Price Promotion of Organic Foods and Consumer Demand

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Abstract:

Existing studies have examined the demand elasticities for organic products only in select categories, and their results for consumers' sensitivity to price changes are inconsistent. Evidence regarding the effects of price promotions on the demand for organic foods versus non-organic foods is scarce. This study aims to 1) examine the own-price elasticities of organic foods versus non-organic counterparts both with and without a promotion in a variety of product categories, and 2) investigate how the distinctive promotion effects between organic and non-organic counterparts depend on food category features. Using purchase data for 36 food categories from the 2015 Nielson Consumer Panel, we find differential own-price elasticities for organic and non-organic foods, regardless of whether the product is purchased with a promotion. When the products are purchased with a promotion, we find stronger price promotion effects of organic virtues than non-organic virtues and weaker price promotion effects of organic vices than conventional vices. Price promotions of organic foods are more likely to induce health-conscious consumers to switch from conventional purchases to organic purchases in virtues.

Keywords: organic virtues, organic vices, demand elasticity

1. Introduction

The U.S. organic industry has seen rapid growth nearly every year since the 1990s, organic food sales reached $50.1 billion in 2019, accounting for 5.8% of total food sales (OTA, 2020). A multitude of studies have investigated the organic price premiums and demand elasticities for organic foods (Jaenicke and Carlson, 2015, Yiridoe et al., 2005). However, their results are mixed regarding consumers' sensitivity to price changes of organic foods (Aschemann-Witzel and Zielke, 2017, Rödiger and Hamm, 2015).

Existing studies have estimated the demand elasticities for organic products only in select product categories (Rödiger and Hamm, 2015). The estimated own-price elasticities for organic milk are much higher in magnitude among certain studies (Jonas and Roosen, 2008, Lopez and Lopez, 2009) than others (Bernard and Bernard, 2009, Schröck, 2012). Glaser and Thompson (2000) find that the demand for organic milk is highly elastic, but it declined over the study period from November 1996 to December 1999. This concords with another finding of elastic demand for organic milk, based on retail scanner data from March 1997 to February 2002 (Dhar and Foltz, 2005). Compared with private label milk, the own-price elasticity for organic milk is higher in magnitude, and the demand for more expensive specialty milk is more elastic, indicating that consumers may abandon the pricy milk options when their prices rise (Lopez and Lopez, 2009). While two studies show more elastic demand for organic fruits and vegetables than their non-organic counterparts (Fourmouzi et al., 2012, Kasteridis and Yen, 2012), another study finds that this conclusion does not always hold for organic vegetables (Zhang et al., 2011).

The variation in product features may be a contributing factor to the inconsistent demand elasticities for organic foods (Aschemann-Witzel and Zielke, 2017). However, to our knowledge, evidence regarding such moderating factors is scarce. Based on store-level data for multiple

product categories, Bezawada and Pauwels (2013) find that the sales elasticity to regular price change is greater for organic than conventional foods. They also show that consumer sensitivity to regular price changes is greater in categories that have higher purchase frequencies, are so-called virtue products, and are less processed (produce, dairy, meat, and poultry), but it is lower for categories with higher organic price premiums.

Due to inconsistent findings of demand elasticities and the lack of evidence regarding consumers' responses to price promotions of organic foods versus non-organic foods, the first objective of this study is to investigate the own-price demand elasticities of organic foods versus non-organic counterparts both with and without a promotion in a wide range of product categories. The second objective of this study is to examine how consumers' differential responses to price promotions of organic foods versus non-organic counterparts depend on food category features, including the vice/virtue classification, whether the food is in a fresh category, the organic price premiums, and purchasing shares of organic foods in a product category. These factors are discussed in detail in the literature review section.

2. Literature Review

Relative vices refer to products that offer immediate hedonic experience but may lead to adverse long-term consequences (e.g., negative health problems). Relative virtues are products that provide less gratifying experience in the short-run but contribute to less negatives outcomes in the future (Wertenbroch, 1998). Past studies have applied the concepts of vices and virtues in two ways. One line of studies describes pairs of foods as relative vices and virtues (Parreño-Selva et al., 2014, Yan et al., 2017). For example, alcohol-free beer and alcoholic beer are considered relative virtues and vices, respectively, in Parreño-Selva et al. (2014). The other line

of studies defines healthy and unhealthy food categories as relative virtues and vices (Liu et al., 2015, Mishra and Mishra, 2011, van Doorn and Verhoef, 2011). For instance, baby carrots and potato chips represent pure virtues and pure vices, respectively, in Liu et al. (2015).

Consumers buy organic products because of their perceived benefits, such as nutrition value, taste, and environmental protection (Paul and Rana, 2012, Pino et al., 2012). In a previous experimental study, 115 participants were asked to evaluate the nutrition and taste of three paired food samples, including cookies, potato chips, and yogurt (Lee et al., 2013). One group of foods in the pair was labeled as "regular" and the other group was labeled as "organic", even though the two groups were actually identical, and both of them were organically produced. Participants perceived the foods with organic labels to be more nutritious, have a higher level of fiber, and have lower levels of fat and calorie than the foods labeled as "regular". Although organic foods are perceived to be healthier than their non-organic counterparts, whether an organic label induces higher food consumption may depend on the food type, especially the vice/virtue classification. Lee et al. (2018) find that an organic label is associated with increased consumption of a relative vice food but reduced intake of a relative virtue food.

Consumers' perceptions of quality, healthfulness, and environmental benefits may differ between virtues and vices, leading to differential willingness-to-pay (WTP) for vice and virtue foods. Based on multiple studies, van Doorn and Verhoef (2011) find that an organic claim's positive effect of prosocial benefits on WTP is stronger for vices than virtues, whereas the positive effect of quality perception on WTP is stronger for virtues than vices. There is also evidence showing that consumers are willing to pay a higher premium in fresh categories such as fruits and vegetables (Gil et al., 2000).

Previous studies have found distinct price promotion effects in relative vices and virtues. Parreño-Selva et al. (2014) show that consumers are more sensitive to price promotions of vice products (alcoholic beer) than virtue products (non-alcoholic beer). Consistent with this finding, Yan et al. (2017) also find that the price promotion effects are stronger for relative vice products than virtue products (i.e., "low fat", "low sugar", "low calorie") in crisps and beer. However, this finding is reversed in different food categories. That is, the price promotion effects are stronger for relative virtue products than vice products in baked beans and fresh fruit juices (Yan et al., 2017).

In addition to the vice/virtue nature, whether consumers are more sensitive to price changes of organic foods than non-organic counterparts may also depend on a number of other food category factors such as price premium and share of purchases (Bezawada and Pauwels, 2013). For example, Sridhar et al. (2012) find that the share of organic purchases varies across product categories, with less processed categories being the highest, and Van Doorn and Verhoef (2015) find that consumers are more likely to purchase organic foods in fresh and virtue categories.

Three review studies unequivocally conclude that price is the major barrier to organic purchases (Aertsens, 2009, Aschemann-Witzel and Zielke, 2017, Hughner et al., 2007). There are only a few studies that find other factors such as availability, information/knowledge, and product assortment as the primary inhibitors, but they rely on data from markets in early stages of development or from habitual consumers in mature markets (Aschemann-Witzel and Zielke, 2017). Organic price premiums and promotion intensity are negatively associated with shares of organic purchases (Van Doorn and Verhoef, 2015).

Studies of WTP for organic products have yielded varied estimates ranging from 0% to over 100% (Aschemann-Witzel and Zielke, 2017). The great variation can be attributed to several factors, including product category (product-specific features), consumer segment (consumer-specific characteristics), and labeling practice. For instance, a higher percentage of consumers in Greece are willing to pay a price premium of 30% or more for organic fruits and vegetables compared to other product categories (Krystallis, 2005). Hamzaoui-Essoussi and Zahaf (2012) divide consumers into three segments, including true organic food consumers, sporadic organic food consumers, and inexperienced organic food consumers. They find that true organic food consumers are willing to pay for the highest price premiums, whereas inexperienced organic food consumers are willing to pay for the lowest for all product categories (Hamzaoui-Essoussi and Zahaf, 2012). Consumers are willing to pay more for jams labeled as "100% organic", but the "95% organic" seal is not significantly associated with a price premium (Hu et al., 2011).

Sociodemographic characteristics rarely fall in the scope of the primary research question, but they are also important predictors for organic food purchases. Studies that are based on large sample sizes (e.g., consumer panel data) and rigorous research methods tend to confirm a positive relationship between household income and organic food choices (Jonas and Roosen, 2008, Ngobo, 2011, Schröck, 2012, Smith et al., 2009a). Educational attainment has been considered simultaneously with the income level to measure social class (Loureiro and Hine, 2002). A higher level of education is often associated with a higher propensity to shop for organic foods (Ngobo, 2011, Smith et al., 2009a, Wier et al., 2008). The presence of children is not always found to increase the probability of patronizing organic foods (Jonas and Roosen, 2008), but it tends to have a positive impact among families with young children (Smith et al.,

158 2009a, Wier et al., 2008). On the one hand, parents perceive organic foods as healthier
159 alternatives to conventional counterparts (Smith et al., 2009a). On the other hand, a larger
160 number of children and household size may impose a budget constraint that hinders organic food
161 purchases (Schröck, 2012).

162 **3. Data and Modeling Approach**

163 The Nielsen Consumer Panel data track all the food and non-food purchases of a panel of
164 households representative of the population in the United States. The households use in-home
165 scanners to record their purchases from anywhere. Using data from the 2015 Nielsen Consumer
166 Panel, we analyze consumer responses to price promotions of organic and non-organic products
167 in 36 food categories. Similar to previous studies (Liu et al., 2015, Mishra and Mishra, 2011),
168 relatively healthy and unhealthy foods as considered as relative virtues and vices, respectively, in
169 this study. A total number of 17,494,986 purchases (observations) are included in our analysis.

170 To estimate the own-price demand elasticities of organic versus non-organic foods both
171 with and without a promotion (objective 1), we use the following model specification:

172 $$lnQ_{ijt} = \beta_0 + \beta_1 lnPRICE_{ijt} + \beta_2 OR_{ijt} + \beta_3 PRO_{ijt} + \beta_4 lnPRICE_{ijt} * OR_{ijt} + \beta_5 lnPRICE_{ijt}$$

173 $$* PRO_{ijt} + \beta_6 OR_{ijt} * PRO_{ijt} + \beta_7 lnPRICE_{ijt} * OR_{ijt} * PRO_{ijt} + \beta_8 COLLEGE_j$$

174 $$+ \beta_9 FULLTIME_j + \beta_{10} INCOME_j + \beta_{11} SIZE_j + \beta_{12} CHILDREN_j$$

175 $$+ \beta_{13} MARRIED_j + \varepsilon_{ijt}$$

176 $$PriceElasticity = \begin{cases} \beta_1 & if\ \ OR_{ijt} = 0\ and\ PRO_{ijt} = 0 \\ \beta_1 + \beta_4 & if\ \ OR_{ijt} = 1\ and\ PRO_{ijt} = 0 \\ \beta_1 + \beta_5 & if\ \ OR_{ijt} = 0\ and\ PRO_{ijt} = 1 \\ \beta_1 + \beta_4 + \beta_5 + \beta_7 & if\ \ OR_{ijt} = 1\ and\ PRO_{ijt} = 1 \end{cases}$$

177 lnQ_{ijt} refers to the natural logarithm of the quantity of product i purchased at time t for
178 household j, measured as ounces. Each regression is conditional on a positive purchase of the

product. OR_{ijt} is a dummy variable indicating whether the product is organic. $lnPRICE_{ijt}$ indicates the natural logarithm of the unit price of product i at time t, measured as dollars per ounce. For each purchase, coupon value is deducted from the total price paid by consumers to generate the final price that consumers pay. We then calculate the unit price per ounce by dividing the total price by the total number of ounces. PRO_{ijt} indicates if a coupon is used or if there is an in-store sale for the purchase. $COLLEGE_j$ indicates whether the household head has a college degree. $FULLTIME_j$ is a dummy variable indicating whether the household head is employed fulltime. $INCOME_j$ is a categorical variable showing the income level of a household. $SIZE_j$ represents the household size. $CHILDREN_j$ and $MARRIED_j$ are both dummy variables indicating whether a household has children and whether the household head is married, respectively. ε_{ijt} is the residual term. The regression is estimated by OLS, and the standard errors are clustered by the household identifier.

Corresponding to the first objective, β_1 and $\beta_1 + \beta_4$ represent the own-price elasticities of organic foods and non-organic foods without a promotion. The own-price elasticities of organic foods and non-organic foods with a promotion are represented by $\beta_1 + \beta_4 + \beta_5 + \beta_7$ and $\beta_1 + \beta_5$, respectively. The differential price promotion effects are captured by $\beta_4 + \beta_7$. When $\beta_4 + \beta_7 < 0$, the own-price elasticity of organic foods is higher (in magnitude) than that of non-organic foods, suggesting stronger price promotion effects of organic products. When $\beta_4 + \beta_7 > 0$, the price promotion effects of organic foods are weaker than non-organic foods. Corresponding with the second objective, the sign of $\beta_4 + \beta_7$ is expected to be dependent on a number of product category features that are reviewed in the literature review section.

Following Van Doorn and Verhoef (2015), we classified the 36 food categories into 15 virtue foods, 13 vice foods, and 8 categories that are neither virtue nor vice. Two-sample t-tests

are used to examine how the sign of $\beta_4 + \beta_7$ differs among virtue/vice/neutral food categories, and fresh/non-fresh food categories. Pearson's correlations are used to investigate the association between differential promotion effects and organic price premiums, and the association between differential promotion effects and share of organic purchases. Organic rice premium is measured as the percentage difference in unit price between organic and conventional products in a product category. Share of organic purchases is calculated as the number of organic purchases relative to the total number of purchases in a food category.

4. Results and Discussions

Table S1 in the supplementary materials presents the characteristics of the 36 food categories. In most food categories, organic versions of the product enjoy price premiums ranging from 5.49% (baby food) to 297.67% (carbonated beverage). Our calculated price premiums are consistent with previous studies. For example, the price premium of organic milk is approximately 64%, which is similar to the numbers estimated (60% for manufacturer brands and 75% for store brands) in Glaser and Thompson (2000). But it is lower than the price premium estimated in Smith et al. (2009b). Using a hedonic model with baby food and store characteristics as the explanatory variables for price, Maguire et al. (2004) find that consumers are willing to pay 3 or 4 cents more per ounce for organic baby food, almost identical to our calculation of 4 cents per ounce. Surprisingly, consumers pay lower prices for the organic versions of the product in certain food categories such as canned seafood and desserts, after deducting coupons from each purchase.

Almost all the purchasing shares of organic food are below 10%, except for baby food. Thirteen out of the 36 food categories have organic purchasing shares below 1%. Consumers are

most likely to buy the organic versions of two food categories—baby food and fresh produce, with organic purchasing shares equal to 17.56% and 9.97%, respectively. The shares of organic purchases are generally higher in virtue categories than vice categories.

Table S2 in the supplementary materials demonstrates a series of coefficients estimated by OLS with clustered standard errors. The volume of each food purchase is significantly influenced by household demographic characteristics. Having a college degree, higher household income, larger household size, and being married are positively associated with the volume of each transaction in most of the food categories. In contrast, having a full-time job or children is significantly associated with smaller transaction volumes for most of the food categories.

As expected, the signs of β_4 and $\beta_4 + \beta_7$ vary across the 36 food categories, indicating differential responses to price changes between organic products and non-organic products in various food categories, regardless of whether the product is purchased with a promotion or not. When $\beta_4 + \beta_7 < 0$, the demand elasticity for organic food is higher (in absolute value) than that for non-organic food with a promotion. For instance, consumers are more responsive to price promotions of organic fresh produce than non-organic fresh produce. When $\beta_4 + \beta_7 > 0$, the demand elasticity for organic food is lower (in absolute value) than that for non-organic counterparts with a promotion. For example, consumers are less sensitive to the price promotions of organic candy than non-organic candy.

The differential promotion effects ($\beta_4 + \beta_7$) between organic and non-organic foods by the virtue/vice status are depicted in Figure 1. $\beta_4 + \beta_7$ is negative for most virtue foods, but it is positive for most vice foods. The mean of $\beta_4 + \beta_7$ for virtue foods is -0.076 (Table 1), indicating stronger price promotion effects of organic virtues than non-organic virtues. In contrast, the mean of $\beta_4 + \beta_7$ for vice foods is 0.105 (Table 1), suggesting stronger price promotion effects of

248 non-organic vices than organic vices. The two means are significantly different from each other
249 (p=0.002 from a two-sample t-test). Other comparisons (virtue vs neither, vice vs neither, and
250 fresh vs non-fresh) do not show statistical significance. Our findings are consistent with a
251 previous study showing a higher sensitivity of organic promotions in virtue food categories
252 (Bezawada and Pauwels, 2013) and with two studies (Fourmouzi et al., 2012, Kasteridis and
253 Yen, 2012) that find higher own-price demand elasticities for organic fruits and vegetables than
254 non-organic counterparts.

255 Our results are also likely consistent with prior research, Yan et al. (2017), that shows
256 price promotion effects are stronger for relatively healthier alternatives (i.e., "low fat", "low
257 sugar", "low calorie") than the original products in the virtue food categories (i.e., baked beans
258 and fresh fruit juices), and that the price promotion effects are weaker for the relatively healthier
259 options in the vice food categories (i.e., crisps and beer). While our results do not specifically
260 account for healthiness attributes, a previous experimental study shows that consumers perceive
261 organic foods to be lower in fat and higher in fiber, or relatively healthier than their non-organic
262 counterparts (Lee et al., 2013). Therefore, our study lends further evidence in this regard.

263 The differential responses may be associated with the motivations of purchases in a virtue
264 versus a vice food category. A relative virtue food category tends to offer long-term benefits, but
265 less gratifying consumption experience. Because the organic attribute affects consumers' taste
266 perception (Fillion and Arazi, 2002), the level of gratification, and therefore the relative virtue
267 versus vice distinction may be affected by the attribute itself. For instance, sensory analysis
268 indicates that organic orange juice tastes better than conventional orange juice (Fillion and Arazi,
269 2002). A more intense flavor in organically grown tomatoes have been reported in another
270 sensory analysis (Zhao et al., 2007). Organic yogurt is perceived to be more flavorful and have

better taste than regular yogurt (Lee et al., 2013). Besides, organic foods are often perceived to be healthier than their conventional counterparts. Individuals may underestimate the caloric content of organic foods (Lee et al., 2013), leading to less guilty in overconsumption. This "health halo" effect of organic foods is reinforced in a virtue food category. In contrast, people consume relatively vice food to get the immediate hedonic experience, with less emphasis on the negative health effects in the long run. Wertenbroch (1998) suggests that the self-control mechanism prevents consumers from buying large quantities of vice products in response to price changes. As such, the health halo effect of an organic label may not work on a vice product, since individuals who shop for vice foods are less concerned about the health benefits.

A previous study, Bezawada and Pauwels (2013), shows higher sensitivity to organic promotions in food categories with higher purchase frequencies. However, Pearson's correlations in this study do not show significant associations between differential promotion effects and organic price premiums, and between differential promotion effects and share of organic purchases. Nevertheless, price is one of the most important factors that prevent consumers from buying organic products in all food categories (Vega-Zamora et al., 2014). As such, price promotions may act as a catalyst that induces consumers to switch from conventional products to organic products in virtues.

5. Conclusion

While many studies have estimated the demand elasticities of organic foods in selected product categories, this study compares the own-price elasticities of organic foods with those of their conventional counterparts both with and without a promotion in a wide range of product categories. Rather than making an undiscriminating conclusion that consumers are less or more

reactive to prices of organic products than those of conventional products, we conclude that it depends on a number of product category features.

We find that the price promotion effects of organic foods are stronger than non-organic counterparts in categories of virtue nature. Consumers are more likely to have a higher price sensitivity for organic foods than non-organic counterparts in virtue categories. As reflected in the higher organic purchase shares of virtue foods than vice foods, consumers are generally more interested in purchasing organic foods in virtue categories. However, price is one of the most important factors that prevent consumers from buying organic products, making a price discount enticing for health-conscious consumers. They tend to perceive organic foods as healthier and underestimate the caloric content of organic foods. This health halo effect of organic foods may be reinforced in virtue categories, making the demand for organic virtues more price elastic. Because of the negative health effects of vices, consumers tend to impose quantity constraints and resist the temptation to consume more organic vices in response to price discounts.

The findings from this study may help shed some light on the distinctive price promotion strategies for organic virtues and vices. As the price promotion effects of organic foods are stronger than non-organic counterparts in categories of virtue nature, intensive organic price promotions may help convert conventional shoppers to organic consumers in such categories.

Statement

Researcher(s) own analyses calculated (or derived) based in part on data from Nielsen Consumer LLC and marketing databases provided through the NielsenIQ Datasets at the Kilts Center for Marketing Data Center at The University of Chicago Booth School of Business.

316 The conclusions drawn from the NielsenIQ data are those of the researcher(s) and do not
317 reflect the views of NielsenIQ. NielsenIQ is not responsible for, had no role in, and was not
318 involved in analyzing and preparing the results reported herein.

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320 **References**

321 Aertsens, J. 2009. Personal determinants of organic food consumption: a review. *British Food Journal,*
322 111**,** pp. 1140-1167.
323 Aschemann-Witzel, J. and Zielke, S. 2017. Can't Buy Me Green? A Review of Consumer Perceptions of
324 and Behavior Toward the Price of Organic Food. *Journal of Consumer Affairs,* 51, pp. 211-251.
325 Bernard, J. C. and Bernard, D. J. 2009. What Is It About Organic Milk? An Experimental Analysis.
326 *American Journal of Agricultural Economics,* 91, pp. 826-836.
327 Bezawada, R. and Pauwels, K. 2013. What is special about marketing organic products? How organic
328 assortment, price, and promotions drive retailer performance. *Journal of Marketing,* 77, pp. 31-
329 51.
330 Dhar, T. and Foltz, J. D. 2005. Milk by any other name… consumer benefits from labeled milk. *American*
331 *Journal of Agricultural Economics,* 87, pp. 214-228.
332 Fillion, L. and Arazi, S. 2002. Does organic food taste better? A claim substantiation approach. *Nutrition*
333 *& Food Science*, 32(4), pp. 153-157.
334 Fourmouzi, V., Genius, M. and Midmore, P. 2012. The Demand for Organic and Conventional Produce in
335 London, UK: A System Approach. *Journal of Agricultural Economics,* 63, pp. 677-693.
336 Gil, J. M., Gracia, A. and Sánchez, M. 2000. Market segmentation and willingness to pay for organic
337 products in Spain. *The International Food and Agribusiness Management Review,* 3, pp. 207-226.
338 Glaser, L. K. and Thompson, G. D. 2000. Demand for organic and conventional beverage milk.
339 Hamzaoui-Essoussi, L. and Zahaf, M. 2012. Canadian Organic Food Consumers' Profile and Their
340 Willingness to Pay Premium Prices. *Journal of International Food & Agribusiness Marketing,* 24,
341 pp. 1-21.
342 Hu, W., Batte, M. T., Woods, T. and Ernst, S. 2011. Consumer preferences for local production and other
343 value-added label claims for a processed food product. *European Review of Agricultural*
344 *Economics,* 39, pp. 489-510.
345 Hughner, R. S., Mcdonagh, P., Prothero, A., Shultz Ii, C. J. and Stanton, J. 2007. Who are organic food
346 consumers? A compilation and review of why people purchase organic food. *Journal of*
347 *Consumer Behaviour,* 6, pp. 94-110.
348 Jaenicke, E. C. and Carlson, A. C. 2015. Estimating and Investigating Organic Premiums for Retail-Level
349 Food Products. *Agribusiness,* 31, pp. 453-471.
350 Jonas, A. and Roosen, J. 2008. Demand for milk labels in Germany: organic milk, conventional brands,
351 and retail labels. *Agribusiness,* 24, pp. 192-206.
352 Kasteridis, P. and Yen, S. T. 2012. U.S. demand for organic and conventional vegetables: a Bayesian
353 censored system approach. *Australian Journal of Agricultural and Resource Economics,* 56, pp.
354 405-425.
355 Krystallis, A. 2005. Consumers' willingness to pay for organic food: Factors that affect it and variation per
356 organic product type. *British Food Journal,* 107, pp. 320-343.
357 Lee, W.-C. J., Shimizu, M., Kniffin, K. M. and Wansink, B. 2013. You taste what you see: Do organic labels
358 bias taste perceptions? *Food Quality and Preference,* 29, pp. 33-39.

Liu, P. J., Haws, K. L., Lamberton, C., Campbell, T. H. and Fitzsimons, G. J. 2015. Vice-Virtue Bundles. *Management Science,* 61, pp. 204-228.
Lopez, E. and Lopez, R. A. 2009. Demand for differentiated milk products: implications for price competition. *Agribusiness,* 25, pp. 453-465.
Loureiro, M. L. and Hine, S. 2002. Discovering niche markets: A comparison of consumer willingness to pay for local (Colorado grown), organic, and GMO-free products. *Journal of Agricultural and Applied Economics,* 34, pp. 477-487.
Maguire, K. B., Owens, N. and Simon, N. B. 2004. The price premium for organic babyfood: a hedonic analysis. *Journal of Agricultural and Resource Economics*, pp. 132-149.
Mishra, A. and Mishra, H. 2011. The Influence of Price Discount versus Bonus Pack on the Preference for Virtue and Vice Foods. *Journal of Marketing Research,* 48, pp. 196-206.
Ngobo, P. V. 2011. What Drives Household Choice of Organic Products in Grocery Stores? *Journal of Retailing,* 87, pp. 90-100.
OTA. 2020. *COVID-19 will shape organic industry in 2020 after banner year in 2019* [Online]. Available: https://ota.com/news/press-releases/21328 [Accessed June 26 2020].
Paul, J. and Rana, J., 2012. Consumer behavior and purchase intention for organic food. *Journal of consumer Marketing*, 29(6), pp. 412-422.
Pino, G., Peluso, A.M. and Guido, G., 2012. Determinants of regular and occasional consumers' intentions to buy organic food. *Journal of Consumer Affairs*, 46(1), pp. 157-169.
Parreño-Selva, J., Mas-Ruiz, F. J. and Ruiz-Conde, E. 2014. Price promotions effects of virtue and vice products. *European Journal of Marketing*, 48, pp. 1296-1314.
Rödiger, M. and Hamm, U. 2015. How are organic food prices affecting consumer behaviour? A review. *Food Quality and Preference,* 43, pp. 10-20.
Schröck, R. 2012. The Organic Milk Market in Germany Is Maturing: A Demand System Analysis of Organic and Conventional Fresh Milk Segmented by Consumer Groups. *Agribusiness,* 28, pp. 274-292.
Smith, T. A., Huang, C. L. and Lin, B.-H. 2009a. Does price or income affect organic choice? Analysis of US fresh produce users. *Journal of Agricultural and Applied economics,* 41, pp. 731-744.
Smith, T.A., Huang, C.L. and Lin, B.H., 2009b. Estimating organic premiums in the US fluid milk market. *Renewable Agriculture and Food Systems*, 24(3), pp. 197-204.
Sridhar, K., Bezawada, R. and Trivedi, M. 2012. Investigating the Drivers of Consumer Cross-Category Learning for New Products Using Multiple Data Sets. *Marketing Science,* 31, pp. 668-688.
Van Doorn, J. and Verhoef, P. C. 2011. Willingness to pay for organic products: Differences between virtue and vice foods. *International Journal of Research in Marketing,* 28, pp. 167-180.
Van Doorn, J. and Verhoef, P. C. 2015. Drivers of and Barriers to Organic Purchase Behavior. *Journal of Retailing,* 91, pp. 436-450.
Vega-Zamora, M., Torres-Ruiz, F. J., Murgado-Armenteros, E. M. and Parras-Rosa, M. 2014. Organic as a Heuristic Cue: What Spanish Consumers Mean by Organic Foods. *Psychology & Marketing,* 31, pp. 349-359.
Wertenbroch, K. 1998. Consumption self-control by rationing purchase quantities of virtue and vice. *Marketing science,* 17, pp. 317-337.
Wier, M., O'doherty Jensen, K., Andersen, L. M. and Millock, K. 2008. The character of demand in mature organic food markets: Great Britain and Denmark compared. *Food Policy,* 33, pp. 406-421.
Yan, J., Tian, K., Heravi, S. and Morgan, P. 2017. The vices and virtues of consumption choices: price promotion and consumer decision making. *Marketing Letters,* 28, pp. 461-475.

405 Yiridoe, E. K., Bonti-Ankomah, S. and Martin, R. C. 2005. Comparison of consumer perceptions and
406 preference toward organic versus conventionally produced foods: A review and update of the
407 literature. *Renewable Agriculture and Food Systems*, 20(4), pp. 193-205.
408 Zhang, F., Huang, C. L., Lin, B.-H., Epperson, J. E. and Houston, J. E. 2011. National Demand for Fresh
409 Organic and Conventional Vegetables: Scanner Data Evidence. *Journal of Food Products*
410 *Marketing,* 17, pp. 441-458.
411 Zhao, X., Chambers Iv, E., Matta, Z., Loughin, T. M. and Carey, E. E. 2007. Consumer sensory analysis of
412 organically and conventionally grown vegetables. *Journal of food science,* 72, pp. S87-S91.

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Table 1. Differential Promotion Effects between Organic Foods and Non-organic Foods by Category Features

Category Features	Mean of $\beta_4 + \beta_7$	Standard Deviation	Minimum	Maximum
Virtue	-0.076	0.150	-0.311	0.254
Vice	0.105	0.132	-0.127	0.396
Neither	0.060	0.210	-0.183	0.518
Fresh	0.011	0.199	-0.311	0.254
Non-fresh	0.022	0.173	-0.262	0.518

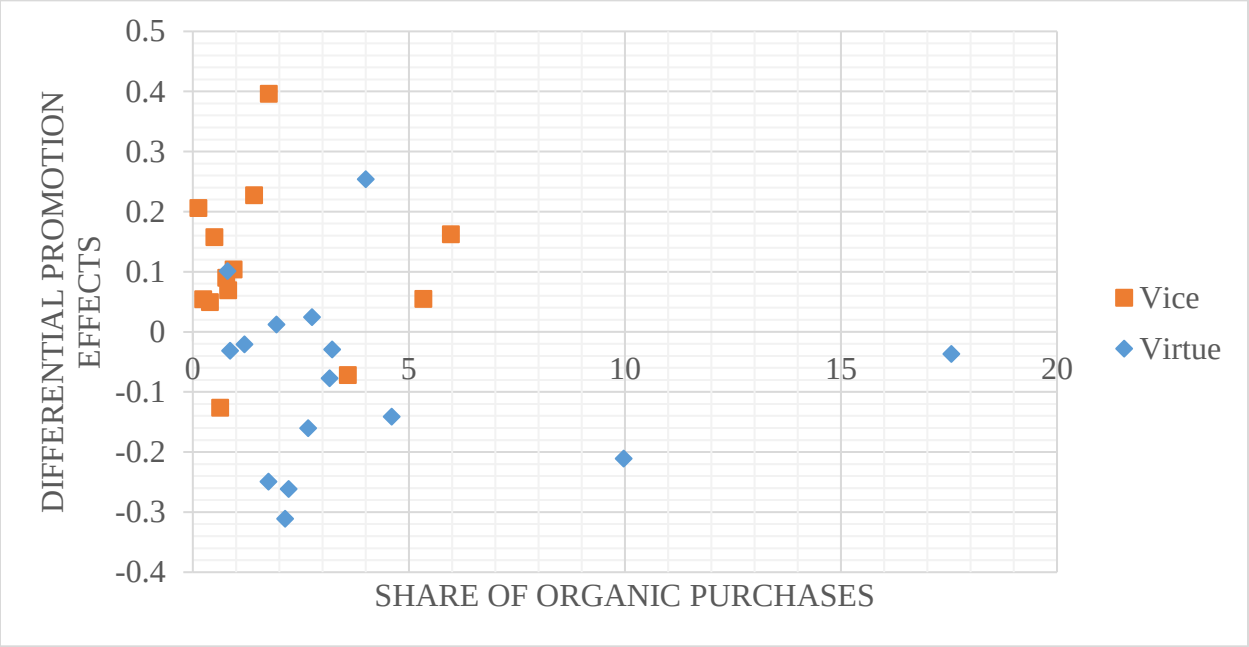

Figure 1. Differential Promotion Effects between Organic Foods and Non-organic Foods in Virtue and Vice Food Categories

Supplementary Materials for

"Price Promotion of Organic Foods and Consumer Demand"

Table S1. Characteristics of 36 Food Categories from the 2015 Nielsen Consumer Panel

Type	Product Category	Number of non-organic food purchases	Unit price of non-organic foods ($/oz)	Number of organic food purchases	Unit price of organic foods ($/oz)	Price premium of organic foods	Purchasing share of organic foods	Fresh Category
Virtue	Baby food	99,935	0.76	21,282	0.8	5.49%	17.56%	No
Virtue	Fresh produce	1,115,614	0.45	123,556	0.52	16.26%	9.97%	Yes
Virtue	Dried fruit	198,517	0.47	9,573	0.91	95.66%	4.60%	No
Virtue	Milk	1,588,951	0.05	66,239	0.08	63.81%	4.00%	Yes
Virtue	Soup	891,423	0.24	29,729	0.22	-7.95%	3.23%	No
Virtue	Cereal	1,037,124	0.25	33,932	0.31	22.41%	3.17%	No
Virtue	Canned vegetables	1,087,632	0.13	30,873	0.16	18.93%	2.76%	No
Virtue	Canned/bottled juice drinks	1,277,947	0.07	35,014	0.15	109.49%	2.67%	No
Virtue	Frozen prepared foods	1,319,829	0.3	29,958	0.49	64.71%	2.22%	No
Virtue	Yogurt	1,162,122	0.29	25,361	0.34	19.35%	2.14%	Yes
Virtue	Ready-to-serve prepared food	663,487	0.28	13,111	0.34	21.20%	1.94%	No
Virtue	Frozen vegetables	809,461	0.16	14,451	0.22	39.95%	1.75%	No
Virtue	Packaged milk and modifiers	431,902	0.22	5,243	0.24	12.16%	1.20%	No
Virtue	Canned fruit	313,962	0.14	2,734	0.26	90.29%	0.86%	No
Virtue	Bread and baked goods	2,526,078	0.19	20,444	0.23	21.04%	0.80%	No
Vice	Frozen desserts	177,439	0.21	11,275	0.37	75.36%	5.97%	No
Vice	Sugar and sweeteners	99,525	0.22	5,609	0.4	77.82%	5.34%	No

Vice	Table syrups and molasses	82,337	0.18	3,067	0.53	197.26%	3.59%	No
Vice	Non-carbonated soft drinks	555,148	0.22	9,936	0.19	-12.96%	1.76%	No
Vice	Desserts, gelatins, and syrup	421,394	0.42	6,065	0.31	-25.64%	1.42%	No
Vice	Crackers	611,250	0.28	5,816	0.56	97.22%	0.94%	No
Vice	Cookies	820,141	0.32	6,792	0.53	68.47%	0.82%	No
Vice	Cot cheese, sour cream, and toppings	496,451	0.17	3,889	0.3	73.10%	0.78%	Yes
Vice	Ice cream and novelties	487,462	0.11	3,088	0.18	61.70%	0.63%	No
Vice	Candy	1,801,804	0.65	9,060	1.54	137.24%	0.50%	No
Vice	Cheese	1,674,938	0.4	6,710	0.75	90.61%	0.40%	Yes
Vice	Carbonated beverages	1,558,716	0.08	3,793	0.33	297.67%	0.24%	No
Vice	Beer	229,140	0.15	290	0.33	114.65%	0.13%	No
Neither	Tea	284,308	0.43	11,696	0.39	-9.05%	3.95%	No
Neither	Spices, seasoning, and extracts	409,776	1.74	12,760	5.5	215.20%	3.02%	No
Neither	Pasta	418,612	0.13	8,863	0.27	104.61%	2.07%	No
Neither	Fresh meat	220,971	0.34	4,113	0.52	55.27%	1.83%	Yes
Neither	Coffee	339,937	0.57	4,562	0.69	20.11%	1.32%	No
Neither	Deli-packed meats	1,486,815	0.38	3,405	0.73	91.17%	0.23%	Yes
Neither	Baking mixes	361,305	0.15	799	0.26	69.91%	0.22%	No
Neither	Canned seafood	232,525	0.62	184	0.22	-65.11%	0.08%	No

Table S2. Coefficients Estimated by OLS with Clustered Standard Errors

Independent Variable	Intercept	Ln(P)	Organic	Promotion	Ln(P)*Organic	Ln(P)*Promotion	Organic*Promotion	Ln(P)*Organic*Promotion	College	Full time	Household income	Household size	Children	Married
Product Category	β_0	β_1	β_2	β_3	β_4	β_5	β_6	β_7	β_8	β_9	β_{10}	β_{11}	β_{12}	β_{13}
Baby food	1.251***	-0.329***	-0.270***	0.167***	-0.242***	0.049**	-0.056	0.205***	0.034†	0.038	0.002	0.014	0.030	-0.025
Fresh produce	1.264***	-0.704***	-0.211***	0.362***	-0.201***	0.213***	-0.253***	-0.011	0.015***	-0.002	0.005***	0.018***	0.000	-0.006
Dried fruit	1.049***	-0.868***	0.369***	0.182***	-0.177***	0.281***	-0.229***	0.035	0.082***	-0.077***	0.011***	0.010**	-0.111***	0.042***
Milk	1.706***	-0.768***	0.948***	0.907***	0.221***	0.279***	-0.133†	0.032	-0.003	0.017***	-0.003***	0.051***	0.057***	0.033***
Soup	1.142***	-0.624***	0.695***	0.556***	0.004	0.242***	-0.326***	-0.034†	0.029***	-0.026***	0.008***	0.002	-0.060***	0.005
Cereal	1.683***	-0.617***	0.356***	0.451***	0.205***	0.349***	-0.401***	-0.283***	0.016***	-0.033***	0.003***	0.013***	-0.016**	0.027***
Canned vegetables	1.819***	-0.315***	-0.136***	0.361***	-0.250***	0.133***	0.295***	0.274***	-0.003	-0.017***	0.003***	0.018***	-0.033***	0.002
Canned/bottled juice drinks	2.097***	-0.578***	-0.099***	0.768***	-0.070***	0.279***	-0.532***	-0.090***	0.036***	-0.052***	0.007***	0.008***	-0.012†	0.043***
Frozen prepared foods	1.957***	-0.373***	-0.308***	0.086***	-0.149***	0.139***	-0.079***	-0.113***	0.016**	-0.016**	0.005***	0.048***	0.020*	0.083***
Yogurt	1.374***	-0.449***	0.014	0.115***	-0.328***	0.228***	-0.044	0.016	0.042***	-0.055***	0.003***	0.029***	0.031**	0.012
Ready-to-serve prepared food	1.730***	-0.414***	0.249***	0.148***	-0.036*	0.096***	0.039	0.048†	0.007*	-0.019***	0.004***	0.024***	-0.042***	0.016***
Frozen vegetables	1.850***	-0.460***	-0.462***	0.359***	-0.446***	0.232***	0.118*	0.196***	-0.031***	0.015***	-0.001***	0.036***	-0.014*	0.015***
Packaged milk and modifiers	1.401***	-0.728***	0.036	0.318***	-0.213***	0.171***	0.074	0.192***	-0.019**	0.000	0.005***	0.014***	-0.016†	0.038***
Canned fruit	2.067***	-0.336***	-0.166†	0.301***	-0.185***	0.150***	0.081	0.153*	0.022***	0.002	0.002***	0.010***	0.017*	0.008†
Bread and baked goods	1.862***	-0.383***	0.508***	0.184***	-0.022	0.108***	0.051	0.123***	0.031***	-0.022***	0.006***	0.009***	-0.012***	0.013***
Frozen desserts	1.727***	-0.488***	-0.095	-0.036*	-0.456***	0.020†	0.384***	0.619***	0.081***	0.044***	0.010***	0.016***	0.022	-0.060***
Sugar and sweeteners	1.839***	-0.529***	-0.004	-0.182***	-0.368***	-0.029**	0.549***	0.422***	0.002	0.000	0.001	0.012***	-0.006	0.051***
Table syrups and molasses	2.163***	-0.402***	0.066†	0.315***	-0.481***	0.165***	-0.256***	0.409***	0.004	-0.012**	0.003***	0.019***	0.005	0.016**
Non-carbonated soft drinks	1.225***	-0.873***	0.827***	0.043***	0.282***	0.005	0.023	0.114*	-0.016†	-0.019*	0.009***	0.027***	-0.032**	0.040***
Desserts, gelatins, and syrup	0.428***	-0.954***	0.828***	0.365***	0.013	0.203***	0.051	0.214**	0.019**	0.040***	0.007***	0.021***	0.100***	-0.046***
Crackers	1.609***	-0.472***	0.021	0.229***	0.094***	0.177***	-0.107***	0.010	0.002	-0.022***	0.003***	0.017***	-0.011*	0.032***
Cookies	1.466***	-0.500***	-0.018	0.286***	-0.316***	0.201***	-0.070†	0.385***	0.009**	-0.008*	0.006***	0.008***	-0.001	0.049***
Cot cheese, sour cream, and toppings	1.829***	-0.476***	0.307***	0.312***	0.031	0.198***	-0.180	0.059	0.011**	-0.015***	0.001	0.021***	-0.051***	0.008†

Ice cream and novelties	2.123***	-0.663***	0.927***	0.521***	0.356***	0.246***	-1.138***	-0.483***	-0.021***	-0.040***	-0.001***	0.018***	-0.009	0.077***
Candy	0.847***	-0.699***	0.065*	0.160***	0.150***	0.179***	-0.178***	0.007	0.029***	-0.029***	0.012***	-0.013***	-0.071***	0.059***
Cheese	1.610***	-0.565***	0.128***	0.227***	0.238***	0.336***	-0.269***	-0.189***	0.006*	-0.010***	0.002***	0.029***	-0.024***	0.020***
Carbonated beverages	2.306***	-0.518***	0.057**	1.004***	0.230***	0.242***	-1.120***	-0.175***	-0.041***	-0.032***	0.006***	0.007*	-0.073***	0.117***
Beer	2.310***	-0.854***	-0.187*	0.182**	0.182**	0.018	-0.121	0.024	-0.104***	-0.050†	0.018***	-0.009	-0.051	0.153***
Tea	1.096***	-0.897***	0.131**	0.309***	0.161***	0.138***	0.588***	0.356***	-0.022*	-0.077***	0.012***	0.003	-0.042**	0.065***
Spices, seasoning, and extracts	0.720***	-0.745***	0.402***	-0.053***	-0.149***	0.061***	-0.259***	0.138***	0.045***	-0.023***	0.010***	-0.002	-0.024***	0.007
Pasta	2.044***	-0.278***	-0.084***	0.394***	-0.139***	0.191***	-0.300***	-0.044*	-0.003	0.000	0.001***	0.015***	-0.011***	0.003
Fresh meat	2.318***	-0.588***	0.317***	0.094***	-0.174***	0.132***	-0.163***	0.277***	-0.045***	0.017*	-0.004***	0.068***	-0.053***	0.030***
Coffee	1.728***	-0.829***	0.319***	0.341***	0.187***	0.367***	-0.267***	-0.156***	-0.022**	-0.045***	0.009***	-0.005	-0.066***	0.105***
Deli-packed meats	1.765***	-0.497***	0.212***	0.202***	0.048	0.208***	-0.255***	0.058	0.004	-0.025***	0.006***	0.020***	-0.044***	0.031***
Baking mixes	1.700***	-0.423***	0.486***	0.466***	-0.092*	0.216***	-0.230†	-0.014	0.022***	-0.015***	0.005***	0.014***	0.003	0.024***
Canned seafood	1.254***	-0.461***	0.749***	0.065***	0.459***	0.256***	-0.383***	-0.437***	0.019**	-0.065***	0.009***	0.018***	-0.056***	0.034***

p≤0.001***, p≤0.01**, p≤0.05*, p≤0.1†.