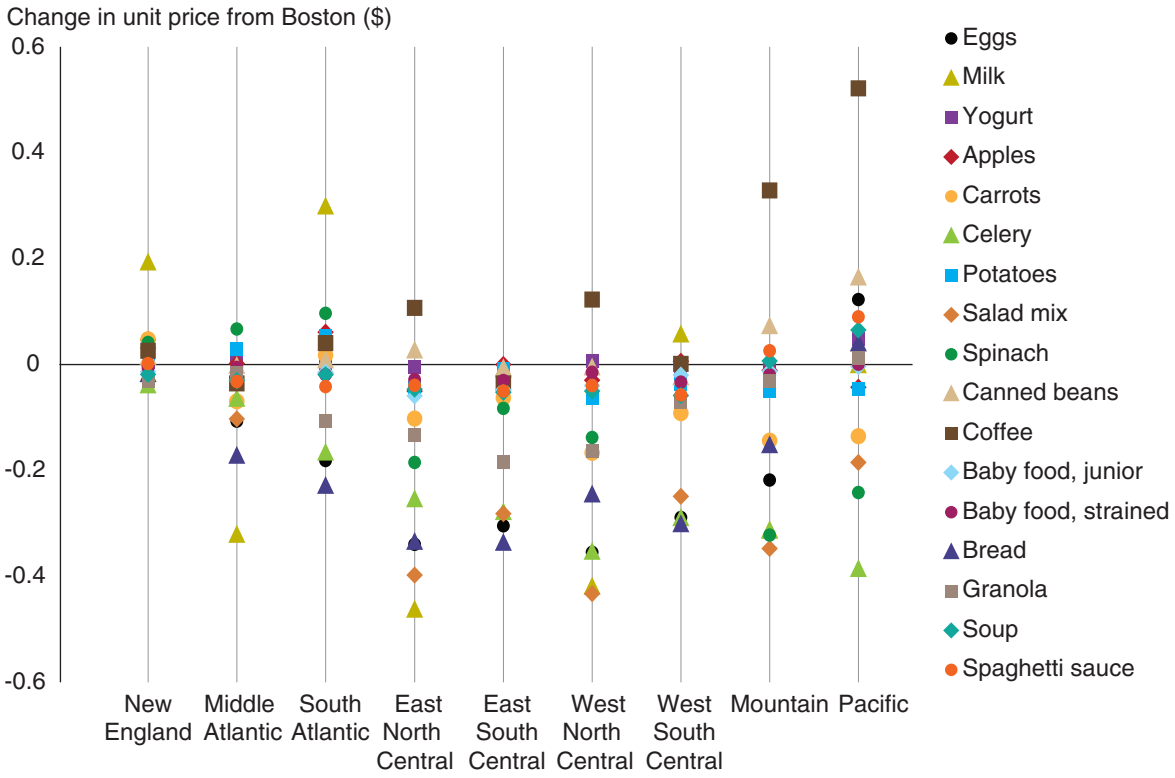


Notes: Each dot represents the average change in price for that product, compared to January of the same year. For example, celery costs about $0.05 per bunch more in February than in January. This estimate is an average of 2004-10 for every item in the product category, not just the organic items.
Source: USDA, Economic Research Service estimates from Nielsen Homescan data (2004-10).

demand. We might see prices increasing throughout the year under normal inflation; thus prices that are higher in November or December compared to January do not necessarily mean that these products exhibited a seasonal fluctuation in these months. However, prices that are consistently higher or lower in April, May, June, July, August, or September than in the other months may mean there are seasonal effects to the price of the product. For example, eggs are consistently less expensive from April through November. Since chickens lay more eggs in the summer months, this may represent a supply-side seasonal effect. Similarly, apples increase in price until July and start to decrease in price as the new harvest appears in stores in late August and September. Soup is more expensive from May through August–the price decreases in the fall months. Chevalier et al. (2003) also found that soup is less expensive during colder weather, and suggest stores charge a lower price during peak demand times.

Geographic market. The analysis included a fixed effect for each individual market, defined as major metropolitan areas, and an additional set for rural areas for each census division. Differences in prices of aggregate food groups by these same geographic markets are documented by the Quarterly Food at Home Prices Database (QFAHPD) (Todd et al., 2010). We estimate geographic differences for individual products instead of groups of products, so direct comparison to the QFAHPD is not possible for most of our products. However, Todd et al. (2010) demonstrate that geographic price differences are significant, which we also found to be true. For example, we compare the change in the unit price between Boston and other markets in figure 4. Each dot represents a separate market. Not surprisingly, prices in New England are closer to prices in Boston than

Figure 4
Impact of region on unit price



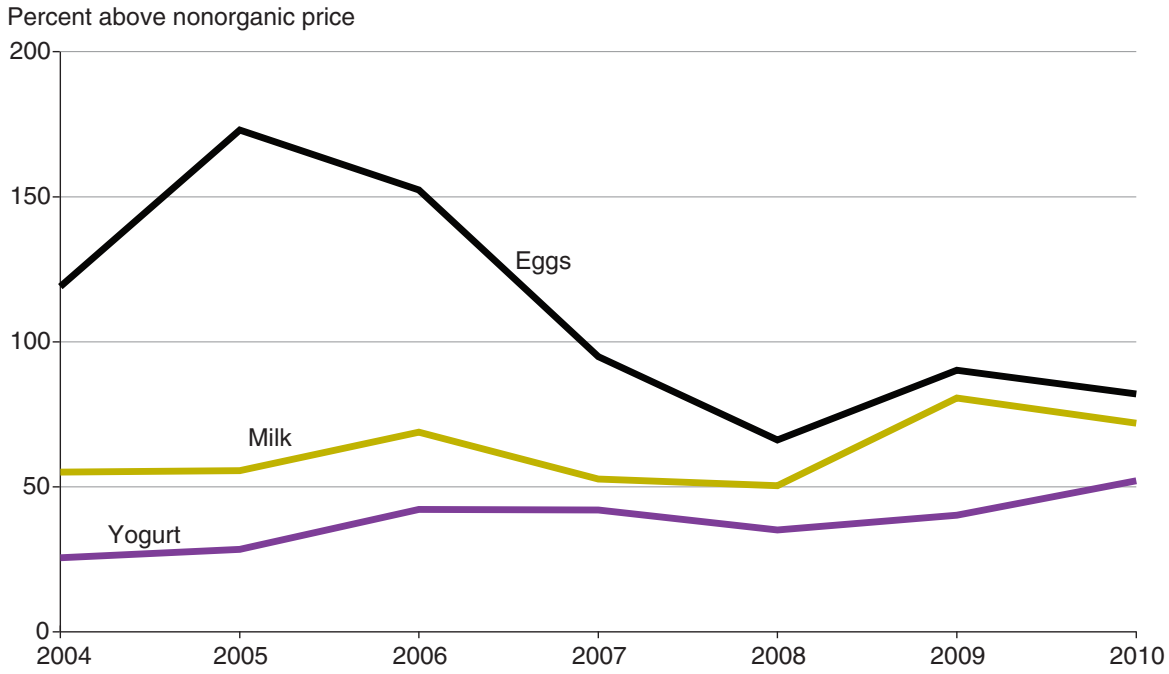
Note: Each dot represents the average change in price for that product, compared to Boston, MA. For example, milk costs about $0.30 per gallon more in the South Atlantic States than in Boston. This estimate is an average of 2004-10 for every item in the product category, not just the organic items.
Source: USDA, Economic Research Service estimates from Nielsen Homescan data (2004-10).

in other parts of the country. Yogurt has a consistent price across the entire country. Milk generally costs less in the Middle Atlantic and the North Central regions, where milk is commonly produced; however, it cost more in the Pacific, including California, which is also a large dairy production State. Compared to prices in Boston, eggs are typically cheaper in most other cities (except for those in the Pacific market). Produce prices seem to decrease in markets that are further west; most produce items included in this study are produced in the West, especially the Mountain and Pacific regions. Canned beans and baby food demonstrate consistent prices across the country, while coffee is more expensive in the Mountain and Pacific markets. The Central and Mountain markets had lower prices than Boston for bread, granola, and soup, and the Central markets also had lower prices for spaghetti sauce.

Eggs and Dairy

Yogurt, milk, and eggs had organic price premiums that were generally higher than the other products (fig. 5). This difference was likely driven by supply-side cost issues since organic livestock farmers must provide their animals with organic feed and pasture land, cover the cost of transitioning from a conventional to an organic herd, and only use organic healthcare practices (which do not allow the use of antibiotics or growth hormones).

Figure 5
Organic price premiums for dairy and eggs



Source: USDA, Economic Research Service estimates from Nielsen Homescan data (2004-10).

Eggs, milk, and yogurt are considered part of the organic dairy sector, which experienced a 7.1-percent growth in 2012. From 1999 to 2009, the sector experienced a 22-percent compound annual growth rate, compared to 17 percent for the entire organic market.[8] The limited number of producers kept premiums high through at least 2012 (Organic Trade Association, 2013a). The premiums for two of the three products—milk and eggs—were the highest in the study, so it is not surprising that the lower priced private label has come to be an important part of the market since 2009, particularly in the period beyond the years of this study.

Despite the higher premium for these three products, they are among the most popular organic foods chosen by consumers. In 2012, 89 percent of households with children who purchased organic food purchased organic dairy products, and 25 percent of these households reported that they always choose organic (Organic Trade Association, 2013b).

Eggs. In 2012, the organic egg market grew by 17.5 percent from 2011 (Organic Trade Association, 2013a). A major difference between organic and conventional eggs is that most organic eggs are brown, and brown-egg-laying hens tend to be less productive but get along better in a cage-free setting (Chang et al., 2010). Unlike other retail products, customers have a range of nonorganic options that have some of the attributes carried by the organic certification, including cage free, free range, and no hormones or antibiotics. Consumers can also choose nonorganic brown eggs, which

[8]The entire organic market includes all organic products including food and nonfood. Unless otherwise noted, this paper focuses on only the food market.

they may perceive as being more *natural*[9] than white eggs. Our data did not allow us to include cage free or free range in our model, but we did include the egg color. Other attributes included in the model are omega 3 content, pasteurized, size, and grade, all of which have been shown to affect the price of eggs on a national level (Chang et al., 2010). In recent years, producers are experiencing pressure to switch to cage free, nonorganic eggs (Organic Trade Association, 2013a). These eggs would keep the laying hens out of small cages, but farmers would not need to provide organic feed and could still use antibiotics.

Eggs saw the most dramatic drop in the organic price premium, though they still have the highest premiums in the study. In 2010, the organic egg premium was about 82 percent of the total conventional price, down from 173 percent in 2005. During this time, the Consumer Price Index (CPI) for eggs (dominated by nonorganic eggs) rose 33 percent in 2007, dropped during 2008-09, and rose again in 2010 (U.S. Department of Labor, 2014). While the 38-percent increase in the wholesale price of nonorganic eggs was due to salmonella in California, Minnesota, and Colorado (Piller and Brasher, 2010), the egg CPI continued to rise through 2014. The size of the organic price premium, on the other hand, followed the opposite trend. These price shocks to conventional eggs may explain the drop in the price premium as organic eggs may face different supply-side and demand-side factors than nonorganic eggs. Dimitri and Oberholzer (2009) found widely varying price premiums between 2004 and 2006, but their analysis only compared organic and nonorganic eggs, and did not consider other egg attributes. Chang et al. (2010) use quarterly point-of-sale data and observed an average premium of 85 percent for organic eggs during 2004-08. Our results appeared to be slightly higher, estimated on annual bases. Chang et al. (2010) did not control for the use of hormone or antibiotic use or the type of store or market; they also did not include an interaction term between private label and organic. However, they did include more attributes on production methods, such as cage free, pasture raised, and type of feed used, which our data did not allow us to include.

Milk. In 2012, milk and cream experienced a nearly 9-percent growth in organic sales and occupied about 57 percent of organic dairy sales (Organic Trade Association, 2013a). We observed that about 5.5 percent of fluid milk sales were organic in 2010, which is comparable to the Organic Trade Association's estimation of 5 to 6 percent. The Organic Trade Association (2013a) listed the size of the organic milk market in 2010 at $3.9 million. The price premium for organic milk fluctuated for a few reasons. The organic premium was affected by world (nonorganic) milk prices, which are typically cyclical. Milk prices rose rapidly in 2007 after both very low prices in 2006 (Glauber, 2008) and the droughts in Australia and New Zealand (Organic Trade Association, 2013a). Like eggs, the CPI (dominated by nonorganic milk) for milk rose 7.4 percent in 2007, dropped during 2008-09, and rose again in 2010 (U.S. Department of Labor, 2014). Organic milk did not experience the same price increase, so the premium as a percent of conventional milk price followed the opposite pattern. However, organic milk customers are more loyal than other categories—organic milk is one of the first products adopted and one of the last they forgo when budgets become tight (Organic Trade Association, 2013b). Despite this, we observed higher market penetration rates for other products, including apples, spinach, salad, carrots, baby food, and granola.

There were also other factors at play on the organic milk supply. First, milk yields are lower for organic practices than conventional practices—in 2010, an organic cow produced 13,552 pounds of milk while a conventional cow produced an average of 20,961 pounds (McBride, 2013). Pasture

[9]Unlike the word *organic*, *natural* does not have a legal definition in the United States. Consumers and food manufacturers may have different definitions of the term.

requirements for organic cows were clarified in 2010; regulations now require that organic cows graze for a minimum of 120 days and get at least 30 percent of their nutritional needs from grazing. Pasture grazing also reduces production (Greene and McBride, 2015). There is no pasture requirement for nonorganic cows, but a 2005 study indicated 18 percent of nonorganic dairies use some pasture grazing (Greene et al., 2009). The same study found that only 0.2 percent of domestic corn and soybean acres were certified organic; the shortages were even more severe in 2014 (Organic Trade Association, 2015a). Short supplies of certified organic feed may have forced organic dairies to make even greater use of pasture land or pay increasingly high prices for organic feed. There were also changes in the supply market chain as private-label milk increased from under 10 percent in 2004 to over 25 percent in 2010, according to our analysis of the Homescan data.

The milk model included package size, fat content, no lactose, calcium fortified, and kosher milk (we did not include flavored or shelf-stable milk in this estimate). The premium in 2010 was about 72 percent of nonorganic milk, and we found that milk premiums neither steadily increased nor decreased during the study period (although, like Dimitri and Oberholtzer (2009), we observed a large price spike in 2006). Our estimate for the organic milk premium in 2006 ($2.27/ gallon) is lower than that of Smith et al. (2009) ($1.86/half gallon or $3.72/gallon) or Dimitri and Oberholtzer (2009) (roughly double nonorganic prices 2004-06), but we included all sizes of milk packages, as well as additional attributes. When Smith et al. (2009) estimated the price premiums for 2006 data, half gallons were often the only available package size for organic milk. While this size still remains the most common, some Homescan participants reported purchasing organic milk in gallon containers.

Yogurt. According to market research firm Mintel, sales of yogurt and yogurt drinks grew 32 percent from 2004-09 (Mintel Group, 2009). During most of the 2004-10 time period, new product introduction was a primary driver of market growth—more than 800 new refrigerated yogurt products were introduced from January 2005 to October 2009 (Mintel Group, 2009). Greek yogurt brands, which are now widely popular, had not caught on until the end of the 2004-10 period. For example, the Greek yogurt brand Chobani's sales grew by almost 250 percent between 2009 and 2010 (Mintel Group, 2010). Dannon's Activia was also becoming an important brand; the Activia Light brand grew 19.8 percent from 2008 to 2009, although its primary brand (Activia) had no real growth over those 2 years (Mintel Group, 2009). In more recent years, the growing diversity in the yogurt market, especially the continued popularity of Greek yogurt, led to a small decline in organic yogurt sales in 2012 (Organic Trade Association, 2013a).

The diversity of yogurt is reflected in the number of attributes we were able to control for in our model. These included plain, flavored, fat, lactose level, probiotic (such as Activia), Greek or Skyr, added items (such as granola or fruit), nondairy, and an indicator for yogurt-based snacks. The organic price premium for yogurt increased over time, rising steadily from 25 percent of the conventional price in 2004 to 52 percent in 2010.

Fresh Fruits and Vegetables

Fresh fruits and vegetables are usually listed as the largest sector of the organic market, though this may partly be due to the sheer size of the produce category. In 2012, nearly all (97 percent) U.S. families who purchased organic foods chose organic fruits and vegetables at least some of time, while 28 percent chose organic produce all the time (Organic Trade Association, 2013b). Organic fruits and vegetables were about 35 percent of organic sales in 2012, up from 33.2 percent in 2010, with fresh fruits and vegetables representing about 90 percent of this category (Organic Trade

Association, 2013a). The Organic Trade Association reports 2010 total sales for fruits and vegetables, including canned and frozen, at over $8 billion.

When examining the organic sales of individual products (table 1), organic spinach sales were the highest in the study, but other fruits and vegetables were outranked by granola and baby food. Spinach was the only organic produce item whose price premium and relative premium decreased during 2004-10. Salad mix and carrots both saw an increase in the actual price premium, but not the relative premium. All other produce items examined had price premiums that may be exhibiting price cycles or are otherwise fluctuating. Price premiums for apples and vegetables that are predominately consumed fresh (salad mix and spinach) are in figure 6, while figure 7 shows vegetables that are more commonly cooked (potatoes) or are commonly used as an ingredient in cooked dishes (carrots and celery).

We compared our results to earlier ERS research using the 2005 Homescan data conducted by Lin et al. (2008) and expanded in an ERS report (Greene et al., 2009). Lin et al. (2008) included demographic and seasonal controls but did not include individual product attributes or interaction terms (our study included controls for markets but not demographics). While each produce item appeared to be fairly homogenous, there were product attributes that explained some of the variation in prices. In addition to ERS's work, He and Bernard (2011) compared the premiums for both organic and nonorganic/not genetically modified products for fresh and processed products; contrary to common opinion at the time, they did not find higher organic or nonorganic/not genetically modified premiums on fresh products over processed ones.

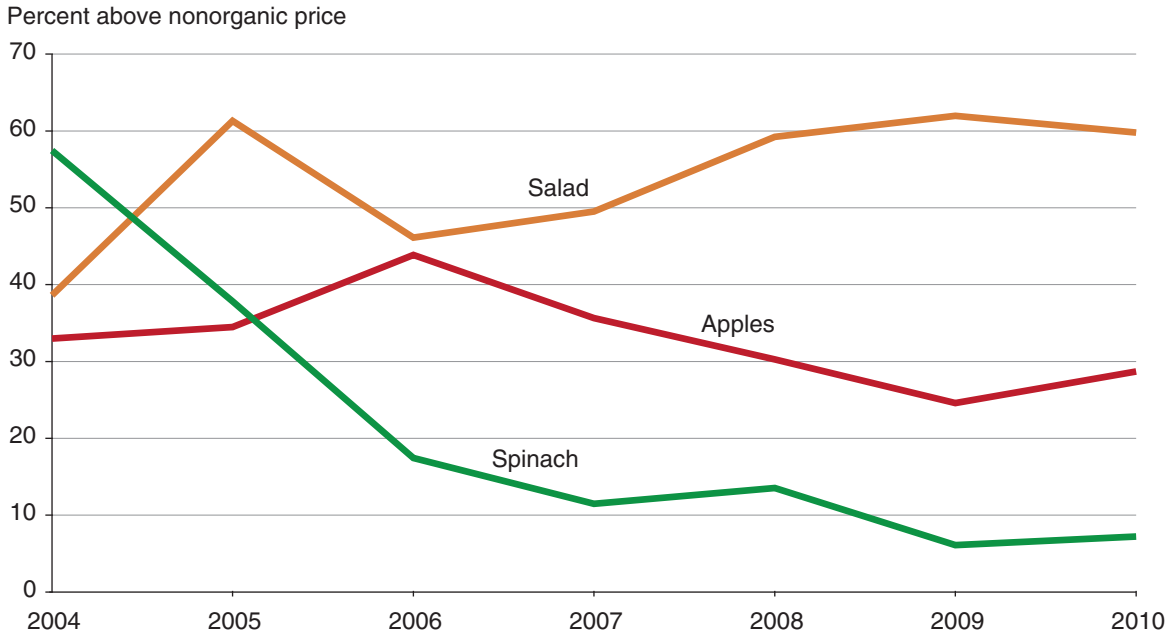
Apples. Apples were the most common organic fruit of choice for consumers in 2012 (Organic Trade Association, 2013a). We observed a penetration rate of 6.6 percent of total sales in 2010. At most stores, consumers can choose from a variety of apples, though the general 3-pound bag of apples is still available. The choice of type may also determine the decision whether to purchase organic apples. According to the 2010 Homescan data, the most common type of nonorganic apple was red delicious (29 percent of all nonorganic apple-purchase observations), but for organic apples, it was galas (53 percent of organic purchases)—organic red delicious represented only 8 percent of the organic purchase observations, and gala apples were only 21 percent of the nonorganic apples. Similarly, Pink Lady was more common in the organic market than in the nonorganic market (6 percent versus 1.5 percent, respectively) and Macintosh was more common in the nonorganic market (9 percent), while organic was very close to 0 percent. Other types of apples were about the same in the organic and nonorganic markets. Package size was also similar across both organic and nonorganic apples, and the 3-pound bag was the most common size.

The organic apple price premium decreased since its peak in 2006 to around $0.29 per pound or 29 percent of the conventional price in 2010. Our estimates were slightly higher than Lin et al. (2008) for 2005 ($0.32/pound versus $0.29/pound, respectively), but we included all types of apples (rather than treating apples as a uniform product). The most important price differentiating attribute was the type of apple.

Salad Mix. Prewashed and chopped salad mix changed dramatically during the 2000s. As consumers continue to seek out healthy convenience products, it may continue to occupy an expanded shelf space in the produce section. Salad mix has grown from a bin of spring greens sold on a random-weight basis to a varied prepackaged product with many different lettuce varieties and other vegetables mixed in. Products in this category now include cabbage and iceberg-lettuce-based

Figure 6

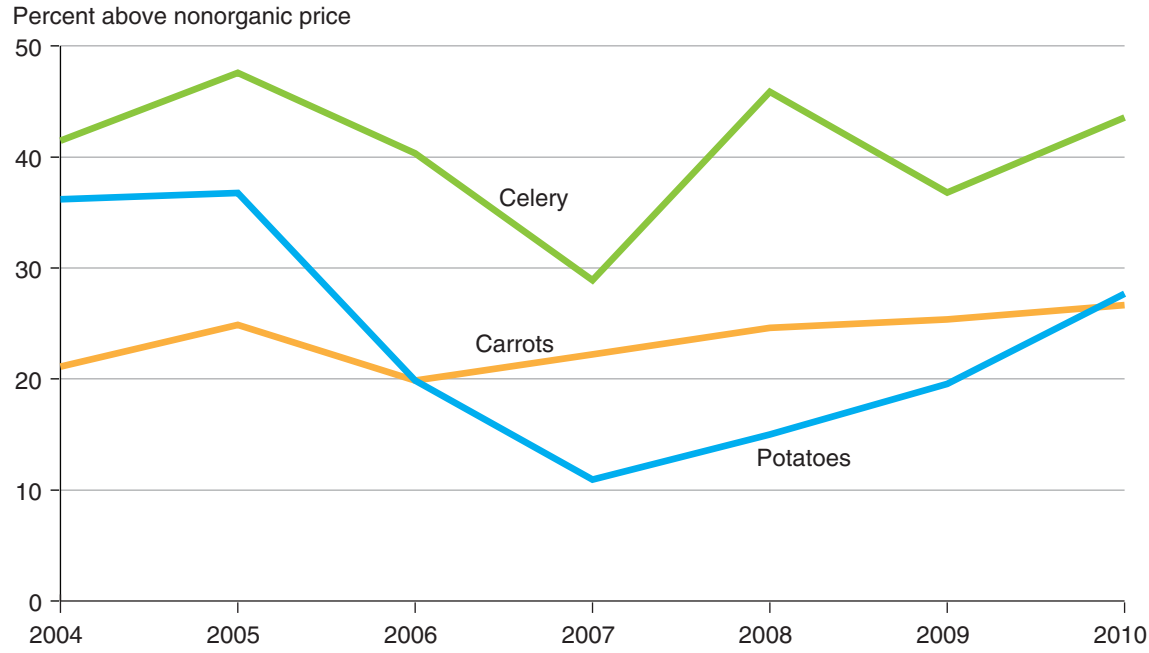
The spinach organic price premium is the only fruit and vegetable premium that fell significantly during 2004-10



Source: USDA, Economic Research Service estimates from Nielsen Homescan data (2004-10).

Figure 7

Organic price premiums for fresh vegetables are fluctuating



Source: USDA, Economic Research Service estimates from Nielsen Homescan data (2004-10).

mixes, packages that include spring greens and other more expensive mixes, and salad kits which include dressing, croutons, nuts, and dried fruit. Some mixes also include canned meat or bacon bits.

The data allowed us to determine the type of salad mix (though about half of the observations do not specify whether it was Caesar, spring, iceberg, Asian, meat, taco, arugula, cabbage, slaw, spinach, or herb mix). Only about 15 percent indicated how the greens were cut (chopped, cut, shredded, julienne, flat leaf, fine shred). Since these types were all significant and in the expected direction (premium mixes were higher cost while iceberg- and cabbage-based mixes were less expensive), we believe the remaining mixes were a general mix of different lettuces, cut in a variety of ways. The model also included an indicator for salad kits. Additionally, although the model includes a continuous variable for package size, preliminary analysis noted that the relationship between package size and price is not the same across the entire range of package sizes. There were two places where the linear relationship changed: one at 12 ounces (small) and one at 24 ounces (big). Finally, we included a set of indicator variables for minor nonorganic brands.

As a result of the dramatic changes to the salad-mix product, it is not surprising that the organic premium fluctuated during 2004-10. The 2010 premium was estimated at $2.17/pound or 60 percent of the conventional price.

Spinach. Organic spinach had the greatest market penetration of all products examined in this study (about 40 percent of total sales dollars, 28 percent of the quantity sold, and 31 percent of the purchase transactions in 2010) (table 1). Packaged organic salad greens (including spinach) were the top sellers in organic fresh vegetables in 2012 (Organic Trade Association, 2013a). Schroeter and Cai (2011) report that California and Arizona produce 85 percent of the U.S. spinach supply, and organic spinach sales increased by 250 percent from 2007 to 2010 (total organic and nonorganic spinach sales increased by 57 percent during the same time).

Spinach was also the most homogenous product of all items studied—the only real differences were baby and mature spinach and the package size. Our data did not allow us to determine the type of package (such as a clamshell or microwave-ready bag), which may affect results. In the spinach model, we interacted the indicator variable for baby spinach with the organic indicator one to control for differences on the supply side. Organic baby spinach carries a smaller premium (indicated by the negative sign on the organic*baby coefficients listed in appendix table A7). This could be because organic spinach growers elect to harvest earlier (baby spinach) to prevent insect damage. For those growers who wait to harvest the mature spinach, extra measures must be taken to control insect damage. Since nonorganic spinach growers can use pesticides to control insects, the production of nonorganic baby and mature spinach is more similar. Like in the salad-mix model, preliminary analysis found two points where the relationship between package size and price is nonlinear: one just below 5.5 ounces (small) and the other just above 1 pound (large). The model also included a set of binary variables for the nonorganic minor brands.

Spinach was the one produce item examined in this report whose organic price premium statistically dropped during the study period. We estimate that the 2010 premium for organic spinach was about $0.38 per pound or 7 percent of the nonorganic price, compared to $1.78 per pound, or 57 percent higher than the nonorganic price in 2004. The 2010 premium is actually up from $0.31 per pound or 6 percent of the nonorganic price in 2009. This overall decrease in both the premium and relative premium price may explain the rapid increase in organic spinach sales.

Carrots. Carrots are distributed by two major California sellers: Bolthouse Farms and Grimmway Farms supply 96 percent of the Nation's carrots (Wright and Marsh, 2012). They are sold under a variety of different brands and private labels. However, at any one store, consumers generally can only choose between private label and a brand (or they may have just one choice). Carrots are available in a variety of levels of convenience, including full size with limited processing, baby carrots, and a variety of precut carrots for salads and cooking (baby carrots are generally large carrots that are cut to smaller sizes). The most common package size was 1 pound.

Organic carrot price premiums generally increased from about 25 cents per pound in 2004 to 34 cents per pound in 2010, or 27 percent of the nonorganic price. However, the market fluctuated as a percent of the nonorganic price. Our 2005 estimate of the premium as a percent of the nonorganic price was 25 percent, compared to Lin et al.'s (2008) finding of 14.6 percent. Lin et al. included random-weight carrots, which we were not able to do. They also treated all carrots as the same product, while we included all packaged carrots (including baby, cut, and different bag sizes).

Celery. Consumers can purchase both whole stalks (or bunches) of celery and celery hearts, as well as precut sticks, diced for salad and cooking, and in kits with peanut butter and other complementary products. Celery sold as bunches or hearts is typically sold by count (or by the bunch), while the other products are sold by weight. Since the vast majority of the celery represented in our data was sold by bunch, we opted to estimate the premium over just the celery sold by count.

The organic premium for celery was about 44 percent of the nonorganic price, or about $0.60 per bunch or heart in 2010. Celery hearts are slightly more expensive per count (5 cents) than the whole bunch. The organic premium fluctuated throughout the study period.

Potatoes. Although potatoes are relatively inexpensive, the share of the organic market is quite small compared to other fresh produce items—less than 2 percent of all fresh potatoes purchased by Homescan participants in 2010 were organic. The main variation in the price of potatoes is the type of potatoes—sweet potatoes, gold, russet, red, regular white, Idaho, gourmet, and other specialty potatoes (e.g., new or multicolored). The major difference between the organic and nonorganic market was in sweet potatoes—in 2010, a higher percent of organic potatoes were sweet potatoes (10 percent) than in the nonorganic market (2 percent). Bag size is also important; in 2010, 55 percent of organic potatoes were sold in less than 5-pound bags, while only 12 percent of nonorganic potatoes were sold in small bags.

The organic price premium for potatoes appeared to vary from year to year and was not strictly decreasing or increasing. In 2010, it was about 16 cents per pound, or 28 percent of the conventional price. Our 2005 estimates were considerably lower than Lin et al.'s (2008)—$0.16/pound versus $0.47/pound, respectively. The major difference appears to be that our estimate controlled for the type of potato and the bag size. Since organic potatoes are more likely to be sold in the more expensive forms (sweet and small bags), not including the type and bag size would distort the price premium.

Processed Foods

Processed foods are the fastest growing sector of the organic market; they reached about 9 to 11 percent of the organic market by 2012 (Greene, 2013). The Organic Trade Association (2013a) classifies the foods we examined into several categories: canned fruits and vegetables (canned beans); beverages (coffee); breads and grains (bread, granola); and packaged and prepared food (baby food, soup, and pasta sauce). Canned organic products are an emerging category, partly due to the low

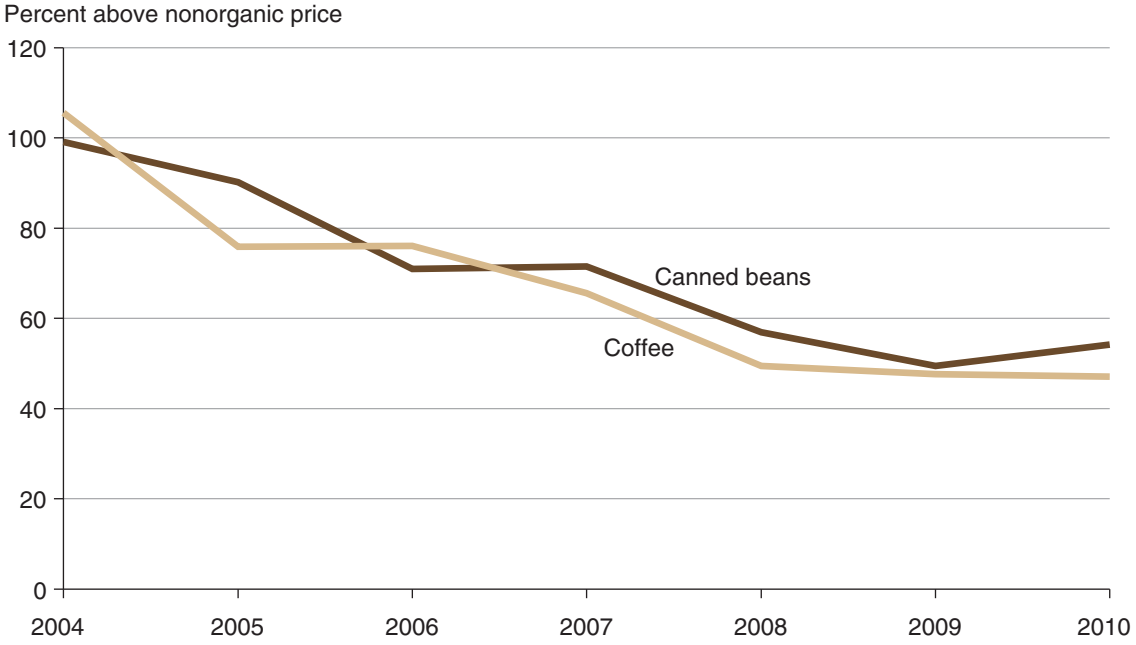
cost and high convenience of organic canned beans. All other categories have relatively low market penetration when compared to fruits and vegetables, but also represent the fastest growing parts of the organic food market (Organic Trade Association, 2013a).

Products in this section were chosen because of their high levels of market penetration. In particular, granola and baby food had market shares comparable to the fresh produce items chosen for this study. Snack foods and condiments are emerging categories listed by the Organic Trade Association (2013a), but we did not observe high penetration rates in our data for any single product in this category.

Despite the level of market share, we were not able to find any estimates of organic price premiums to compare our results. He and Bernard (2011) found differences in willingness to pay between organic and nonorganic processed food products but not genetically modified and conventional versions of similar products; these authors also found that consumers were more willing to substitute between the three categories (organic, nonorganic/not genetically modified, and nonorganic/genetically modified) for processed foods than they were for fresh products. We discuss single-ingredient products (canned beans and coffee in figure 8), multi-ingredient products (fig. 9), and baby food (fig. 10)—all of these products were more complex than both the eggs and dairy and fresh produce items.

Canned Beans. The biggest differentiating factors in canned beans were the type of bean and type of package. Pinto beans were the most common canned bean purchased by Homescan participants, while the most expensive was cranberry beans (green beans were not included). The standard package was a can, but beans could also be purchased in glass jars, plastic containers, and (more recently) in envelopes or pouches. The model included a set of binary coefficients for the nonorganic minor brands. The organic price premium decreased slightly, though it has decreased significantly

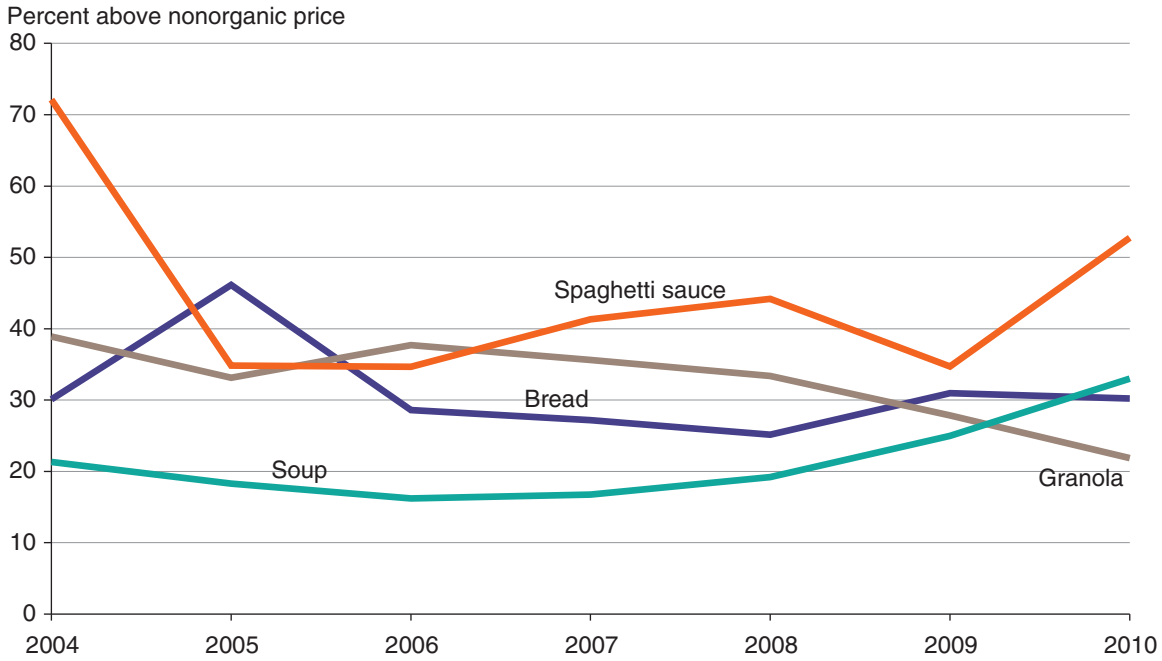
Figure 8
Organic price premium for single-ingredient processed foods decreased, 2004-10



Source: USDA, Economic Research Service estimates from Nielsen Homescan data (2004-10).

Figure 9

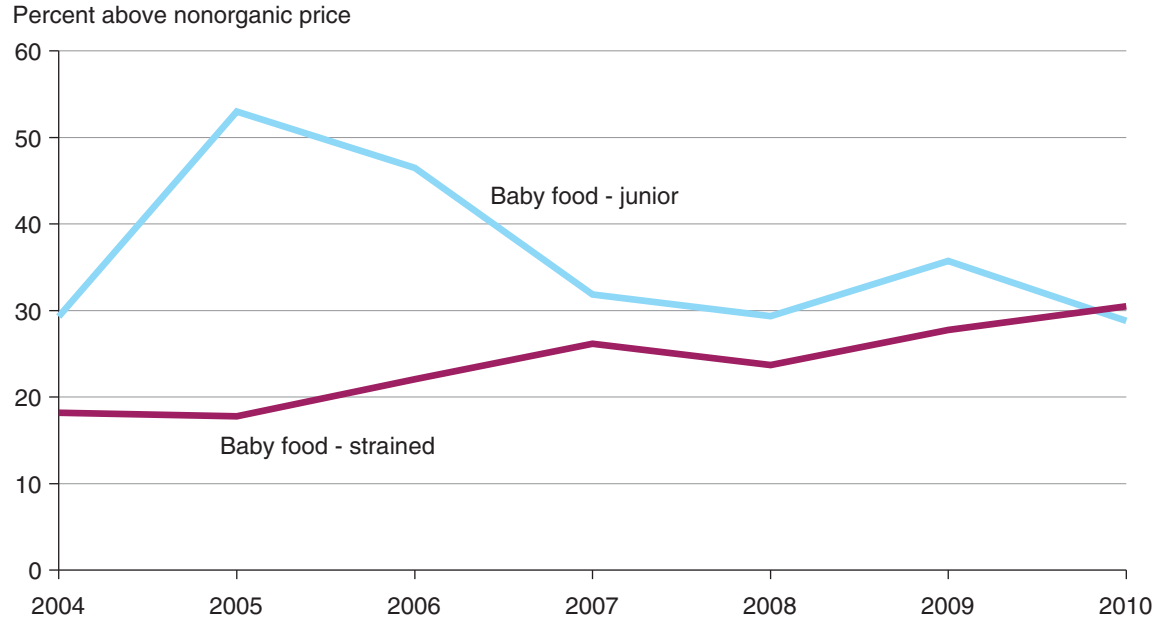
Organic price premium for soup is increasing



Source: USDA, Economic Research Service estimates from Nielsen Homescan data (2004-10).

Figure 10

Despite rising organic baby food sales, the premium for strained baby food rose over 2004-10



Source: USDA, Economic Research Service estimates from Nielsen Homescan data (2004-10).

as a share of the nonorganic price (from 99 percent in 2004 to 54 percent in 2010). The relative premium was higher than most of the fruits and vegetables included in this study, but the relatively low price of canned beans led the Organic Trade Association (2013a) to point out that paying the extra premium for organic beans was a small step for many consumers.

Coffee. Less than 1 percent of coffee by weight is organic, but organic coffee is almost 3 percent of sales among 2010 Homescan participants. Coffee also represents the highest category of all imported organic foods, mostly due to the fact that the only State in the United States with a climate suitable for growing coffee is Hawaii (Organic Trade Association, 2015a). Organic coffee sales grew dramatically in 2011 and 2012, but faced competition from fair trade and shade-grown coffee (Organic Trade Association, 2013a), not all of which was organic. Our data did not allow us to identify fair trade and shade-grown coffee, which may bias our results if the percent of coffee sold as fair trade or shade grown was different for organic and nonorganic coffee. Coffee was sold in plastic containers, bags, cans, pouches, and pods (the single-serving containers used in some coffee makers). This model did not include instant coffee, but includes all types of roasts. Random-weight coffee was not available in the data. Like canned beans, the organic coffee premium dropped steadily during the study period—from $3.97 per pound in 2004 to $2.36 in 2010. The percent of the nonorganic price also dropped from 106 percent to 47 percent.

Bread. While bread takes up a significant portion of at least one aisle in a typical grocery store, the market share for organic was less than 2 percent of Homescan participants' reported 2010 purchase dollars spent on bread. In 2012, bread was about 35 percent of the bread and grain organic category, which experienced an 8-percent growth rate in 2012 to almost 12 percent of organic food (Organic Trade Association, 2013a). We were not able to identify any dominant nonorganic national brands in the data, and thus did not include the set of binary variables for nonorganic minor brands included in some of the other models. Consumers choose from a wide variety of types of bread—e.g., whole wheat, 100-percent whole wheat, white, bran, oat, fruit, rye, pita, and potato. The organic price premium in 2010 was about $0.52 per pound, or 30 percent of the conventional price. Both the premium and the percent of conventional price fluctuated during the study period, and there is no clear trend.

Granola. In terms of total sales, the quantity sold, and the number of purchase transactions, granola's market share was second only to spinach of all the products included in this study. About 30 percent of granola sales reported in Homescan in 2010 were organic. It also made up 34.5 percent of the organic bread and grains category (Organic Trade Association, 2013a). Although there are a wide variety of granolas available on the market, data limitations prevented us from including more than three attributes: low fat (lower price), low sodium (higher price), and inclusion of flaxseeds (higher price). The model also included a set of binary coefficients to indicate the nonorganic minor brands. We found the overall trend for the price premium to be fluctuating, but the relative premium decreased from 39 percent in 2004 to 22 percent in 2010.

Soup. The market share for organic soup appeared to increase during the study period from less than 1 percent of soup sales in 2004 to about 4 percent in 2010. The Organic Trade Association (2013a) noted that this growth continued into 2012. Although there are a wide variety of flavors of soups available in the average grocery store, only a few attributes made a significant difference in the price: the type (condensed or standard ready to heat), low sodium, diet, and microwave-ready packaging. Despite the fact that market share increased, the premium and percent of the conven-

tional price fluctuated during the study period—in 2010, the price premium for soup was 44 cents per pint or 33 percent of the nonorganic price.

Spaghetti Sauce. The market share for organic spaghetti sauce reached a peak in 2007 (3.4 percent), but remained above 2 percent since 2005. However, sales of organic pasta sauces grew in 2012 (Organic Trade Association, 2013a). The data were very descriptive, particularly for health attributes. The model controlled for reduced fat, cholesterol, and salt, as well as chunky, Alfredo sauce, and imported spaghetti sauce. Consumers purchased spaghetti sauce in jars, cans, bottles, and pouches. The decrease in market share might be partially explained by the increase in both the premium and the percent of the conventional price since 2007. The premium in 2010 was $0.64 per pint, or 53 percent of the conventional price.

Baby Food. Organic strained baby food ranked third in market share of the products selected for this study (about 20 percent of sales). Baby food had the strongest growth among packaged and prepared foods in 2012 (23.2 percent) (Organic Trade Association, 2013a). Parents surveyed in 2012 chose organic baby food for a variety of reasons, but mostly because they believed it was healthier and safer for their babies (Organic Trade Association, 2013b). While junior baby food had a lower market share (6.8 percent), it was still higher than celery, potatoes, eggs, milk, and yogurt. Strained baby food was less complex than the junior baby food. The major attributes for strained baby food were vegetables, fruits, meat, dessert, and yogurt. In addition to these attributes, junior baby food included soup, assorted flavors (in a multipack), dinners, and breakfast. Consumers purchased strained baby food in jars and tubs, but junior baby food also came in bags, boxes, trays, refrigerated, and frozen. In our data, private-label junior baby food was only purchased as organic after 2007. Thus, the model did not include an interaction term for organic and private label until 2008. The strained baby food premium increased since 2004, from about 11 cents per 4 ounces to 22 cents per 4 ounces in 2010 (18 percent of conventional to 31 percent, respectively). The junior baby food premium peaked in 2005, but appeared to decrease after that, ending at $0.34 per 6 ounces or 29 percent of the conventional price in 2010.

Conclusion

Since the implementation of the USDA organic standards in 2002, the organic food sector has been one of the fastest growing parts of the food industry as organic products became available in more retail outlets. This study, which covers the 2004-10 period, estimates organic price premiums at the retail level and finds positive retail organic price premiums for all 17 products analyzed in this study. Additionally, most premiums did not steadily increase or decrease during this period, but fluctuated. Of the 17 products examined, only 3 (spinach, canned beans, and coffee) experienced a steady decrease in the premium, and only yogurt's price premium steadily increased.

We also found that organic premiums in 2010 (the last year of our study period) ranged from 7 percent above the nonorganic price for spinach to 82 percent for eggs. Ten of these products were above the 30-percent premium barrier reported by the Hartman Group (2010) for most consumers. Despite the fact that the premium remains above the perceived barrier, we found that the market share for organic products in our data increased for all products. Our analysis suggests that the levels and trends for organic premiums vary by product and cannot be adequately explained by a single set of factors. Product-specific supply and demand factors help explain some of the differences among our estimated organic price premium results for the 17 products.

Our analysis of organic price premiums in 2004-10 is hampered slightly by some limitations and concerns associated with the Nielsen Homescan data. Nielsen imputes prices from the store-level prices based on average store-level prices, rather than the actual price the consumer paid. There is also the possibility of the underreporting of purchases, particularly in households with very high opportunity costs of time. Additionally, since Homescan participants are recording every food purchase they make, they may become more price conscious over time than nonparticipating households. This potential behavioral change may cause some bias if participants are not purchasing the more expensive products at the same rate as a demographically similar nonparticipating household. Finally, our data do not allow us to study the organic premium in farmers' markets, roadside stands, Community Supported Agriculture (CSA), or other direct-sale markets. However, because of the extremely large number of observations and the strong link between product attributes and prices found in the data, we believe that these limitations are not likely to strongly bias our results.

Looking beyond 2010 to more recent years, shortfalls in domestic supply of organic food, feed, and ingredients caused food retailers and other industry participants to turn to imported organic products. According to a recent study by the Organic Trade Association (2015a), U.S. organic growers exported over $550 million worth of products in 2014. However, the United States imported nearly $1.3 billion in organic products. Although the leading organic import is coffee (which cannot be grown in the 48 contiguous States or Alaska), the second-largest import product is organic soybeans and the tenth largest is organic corn. The United States is also the largest grower of nonorganic soybeans and corn, perhaps reflecting some U.S. farmers' decisions to specialize in the nonorganic market.

Another trend in the U.S. organic market is the acceptance of several international standards as equivalent to the USDA organic standard. Under these USDA trade agreements, the two countries agree to treat their respective organic standards as equivalent. The first agreement was in 2009 with Canada; since then, the United States has added the European Union, Japan, Korea, and Switzerland (Agricultural Marketing Service, 2013, Agricultural Marketing Service, 2016).

These global supply and demand factors, including insufficient U.S. production and strong global demand, are likely to impact organic price premiums beyond 2010 and into the future. Research that investigates organic premiums beyond 2010 would help determine if organic supply shortfalls are causing organic premiums to increase, or if other factors (such as changing energy prices or market conditions) are playing a stronger role.

References

Ahmad, W., and S. Anders. 2011. "The Value of Brand and Convenience Attributes in Highly Processed Food Products," *Canadian Journal of Agricultural Economics/Revue Canadienne d'Agroeconomie* 60(1):113-33.

Cameron, A.C., and P.K. Trivedi. 2010. *Microeconometrics Using Stata, Revised Edition*. College Station, TX: Stata Press.

Chang, J.B., J.L. Lusk, and F.B. Norwood. 2010. "The Price of Happy Hens: A Hedonic Analysis of Retail Egg Prices," *Journal of Agricultural and Resource Economics* 35(3):406-23.

Chevalier, J.A., A.K. Kashyap, and P.E. Rossi. 2003. "Why Don't Prices Rise During Periods of Peak Demand? Evidence from Scanner Data," *American Economic Review* 93(1):15-37.

Dimitri, C., and L. Oberholtzer. 2009. *Marketing U.S. Organic Foods: Recent Trends From Farms to Consumers*, EIB-58, U.S. Department of Agriculture, Economic Research Service. http://www.ers.usda.gov/publications/eib-economic-information-bulletin/eib58.aspx

Einav, L., E. Leibtag, and A. Nevo. 2008. *On the Accuracy of Nielsen Homescan Data*, ERR-69, U.S. Department of Agriculture, Economic Research Service. http://www.ers.usda.gov/publications/err-economic-research-report/err69.aspx

Environmental Working Group. 2015. *EWG's 2015 Shopper's Guide to Pesticides in Produce*™. http://www.ewg.org/foodnews/?gclid=CPez6eCm6coCFYomhgod6UgEZQ

Federal Code of Regulations. 2015. "National Organic Program," Title 7, Subtitle B, Chapter I, Subchapter M, Section 205. http://www.ecfr.gov/cgi-bin/text-idx?rgn=div5&node=7:3.1.1.9.32

Glauber, Joseph. May 2008. "Statement of Joseph Glauber, Chief Economist," U.S. Department of Agriculture, Joint Economic Committee, U.S. Congress.

Greene, C. 2013. "Growth Patterns in the U.S. Organic Industry," *Amber Waves*, U.S. Department of Agriculture, Economic Research Service. http://www.ers.usda.gov/amber-waves/2013-october/growth-patterns-in-the-us-organic-industry.aspx#.VqDUk_krJhE

Greene, C. 2014. "Support for the Organic Sector Expands in the 2014 Farm Act," *Amber Waves*, U.S. Department of Agriculture, Economic Research Service. http://www.ers.usda.gov/amber-waves/2014-july/support-for-the-organic-sector-expands-in-the-2014-farm-act.aspx#.VqDU3fkrJhE

Greene, C., and W. McBride. 2015. "Consumer Demand for Organic Milk Continues to Expand—Can the U.S. Dairy Sector Catch Up?" *Choices* 2015(1).

Greene, C., C. Dimitri, B.-H. Lin, W. McBride, L. Oberholtzer, and T. Smith. 2009. *Emerging Issues in the U.S. Organic Industry*, EIB-55, U.S. Department of Agricuture, Economic Research Service. http://www.ers.usda.gov/publications/eib-economic-information-bulletin/eib55.aspx

Greene, W.H. 2000. *Econometic Analysis*, *Fourth Edition*. Upper Saddle River, New Jersey: Prentice Hall.

Hartman Group. 2010. "Beyond Organic and Natural 2010: Resolving Confusion in Marketing Food and Beverages," Hartman Group, Bellevue, WA. http://www.hartman-group.com/publications/reports/beyond-organic-and-natural

He, N., and J.C. Bernard. 2011. "Differences in WTP and Consumer Demand for Organic and Non-GM Fresh and Processed Foods," *Agricultural and Resource Economics Review* 40(2):218.

Kiesel, K., and S.B. Villas-Boas. 2007. "Got Organic Milk? Consumer Valuations of Milk Labels after the Implementation of the USDA Organic Seal," J*ournal of Agricultural and Food Industrial Organization* 5(1):1-40.

King, R.P., M.S. Hand, G. DiGiacomo, K. Clancy, M.I. Gómez, S.D. Hardesty, L. Lev, and E.W. McLaughlin. 2010. *Comparing the Structure, Size, and Performance of Local and Mainstream Food Supply Chains*, ERR-99, U.S. Department of Agriculture, Economic Research Service. http://www.ers.usda.gov/publications/err-economic-research-report/err99.aspx

Ladd, G.W., and V. Suvannunt. 1976. "A Model of Consumer Goods Characteristics," *American Journal of Agricultural Economics* 58(3):504-10.

Lancaster, K.J. 1966. "A New Approach to Consumer Theory," *Journal of Political Economy* 74(2):132-56.

Ledbetter, C. June 4, 2015. "Apparently, Costco Sells More Organic Food Than Whole Foods," *Huffington Post*. http://www.huffingtonpost.com/2015/06/04/costco-more-organic-whole_n_7513358.html

Lin, B.H., T.A. Smith, and C.L. Huang. 2008. "Organic Premiums of US Fresh Produce," *Renewable Agriculture and Food Systems* 23(03):208-16.

McBride, W. 2013. "Organic Costs and Returns," U.S. Department of Agriculture, Economic Research Service, Commodity Costs and Returns. http://www.ers.usda.gov/data-products/commodity-costs-and-returns/organic-costs-and-returns.aspx

McBride, W.D., C. Greene, L. Foreman, and M. Ali. 2015. *The Profit Potential of Certified Organic Field Crop Production*, ERR-188, U.S. Department of Agriculture, Economic Research Service. http://www.ers.usda.gov/publications/err-economic-research-report/err188.aspx

Mintel Group. 2009. *Yogurt-US-November 2009*, London, United Kingdom. http://store.mintel.com/yogurt-us-november-2009

Mintel Group. 2010. *Yogurt and Yogurt Drinks-US-December 2010*, London, United Kingdom. http://store.mintel.com/yogurt-and-yogurt-drinks-us-december-2010

Mintel Group. 2011. *Natural and Organic Food and Beverage: The Market-US-October 2011*, London, United Kingdom. http://store.mintel.com/natural-and-organic-food-and-beverage-the-market-us-october-2011

Organic Trade Association. 2013a. 2013 *Organic Industry Survey*, Washington, DC.

Organic Trade Association. 2013b. *U.S. Families Organic Attitudes and Beliefs: 2013 Tracking Study*, Washington, DC.

Organic Trade Association. 2015a. *Benchmark Study Yields Key Insights Into Global Organic Food Trade* ed. M. McNeil. Washington, DC.

Organic Trade Association. 2015b. *Organic Looks Like America, Shows New Survey: Diversity Of Organic Buyer Is Increasing, According To OT*A, Press Release, Washington, DC.

Organic Trade Association. 2015c. *U.S. Consumers Across The Country Devour Record Amount of Organic in 2014*, Press Release, Washington, DC.

Piller, D., and P. Brasher. 2010. "Egg Prices Increasing In Outbreak Aftermath," *The Des Moines Register*, August 24, 2010.

Rosen, S. 1974. "Hedonic Prices and Implicit Markets: Product Differentiation in Pure Competition," *Journal of Political Economy* 82(1):34-55.

Schroeter, C., and X. Cai. 2011. "It's All About Produce: Flexing the Muscles of Western US Organic Spinach Consumption," *Western Economics Forum* 10(2):10-22.

Slattery, E., M. Livingston, C. Greene, and K. Klonsky. 2011. *Characteristics of Conventional and Organic Apple Production in the United States*, FTS-347-01, U.S. Department of Agriculture, Economic Research Service. http://www.ers.usda.gov/publications/fts-fruit-and-tree-nuts-outlook/fts34701.aspx

Smith, T.A., C.L. Huang, and B.H. Lin. 2009. "Estimating Organic Premiums in the U.S. Fluid Milk Market," *Renewable Agriculture and Food Systems* 24(03):197-204.

Stevens-Garmon, J., C.L. Huang, and B.-H. Lin. 2007. "Organic Demand: A Profile of Consumers in the Fresh Produce Market," *Choices* 22(2):109-16.

Stewart, H., J. Hyman, J.C. Buzby, E. Frazão, and A. Carlson. 2011. *How Much Do Fruits and Vegetables Cost?*, EIB-71, U.S. Department of Agriculture, Economic Research Service. http://www.ers.usda.gov/publications/eib-economic-information-bulletin/eib71.aspx

Todd, J.E., L. Mancino, E. Leibtag, and C. Tripodo. 2010. *Methodology Behind the Quarterly Food-at-Home Price Database*, TB-1926, U.S. Department of Agriculture, Economic Research Service. http://www.ers.usda.gov/publications/tb-technical-bulletin/tb1926.aspx

U.S. Department of Agriculture. 2014. *Strategic Plan FY 2014-2018*. http://www.ocfo.usda.gov/usdasp/sp2014/usda-strategic-plan-fy-2014-2018.pdf

U.S. Department of Agriculture, Agricultural Marketing Service. 2013. *Importing Organic Products to the U.S*. https://www.ams.usda.gov/sites/default/files/media/Importing%20Organic%20Products%20to%20U.S..pdf

U.S. Department of Agriculture, Agricultural Marketing Service. 2016. *International Trade Partners*. https://www.ams.usda.gov/services/organic-certification/international-trade

U.S. Department of Agriculture, Agricultural Marketing Service. *USDA Market News.* http://www.ams.usda.gov/AMSv1.0/marketnews

U.S. Department of Agriculture, Agricultural Marketing Service, National Organic Program. 2011. *What Is Organic?* https://www.ams.usda.gov/sites/default/files/media/What%20is%20Organic.pdf

U.S. Department of Agriculture, Agricultural Marketing Service, National Organic Program. 2014. *National Organic Program*. http://www.ams.usda.gov/AMSv1.0/ams.fetchTemplateData.do?template=TemplateA&navID=NationalOrganicProgram&leftNav=NationalOrganicProgram&page=NOPNationalOrganicProgramHome&acct=AMSPW

U.S. Department of Labor, Bureau of Labor Statistics. 2014. *CPI Detailed Report: Data for October 2014*. http://www.bls.gov/cpi/cpid1410.pdf

Valpiani, N.H., P.E. Wilde, B.L. Rogers, and H.G. Stewart. 2015. "Price Differences across Farmers' Markets, Roadside Stands, and Supermarkets in North Carolina†," *Applied Economic Perspectives and Policy.*

Wright, D., and M. Marsh. 2012. "Baby Carrots: The Next Snack Food?," ABC News, *Nightline*, February 7, 2012.

Zhang, F., J.E. Epperson, C.L. Huang, and J.E. Houston. 2009. "Organic Price Premiums Paid for Fresh Tomatoes and Apples by US Households: Evidence from Nielsen Homescan Data," *Journal of Food Distribution Research* 40(3):106.

Zhang, F., C.L. Huang, B.H. Lin, and J.E. Epperson. 2008. "Modeling Fresh Organic Produce Consumption With Scanner Data: A Generalized Double Hurdle Model Approach," *Agribusiness* 24(4):510-522.

Zhen, C., J.L. Taylor, M.K. Muth, and E. Leibtag. 2009. "Understanding Differences in Self-Reported Expenditures between Household Scanner Data and Diary Survey Data: A Comparison of Homescan and Consumer Expenditure Survey," *Review of Agricultural Economics* 31(3):470-92.

Appendix Tables—Regression Results

The appendix tables (located at www.ers.usda.gov/publications/err-economic-research-report/err209.aspx) show the full regression results of equation 4 for each of the 17 products covered by this study. Data are drawn from the Nielsen Homescan data for 2004-10. Each product and each year are done as a separate analysis using STATA version 14.

A1: Eggs

A2: Milk

A3: Yogurt

A4: Apples

A5: Salad mix

A6: Spinach

A7: Carrots

A8: Celery sold by bunch

A9: Potatoes

A10: Canned beans

A11: Coffee

A12: Bread

A13: Granola

A14: Soup

A15: Spaghetti sauce

A16: Baby food, junior

A17: Baby food, strained