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Modeling and Testing Consumer Engagement in the U.S. Organic Food Market

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An Honors Paper for the Department of Economics

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Table of Contents

1. Motivating Questions

US food consumers have increased their consumption of organic products consistently since the late 1980s (Greene, ed. Cavanari and Olsen, 2007). Farmers have similarly increased organic production, some increasing production of existing organic acreage, and others transitioning from conventional agricultural practices to organic practices (Greene, ed. Cavanari and Olsen, 2007). In recognition of this trend, this study specifies the consumer types that participate in the organic market and investigates their revealed preferences. To drive the analysis, I ask three main questions:

(1) Which types of consumers buy organic food?

(2) How do their expenditures on organic food fluctuate as prices change?

(3) Can we distinguish consumer types based on purchase frequency?

Given the literature surrounding organic foods, I formulate the following hypotheses:

(1) Well-educated, higher-income people who are African-American and live on the West coast of the United States are most likely to buy organic food.

(2) Consumers are more likely to buy organic food if they have a young child, are married, and live in an urban area.

(3) Following from simple economic logic, I expect household expenditures on organic food to increase as the prices of organic foods relative to conventionally-produced foods decrease, all else constant. In other words, household demand for organic food is downward-sloping.

(4) Households that purchase organic foods more frequently are most likely to have the characteristics outlined in hypotheses 1 and 2.

In order to test my hypotheses, I use a nationwide data set of household purchases of organic and conventional fruits in 2011 and 2012 (The Nielsen Company, 2014). I focus on fruit purchase for two reasons. First, organic fruit is widely available compared to other organic products and, in combination with fresh vegetables, account for roughly one-third of total organic sales in the US (Pearson, Henryks, and Jones, 2011). Second, many people buy organic fruit because they believe it is safer for them than fruit produced using conventional procedures (i.e. with pesticides). Fears of pesticides on produce may motivate many to buy organic fruit (Crinnion, 2010; Hughner et al, 2007; Huang, 1996). Any conclusions one may draw from this paper should recognize this empirical approach and adjust predictions or expectations for different markets accordingly.

2. The U.S. Organic Food Market Today

Before delving into my theoretical model and empirical approach, I wish to lay out the broad functioning of the US organic food industry as it stands today. Although the main aim of this paper is to provide a new theoretical model and empirical study of consumer engagement in the US organic food market, essentially inspecting demand-side factors in the organic food industry, these reasons for consumer engagement in the market need to be informed by a general understanding of the supply-side factors at work in the industry, as well as a review of external scientific literature. For example, in order to talk about how expenditures on organic foods change as prices change, we must first understand supply-side influences on prices of organics. In order to talk about what types of consumers buy organic foods, we must first understand which factors may motivate them to buy organics, some of which are evaluated in clinical studies and other literature associated with the natural sciences.

The remainder of Section 2 contains a broad summary and analysis of the U.S. organic food industry. I begin by first summarizing the economic literature studying the supply-side factors at play in the organic food industry. I then give a brief summary of organic price premiums, which have both supply-side and demand-side influences. Then I introduce demand-side factors in the industry, including studies relevant to organic consumer behavior and preferences. To introduce my theoretical model, I explain the discrepancy between consumer perception of and scientific evidence regarding the benefits of organic food, which is a vital part of the model and may provide valuable insights into consumer engagement in the organic food market. I then lay out the model and its implications in Section 3, including a formulation of three distinct organic consumer types (indifferent consumer, informed organic food lover, and uninformed organic food lover) and the conditions under which they would buy organic products in lieu of conventional varieties. I describe my empirical approach and data in sections 4 and 5.

To motivate my cross-sectional empirical analysis, I analyze price and expenditure trends in Section 6 to show that we need to consider factors other than price to explain organic consumer behavior, and that we also should also treat consumers' participation and consumption decisions as arising through different processes. In Section 7, I introduce my estimation method and the data and present and analyze the raw regression results, followed by calculations of marginal effects and elasticities (income, own-price, and cross-price).To wrap up the cross-sectional analysis, I show how average household characteristics change as household frequency of organic purchases changes.

Finally, I extend my analysis slightly in Section 8 and consider the determinants of the increased organic expenditures in the U.S. from 2011 to 2012 (shown later), determinants that differ somewhat but are largely consistent across the extensive and intensive margins of consumer engagement in the organic fruit market. I also summarize the average household characteristics in each of four subsamples defined by the four possible types of engagement in the organic fruit market across 2011 and 2012. I summarize my main findings in Section 9 and tie them back to the theoretical consumer types.

2.1. Organic Production and Supply

2.1.1. Acreage

US production of organic foods is increasing relative to conventionally produced foods, largely because producers perceive increased profitability in the industry. Although yields on organic farms are lower than those on conventional farms (Nemes, 2009), higher price premiums and lower production costs make up for the loss in yields and make organic farming more economically profitable per acre or hectare (Nemes, 2009; Pimentel et al., 2005). Whereas conventional farming is decreasing nationwide, organic farming is increasing by 12% annually on average (Hughner et al., 2007). Certified organic acreage in the US has increased significantly since the early 1990s, as producers have responded to increasing consumer demand for organic foods and the accompanying price premiums (Dimitri and Greene, 2002). Certified organic crop acreage in the US more than doubled between 1992 and 1997, and it redoubled between 1997 and 2001 for most major crops (Greene, ed. Canavari and Olson, 2007). Certified organic cropland decreased somewhat from 2008 to 2010 due to restrained consumer demand caused by the Great Recession, but these losses have been overcome. The growth rate of certified organic cropland in the US has been re-established to levels similar to those in the pre-recession years (Greene, 2013).

2.1.2. Costs of Production

Different costs experienced by organic producers can typically be categorized as production concerns (e.g. inputs and their effects on yield and total production) or marketing concerns (e.g. product prices, marketing costs, and market availability) (Wynen, ed. Jones et al., 2003). Barriers to organic market expansion include temporary localized supply shortages, limited distribution channels, a lack of information on prices and product availability, and selling prices that are too low to cover production costs (Park and Lohr, 1996). In addition to these production concerns that are only realized once a farm is fully operational, organic producers face several difficulties transitioning from a conventional farm operation to an organic operation. Several years are required to transition from a conventional farm to an organic farm, since land cannot contain any prohibited substances three years prior to the first organic crop harvest (Winter and Davis, 2006). Organic producers face unique risks during this transition period, as yields may decrease, produce cannot fetch higher organic prices since their produce is not yet organically certified, and the producers themselves simply have to learn new farming methods (Greene, ed. Canavari and Olsen, 2007).

2.1.3. Benefits to Production

It is clear that organic farmers can experience unique cost or condition constraints. However, they are also motivated by unique benefits to organic farming. Organic farming offers benefits for farm workers, livestock, and the environment in addition to economic benefits (Lockeretz, ed. Jones et al., 2003). In the early stages of organic market growth, farmers adopted organic practices mainly based on their own ethical choices (Canavari et al., ed. Canavari and Olsen, 2007). For example, farmers continue to be motivated to adopt organic practices by factors not captured in standard profit calculations, such as long-term planning horizons, convenience, and environmental ethics (Dimitri and Greene, 2002; Greene, ed. Canavari and Olsen, 2007). Many organic farmers are motivated to farm organically simply because the production process prohibits chemicals (Greene, ed. Canavari and Olsen, 2007). Organic farms support a healthier biodiversity than conventional farms, as many species and taxonomic groups benefit from the application of organic farming (Bartram and Perkins, ed. Jones et al., 2003). Limited pesticide use employed by organic production has a more positive environmental impact than the common use of pesticides in conventional production, which uses both more pesticides and more synthetic pesticides. Additionally, limited use of pesticides in organic farming can significantly reduce illnesses and injuries obtained by agricultural workers, a benefit of organic farming not often espoused (Winter and Davis, 2006). Recently, the success of the organic market and increasing demand for organic products has incentivized farmers to convert their farming systems from conventional to organic, a process in which they consider traditional profit and returns.

It must be noted that net returns to organic farms vary with biological and economic variables such as soil type, climate, proximity to markets, and other farm-specific factors, as do net returns to conventional farms (Greene, ed. Canavari and Olsen, 2007). In relation to the transitional costs from conventional practices to organic practices referenced above, organic farmers can view these costs as part of a “learning curve” and thus may weigh them less heavily in their profit calculations (Hanson, ed. Jones et al., 2003). However, the net economic return per hectare to organic crops has been estimated to be higher than conventional crops due to retail price premiums (Pimentel et al., 2005). Compared to conventional farms, organic farms seem more able to maintain the capacity to create new wealth over time, albeit in large part likely due to the level of subsidies granted to organic agriculture (Canavari et al., ed. Canavari and Olsen, 2007).

2.1.4. Government Policies

In 1990, the US federal government decided that the benefits of organic production were great enough to warrant policies that incentivized, encouraged, and supported organic production and consumption. As part of the 1990 Farm Bill, the USDA introduced the Organic Foods Production Act (OFPA). This Act contained three main goals: to establish standards for marketing organic products, assure consumers that organic products meet a consistent standard, and facilitate interstate commerce. The National Organic Program Standards, administered by the National Organic Program (NOP), were fully implemented in 2002 and specified the methods, practices, and substances that could be used to produce, process, and handle organic foods (Winter and Davis, 2006). All products sold, labeled, or represented as organic had to comply with these standards by October 2002 (Dimitri and Greene, 2002). Nearly concurrent with first implementation of the NOP standards, the Farm Security and Rural Investment Act of 2002, commonly known as the 2002 Farm Act, provided for the National Organic Cost-Share Program and the Organic Agriculture Research and Extension Initiative. The Cost-Share Program provides financial assistance for organic farmers in 15 states to help pay for organic certification, which is required if the farmers' income is greater than $5000 (Winter and Davis, 2006). The Research and Extension Initiative provides 3 million dollars in grant money yearly. The 2002 Farm Act was followed by the 2008 Farm Act and 2014 Farm Act, both of which contained increased federal support for organic production systems (United States Department of Agriculture, Economic Research Service). Finally, in recognition of the risks faced by organic producers (specified later), Congress passed the Agricultural Risk Protection Act in 2000, which stipulated that organic farming would be covered by Federal crop insurance.

State governments have also done their part to encourage and support organic production – in 2003, the National Association of State Departments of Agriculture (NASDA) released a statement expressing support for expansion of public-sector organic research and education and provision of technical assistance to organic and transitional farmers (Greene, ed. Canavari and Olsen, 2007).

2.1.5. The Retail Landscape

The prevalence and market penetration of organic food products in the United States has changed significantly over the past few decades. Organic foods are sold through three main venues – natural foods stores, conventional supermarkets, and direct-to-consumer markets (farmers markets). Farmers markets are much more common in organic systems than conventional systems (Dimitri and Greene, 2002). By the late 1950s, organic foods could be purchased at small health food stores. At the end of the 1960s, the "Baby Boomer" generation became an influential consumer segment, demanding foods produced without use of chemicals. To accommodate this heightened demand, natural foods supermarkets featuring organic foods developed in the 1980s. By 2000, conventional supermarkets widely began to offer large selections of organic foods (Greene, ed. Canavari and Olsen, 2007). In fact, in 2000 more organic food was purchased in conventional supermarkets than in any other location (Dimitri and Greene, 2002). Supermarkets can effectively promote organic foods and may change consumers' buying habits (Thompson 1998). In general, the growing production of organic foods has opened up new market opportunities for organic food retailers and distributors (Dimitri and Lohr, ed. Canavari and Olson, 2007).

2.1.6. Supply Chain and Marketing

The heightened importance of supermarkets has had implications for both organic producers and the supply chain, since supermarkets prefer to sell organic fresh produce year-round with a regular supply (Hallam, ed. Jones et al., 2003). The link from production site to product sale, or the structure of the organic supply chain, faces unique circumstances and affects the perception of the organic market by producers and consumers alike. Expansion of the organic market entails a broader geographic spread of supply, which conflicts with the traditional association of organic food with locality (Hallam, ed. Jones et al., 2003). Farmers markets are still extensive, with fruits and vegetables the most frequently targeted products (Dimitri and Greene, 2002). Physically, organic fruits and vegetables must be stored and shipped separate from conventional produce. Consumers want to feel confident that the organic products are not only grown organically, but have also retained their organic integrity at each stage in the supply chain (Dimitri and Greene, 2002). They have demanded more precise and transparent information on production and processing aspects of organic products, including traceability (Hallam, ed. Jones et al., 2003). A lack of detailed production and process methods is particularly likely to undermine heavy organic users' confidence in organic products (Wier et al., 2008). In sum, consumers' influence on how organic foods are produced, processed, handled and marketed are key factors in the organic food production chain (Brandtner and Hoebaus, ed. Jones et al., 2003).

2.2. Organic Price Premiums

Organic foods command a price premium over conventional foods. The magnitude of price premiums varies between countries, the level of organic market development, and the specific product under consideration, but it is commonly 20-30% (Hallam, ed. Jones et al., 2003). I evaluate this claim by looking at the annual average price premium for all fruits in the Nielsen dataset, results shown in Table 1. The only fruit that reflects Hallam's claim is organic apples, which commands a 25 to 29 percent price premium, on average, from 2011 to 2012. All organic fruits vary widely in their price premium, with organic raspberries actually being less expensive than conventional raspberries on average, for both years, whereas organic grapes are one to three times as expensive as their conventional alternatives, on average. These summary statistics suggest that price premiums for organic fruits are more variable and larger in magnitude, overall, than price premiums for other organic products.

Table 1. Annual Price Premium, By Fruit, 2011-2012 (12-Month Average)

	Apple	Blackb.	Blueb.	Grape	Grapef.	Lemon	Raspb.	Strawb.	Other
2011	25%	46%	70%	137%	46%	46%	-14%	76%	37%
2012	29%	54%	75%	305%	-24%	59%	-18%	78%	37%

***Note: Calculated based on data from The Neilsen Company (US), LLC and provided by the Marketing Data Center at The University of Chicago Booth School of Business.**

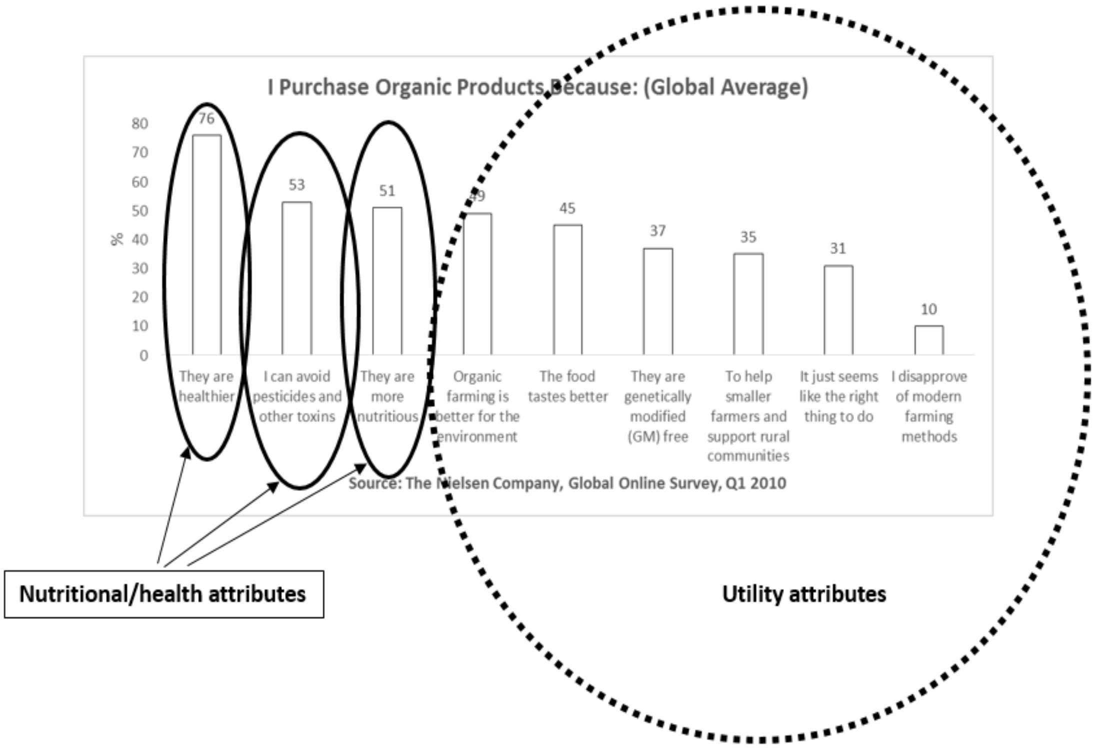
Demand for organic food tends to decline quickly if premiums are over 20% (Yiridoe et al., 2005). Organic price premiums are crucial in assuring the profitability and long-term financial stability of organic farm operations (Yiridoe et al., 2005; Dimitri and Greene, 2002). There are both supply-side and demand-side reasons for why organic foods are more expensive than conventional foods. Stevens-Garmon et al. (2007) note that, in 2004, organic price premiums for fresh produce were likely caused in large part by an excess growth of demand over supply. On the other hand, Carroll et al. (2012) contend that premiums can be caused by limited supply of organic products in relation to demand, higher unit production costs for organic compared to conventional products, and a lack of economies of scale in processing and marketing, which are present in the supply chain of conventional foods. The authors also find that, in the case of strawberries, “farmgate” and retail prices are not highly correlated. They hypothesize that the variation in retail marketing, specifically the higher costs associated with marketing organic strawberries in relation to conventional strawberries, substantially influences the difference in retail prices and consequently organic premiums. Hallam, ed. Jones et al. (2003) synthesizes supply-side and demand-side aspects by stating that organic price premiums stem from both higher production and distribution costs and the tendency for excess demand over supply.

2.3. Organic Consumption

What may motivate someone to pay a higher price for an organic product over its conventional analog? According to the Organic Trade Association, organic food sales represented about 4% of total US food sales in 2010 (Zepeda and Nie, 2012). Per annum growth in organic food retail sales had equaled 15% or more from 1990 to 2007, although it experienced a noticeable decrease in 2008 and 2009, likely due to the Great Recession (Greene, 2013). Since 2010, growth in organic sales has recovered to levels lower than those of pre-recession years. Fresh produce (fruits and vegetables) is the top-selling category of organic products (Dimitri and Greene, 2002). Organic choices may be “congruent,” which means that consumers, after they start to buy one type of organic product, are likely to extend their demand for organic products to a wide variety of goods, assuming that a regular and easy supply exists (Monier et al., 2009). The authors tested this theory and concluded that, in the case of the staple food products eggs and milk, the probability of buying one organic item was reinforced if the consumer bought the other organic product as well.

<u>2.3.1. Why Consumers Buy Organic</u>

Figure 1.



Organic food consumers are not a homogenous group, so different consumers may be attracted to different aspects of organic foods (Lockeretz, ed. Jones et al., 2003). The organic market is unique because organic consumers judge the products not only by traditional metrics such as taste, price, and appearance, but also by the social and environmental benefits they embody (Dimitri and Lohr, ed. Canavari and Olsen, 2007). As Figure 1 shows, most consumers value organic products due to their perceived nutritional attributes, although there is limited scientific evidence that organic food is actually healthier (Hughner et al., 2007). Consumers are often motivated to buy organic because they believe organic production is more environmentally sustainable than conventional production (Zepeda and Nie, 2012). Consumers often buy organic food as insurance and/or investment in health (Yiridoe et al., 2005). Crinnion (2010) extends this claim by stating that the multi-billion dollar food industry is fueled by the consumer perception that organic food is healthier and safer, since it offers greater nutritional value and less toxic chemicals. Other attributes of organic products that motivate organic consumers are environmental benefits and ethical and moral benefits (Pedersen, ed. Jones et al., 2003), corresponding to a certain reflexive shopping practice where price and convenience are lesser concerns of consumers and personal and societal concerns are more important in purchase decisions (Hjelmar, 2011). Consumers may also buy organic products because of food safety concerns (Hughner et al., 2007; Huang, 1995).

Consumers are not only heterogeneous in their motivation for buying organic, but they also differ with respect to how frequently they buy organic products. For example, one can differentiate between households that are likely to buy organics every month of the year and households that are likely to buy organics only one month of the year. Smith et al. (2009) differentiate between “devoted,” “casual” and “nonuser” organic consumer groups. Other studies differentiate between light and heavy users (Wier et al., 2008; Stevens-Garmon et al., 2007), frequent and occasional buyers (Janssen and Hamm, 2012), current market participants and nonparticipants (Smed, 2012), and committed and mainstream consumers (Hallam, ed. Jones et al., 2003).

Classifying organic consumers by purchase frequency can lead to some interesting insights. Light users appear to prefer organic vegetables, while heavy users appear to prefer organic fruits (Stevens-Garmon et al., 2007). Zhang et al. (2008) estimate that the average household will increase organic fresh produce expenditures by 0.37% when their income rises by 1%, whereas an organic-purchasing household will increase these expenditures by only 0.22%. This lower elasticity suggests that organics are more of a “necessity” for organic-purchasing households. In other words, organic-purchasing households buy organics more as a lifestyle choice, not as a response to income changes. These estimates correspond to the finding of Hallam, ed. Jones et al. (2003) that in countries with “developed” organic markets, a core group of organic consumers may have little potential for further expansion and more mainstream consumers are more price-sensitive. A couple of studies have attempted to connect purchase frequency with underlying consumer preferences, but both have done so empirically and qualitatively, not theoretically. In part, my theoretical model attempts to ascribe differing purchase frequencies to consumer preferences.

Also note that, in the studies mentioned in the previous few paragraphs, both market participation and the magnitude of consumption are mentioned. Consumers may or may not participate in the organic market, and if they do, the amount of organic products that they purchase varies widely. This distinction between a consumer’s participation and consumption decisions are both theoretically and empirically significant. I model this tiered decision-making, considering that the variables influencing an individual’s participation decision are theoretically different from the variables influencing an individual’s consumption decision. Roughly speaking, an organic consumer’s participation decision can be thought of as their likelihood of buying organic products at all, whereas an organic consumer’s consumption decision can be thought of as their willingness-to-pay (WTP) for organic foods.

2.3.2. Likelihood of buying organic

Hispanic and African American households are more likely to buy organic produce over conventional produce than white households (Smith et al., 2009; Zhang et al., 2008; Stevens-Garmon et al., 2007). Households with older heads of house are more likely to buy organic foods (Kasteridis and Yen, 2012; Smith et al., 2009; Zhang et al., 2008). Most studies conclude that the presence of children in a household has a positive impact on a household's decision to buy organic foods (Hughner et al., 2007; Thompson and Kidwell, 1998; Kasteridis and Yen, 2012; Smith et al., 2009; Dimitri and Greene, 2002). There is not a broad consensus on whether education exhibits a positive influence on the likelihood of a household buying organic. Thompson and Kidwell (1998) conclude that consumers with graduate or professional degrees are less likely to buy organic. However, the majority of studies claim that education does correlate with a higher likelihood of buying organic foods (Monier et al., 2009; Kasteridis and Yen, 2012; Smith et al., 2009). Zhang et al. (2008) adds to this position by noting that the educational level is highly significant in explaining both market participation and consumption of fresh organic produce. Of particular relevance to my empirical study is the finding that a household is more likely to buy *organic fresh fruits* if the head of household is college educated (Lin et al., 2009). Households with higher incomes are more likely to buy organic products (Zhang et al., 2008; Smith et al., 2009; Lin et al., 2009; Dimitri and Greene, 2002). Married households have been found to be more likely to buy organic (Smith et al., 2009), especially in the case of fresh fruits (Lin et al., 2009). Smaller households are also more likely to buy organic (Zhang et al., 2008; Dimitri and Greene, 2002). Zhang et al. (2008) also conclude from multiple regression technique that urban households are 6% more likely to be organic buyers than are rural households.

In addition to household characteristics, there are several other factors that affect a household's likelihood of buying organic products. If organic produce exhibits more cosmetic defects relative to conventional produce, consumers are less likely to purchase it (Thompson and Kidwell, 1998). Pragmatic and convenience-oriented consumers are more likely to buy organic foods if they are widely available in supermarkets and are clearly visible and easy to find, preferably sporting an eco-label (Hjelmar, 2011). Information that changes consumers' perceived quality of organic fruits and vegetables relative to conventional fruits and vegetables influences the likelihood that the consumers will buy organic. For potential consumers of organic fruit products, information about health benefits and pesticides equally affect whether a consumer participates in the organic fruit market, but only information about health benefits affects whether a consumer purchases more organic fruit when they are already in the market (Smed, 2012). The absence of a farmers' market significantly increases the probability that a consumer will be a careless or uninvolved consumer who is less likely to buy organic (Zepeda and Nie, 2012).

2.3.3. Consumer WTP

Once consumers participate in the organic market, their willingness-to-pay (WTP) organic price premiums can vary according to household characteristics. The effect of age on WTP is not a consensus, as Loureiro and Hine (2001) state that consumer age has a negative effect on the WTP for organic potatoes, while Misra et al. (1991) state that the probabilities of WTP for pesticide-free produce is highest for households with heads of house greater than 60. The effect of education is more consistently estimated, as Loureiro and Hine (2001) and Rousseau and Vranken (2013) both claim that more highly educated households are more willing to pay for organic produce. Families with children are more willing to pay organic price premiums (Batte et al., 2007). The probabilities of WTP for pesticide-free produce are highest among households with more than $35,000 of annual income (Misra et al., 1991).

WTP can also vary due to factors external to a household's characteristics. Knowledge or presence of certification of organic products has been shown to increase consumer WTP. Consumer awareness of the NOP seal can be significant in increasing the probability of consumer WTP for organic foods (Batte et al., 2007). Higher WTP have been estimated for logos that are well-known and trusted with perceived strict organic standards and a strict control system. Certification logos can also have a different effect on WTP depending on how often a consumer purchases organic – Janssen and Hamm (2012) claim that some logos attract a higher WTP for frequent buyers compared to occasional buyers. Specialty grocery shoppers are willing to pay substantially more for organic products compared to traditional grocery shoppers (Batte et al., 2007). Consumers tend to have a higher WTP for organic products with a shorter shelf life, such as fruits and vegetables (Yiridoe et al., 2005).

2.3.4. Geographic differentiation

Another factor explaining organic consumption is geographic location. A household's geographic location can do much to explain organic purchases, as several studies conclude that households are more likely to buy organic produce if they are located in the western U.S., which retains the most organic handlers (packers, shippers, manufacturers, distributors, etc.) in the U.S. (Smith et al., 2009; Lin et al., 2009). Western households have also been estimated to consume more organic produce compared to other regions (Kasteridis and Yen, 2012; Stevens-Garmon et al., 2007). There is some slight disagreement with this result, as Zhang et al. (2008) claim that households with the highest to lowest probability and level of fresh organic produce consumption are located in the East, followed by the West, then the South, and finally the Central states. The same study notes that the eastern region of the U.S. has the highest percentage of certified organic acreage and the western region has the highest level of organic produce production, so perhaps households in these regions have more access or are more aware of fresh organic produce than are households in other regions.

2.4. “Organic”: Perception vs. Reality

As mentioned earlier, consumers will pay an organic price premium because they can obtain some additional value over and above the value contained in conventional products. However, there is a lack of a basic understanding amongst food consumers regarding what the term “organic” represents. The USDA defines organic production as “A production system that is managed in accordance with the [Organic Foods Production] Act and regulations in this part to respond to site-specific conditions by integrating cultural, biological, and mechanical practices that foster cycling of resources, promote ecological balance, and conserve biodiversity” (Dimitri and Greene, 2002). Specifically, the term “organic” expresses only a production philosophy and process and does not imply that organic products are safer or healthier than conventional products for consumers (Winter and Davis, 2006). Organic is a “process” claim that informs consumers how organic foods are produced, not a “product” claim that informs consumers of health or nutritional attributes believed to be contained in organic foods (Lockeretz, ed. Jones et al., 2003).

This fact may clash with the perceptions of organic consumers, who often believe that consuming organic foods results in better health outcomes (Yirido et al., 2005; Crinnion, 2010). However, Welsch (2012) analyzed the relationship between organic consumption and self-rated health status and discovered that although the two variables exhibited a strong, statistically significant relationship using simple regression techniques, the relationship dissipated after instrumenting for organic consumption. The authors suggest that the perceived causal relationship between organic consumption and health may be spurious due to common unobserved factors of organic consumers, potentially health-oriented lifestyles. In other words, the self-reported higher levels of health that people causally attribute to consumption of organics are likely unfounded. Instead, organic consumers probably “feel healthier” not because they eat organic food, but because they lead healthy lifestyles (i.e. exercise) that are unobserved by researchers. In fact, scientific research largely suggests the absence of a causal link between organic consumption and greater health and nutrition, a topic to which I will turn later. In sum, there is a discrepancy between consumer perceptions of organic food and scientific research regarding benefits of organic food.

2.5. Scientific evidence on benefits of organic food

Dabbert, ed. Jones et al. (2003) notes that a “simple” assessment of the health benefits of organic farming to consumers is impossible. Studies in the nutrient content of organic foods vary in results due to specific characteristics of the land, farming operations, and times which underlie the data being analyzed (Crinnion, 2010; Johansson et al., 2014).

Several studies find that the nutritional content of organic foods, such as vitamin C, iron, magnesium, and phosphorus, are higher relative to that of conventional foods, but the positive impact on human health of consuming organic acids and polyphenolics (which may prevent cancer and cardiovascular disease) is not as definitive (Winter and Davis, 2006). Organic fruits and vegetables retain less pesticide residues than conventional analogues, but their underlying production process may instead allow for naturally occurring toxins if crops experience increased pressures from pests, including insects, weeds, or plant diseases (Crinnion, 2010). Additionally, organically-produced livestock may possess higher rates of bacterial contamination than conventionally-produced livestock, since organic production generally prohibits antibiotic use (Winter and Davis, 2006).

However, providing a recent systematic review of peer-reviewed evidence published in the past 50 years, Dangour et al. (2010) provides a strong argument that organically and conventionally produced foods are broadly comparable in their nutritional content. Similarly, Smith-Spangler et al. (2012) claim that there is a lack of strong evidence that organic foods are significantly more nutritious than conventional foods. Johansson et al. (2014) find that in lab experiments, organic cultivation did not influence nutritional content, although animal and *in vitro* studies showed positive health outcomes as a result of organic consumption. Jensen et al. (2013) conclude that systematic nutritional differences in organic foods vs. conventional foods can be observed, but superior nutritional quality resulting from organic cultivation is questionable and it is not really possible to either support or disprove consumer belief that organics are healthier.

As a counter-argument, Holzman (2012) contend that previous studies, notably Dangour et al. (2010), which claim that organics offer no substantial nutritional or health benefits, may underestimate the danger of pesticides, especially in context of population-level risks to public health. The author urges consideration of "subtle" intergenerational adverse genetic and neurodevelopment effects caused by pesticides. Thus, consumer fears of pesticides as a reason for buying organic food may be well-founded.

It is useful now to revisit Figure 4, which shows that the top three reasons people buy organic food are because they believe it is healthier (76%), that they can avoid pesticides and other toxins (53%), and that it is more nutritious (51%). Two of these claims, namely that organic food is healthier and more nutritious, have generally not been substantiated by scientific evidence. The third claim, namely that avoiding pesticides and toxins is beneficial, has been nominally supported by scientific evidence. In my opinion, the broad conclusion of the scientific evidence is that organic foods offer no significant nutritional or health benefits to consumers over and above those offered by conventional products. This evidence is at odds with consumer perception, which largely holds that organics are, in fact, healthier and more nutritious than conventional foods (see Figure 4, also Pearson et al., 2010). One could argue that the lack of pesticides in organic foods has been scientifically shown to be healthier for human consumption, so consumer perception and scientific evidence really don't conflict. However, I argue that the presence of pesticides and its effect on human health is just one component of the health and nutritional attributes consumers find in organics, so it is more accurate to claim that consumer perception of health and nutritional attributes in organics is at odds with the scientific evidence. This claim leads to some interesting insights when incorporated into a theoretical model of organic consumers.

3. Theoretical Model

In the existing literature, most theoretical models of organic consumer behavior rely on expressions of utility and willingness-to-pay functions, at most asserting that consumers' utility for organic foods depends on different utility and health attributes of organics (Huang, 1995; Batte et al., 2007; Misra et al., 1991; Lin et al., 2008; Zhang et al., 2008). These models also frequently note that consumer behavior is driven by relative prices of organic and conventional foods. What these studies have failed to do is provide a theoretical model of organic consumer behavior that explicitly contains these different components (relative prices and utility and health attributes of organics). I describe such a model in the following section (Nelson, 2016).

The typical organic consumer has access to both organic (o) and conventional (c) types of two different types of foods, indexed by j = 1,2. p_{jo} and p_{jc} indicate the market prices of the organic and conventional version, respectively, of the j^{th} food type. These are the prices that organic consumers face. Given the reasons for and existence of organic price premiums in the organic food market as detailed earlier, I assume that $p_c < p_o$for both food types $j = 1{,}2$ (i.e., $p_{1c} < p_{1o}$ and $p_{2c} < p_{2o}$). x_{jo} and x_{jc} indicate a consumer's consumption of the organic (o) and conventional (c) version, respectively, of the j^{th} food type.

The typical organic consumer buys food to satisfy an exogenously defined set of 2 nutritional requirements given by b_k for $k = 1{,}2$ requirements. $b_{k|k=1,2}$ thus represents the total amount of nutritional value the consumer needs to satisfy by consuming his/her food "basket". $\boldsymbol{A_k} = [A_{1c,k}\ A_{2c,k}\ A_{1o,k}\ A_{2o,k}]$ where $k = 1{,}2$ indicates the amount of vitamins or minerals in the consumer's "basket". For example, $A_{1c,1}$ could represent the amount of vitamin C per ounce of conventional apple and $A_{2c,1}$ could represent the amount of vitamin C per ounce of conventional orange. Following from this, $A_{1o,k}$ would represent the amount of vitamin C per ounce of organic apple and $A_{2o,k}$ would represent the amount of vitamin C per ounce of organic orange. It is important to note that these numbers represent the nutritional or health benefits a consumer *believes* he or she would receive from consuming each food type, as the model seeks to model this kind of small-scale decision-making.

The theoretical consumer also buys food according to a utility function that includes taste preferences, environmental concerns, ethical and moral concerns, or food safety concerns. Thus consumers gain unique utility from consuming organic foods.

The theoretical consumer faces the following decision:

Choose $\boldsymbol{x} = [x_{1c}\ x_{2c}\ x_{1o}\ x_{2o}]$ where each x is measured in ounces such that

$$min_x e = \boldsymbol{px} \quad \textbf{(1)}$$

Subject to:

$$\boldsymbol{A_1 x} \geq b_1 \quad \textbf{(2)}$$

$$\boldsymbol{A_2 x} \geq b_2 \quad \textbf{(3)}$$

$$U(\boldsymbol{x}) \geq \overline{U} \quad \textbf{(4)}$$

$$\boldsymbol{x} \geq 0 \quad \textbf{(5)}$$

where $\boldsymbol{p} = [p_{1c}\ p_{2c}\ p_{1o}\ p_{2o}]$ is a vector of prices in dollars per ounce and the consumer is constrained to buy zero or positive ounces of total food. The Lagrangian for this problem is:

$$L(\boldsymbol{x}, \lambda) = \boldsymbol{px} - \lambda_1[b_1 - \boldsymbol{A}_1\boldsymbol{x}] - \lambda_2[b_2 - \boldsymbol{A}_2\boldsymbol{x}] - \varphi[\overline{U} - U(\boldsymbol{x})] \quad \textbf{(6)}$$

$\boldsymbol{x}^* = [x^*_{1c}\ x^*_{2c}\ x^*_{1o}\ x^*_{2o}]$ is the vector of food-type combinations that solves this constrained expenditure problem. In order for $\boldsymbol{x}^*$ to solve equations (1)-(5), a λ^* and a φ^* must exist such that certain Kuhn-Tucker first-order conditions hold (these conditions, corresponding to equations 7-21, are found in Appendix A).

The key parameters that can vary in the model are $U(\boldsymbol{x}) = U([x_{1c}\ x_{2c}\ x_{1o}\ x_{2o}])$ and the consumer's belief in the nutritional content of organic foods relative to conventional foods (i.e. the expression $A_{jc,k} \gtreqless A_{jo,k}$). In simpler terms, the theoretical consumer can point to his/her belief in utility attributes in organic foods ($U(\boldsymbol{x})$) as a motivation for buying and consuming them, and/or he/she can point to his/her belief in nutritional and health attributes in organic foods ($A_{jc,k} \gtreqless A_{jo,k}$) as a motivation for buying and consuming them. The consumer can retain both beliefs (the uninformed organic food lover), either of them (the informed organic food lover), or neither of them (the indifferent consumer). Note that the indifferent consumer type corresponds to the "never" user or "non-user" from the existing economic literature, and the uninformed organic food lover corresponds to the "frequent" user in the existing literature. These preferences are explicitly modelled as follows:

(i) Indifferent consumer $U_{1c} = U_{1o}$ and $U_{2c} = U_{2o}$
$A_{jc,k} = A_{jo,k}$

(ii) Informed organic food lover $U_{1c} < U_{1o}$ and $U_{2c} < U_{2o}$
$A_{jc,k} = A_{jo,k}$

(iii) Uninformed organic food lover $U_{1c} < U_{1o}$ and $U_{2c} < U_{2o}$
$A_{jc,k} < A_{jo,k}$

Given these different consumer types and given the previous assumptions and expenditure problem of equations (1)-(5), it can be shown that each consumer type will have a different "food basket" as their solution to their purchasing decision. I will outline the proof of the first case of this claim for case (i), the indifferent consumer. Proofs of cases (ii) and (iii) are not included in the paper, but I provide their main results as a point of analysis and comparison.

Case (i): The indifferent consumer

(a) $p_{1c} < p_{1o}$

(b) $p_{2c} < p_{2o}$

(c) $\frac{\partial U}{\partial x_{1c}} = \frac{\partial U}{\partial x_{1o}}$

(d) $\frac{\partial U}{\partial x_{2c}} = \frac{\partial U}{\partial x_{2o}}$

(e) $A_{jc,k} = A_{jo,k}$

(a) and (b) restate an assumption stated earlier, namely that prices of organic foods are strictly more than prices of their conventional analogues. (c) and (d) reflect the indifference of this consumer type to the utility attributes frequently attributed to organic foods, such as taste preferences, environmental concerns, ethical and moral concerns, or food safety concerns. This consumer type is indifferent to whether their next unit of purchased food is organic or conventional under these considerations. (e) reflects the belief of this consumer type that the nutritional and health content of organic foods is comparable to that of their conventional analogues. Using assumptions (a)-(e), it can be shown that the indifferent consumer will only buy conventional versions of foods and buy no organic food (i.e. $x_{1c}^* \geq 0, x_{2c}^* \geq 0, x_{1o}^* = 0, x_{2o}^* = 0$).

Under assumptions (c) and (e), equations (7') and (11') are derived from the Kuhn-Tucker conditions (7) and (11) in Appendix B and simplify to:

$$\frac{\partial L}{\partial x_{1c}} = p_{1c} - \lambda_1 A_{1c,1} - \lambda_2 A_{1c,2} - \varphi \frac{\partial U}{\partial x_{1c}} \geq 0 \qquad \textbf{(7')}$$

$$\frac{\partial L}{\partial x_{1o}} = p_{1o} - \lambda_1 A_{1c,1} - \lambda_2 A_{1c,2} - \varphi \frac{\partial U}{\partial x_{1c}} \geq 0 \qquad \textbf{(11')}$$

But under assumption (a), $p_{1c} - \lambda_1 A_{1c,1} - \lambda_2 A_{1c,2} - \varphi \frac{\partial U}{\partial x_{1c}} < p_{1o} - \lambda_1 A_{1c,1} - \lambda_2 A_{1c,2} - \varphi \frac{\partial U}{\partial x_{1c}}$, so

$$\frac{\partial L}{\partial x_{1c}} = 0 \qquad \textbf{(22)}$$

and

$$\frac{\partial L}{\partial x_{1o}} > 0 \qquad \textbf{(23)}$$

Incorporating (22) into equations (8) and (12), located in Appendix A, yields:

$$x_{1c}^{*} \geq 0 \qquad \textbf{(24)}$$

and

$$x_{1o}^{*} = 0 \qquad \textbf{(25)}$$

Thus the indifferent consumer will only buy the conventional variety of food type 1 – his preferences prohibit him from buying any organic amount of that food type. By symmetry, the same result applies to food type 2:

$$x_{2c}^{*} \geq 0 \qquad \textbf{(26)}$$

and

$$x_{2o}^{*} = 0 \qquad \textbf{(27)}$$

This particular combination of purchases $\boldsymbol{x}^{*}$ is the only possible combination of goods for the indifferent consumer. At least one of x_{1c}^{*} and x_{2c}^{*} has to be strictly positive if the consumer is to buy any food, which is a reasonable assumption. The indifferent consumer will not purchase any organic food types, but will only buy conventional food types.

Cases (ii) and (iii), the informed organic food lover and uninformed organic food lover consumer types, possess different results. These consumer types purchase food amounts $\boldsymbol{x}^{*} = [x_{1c}^{*}\ x_{2c}^{*}\ x_{1o}^{*}\ x_{2o}^{*}]$ that differ quantitatively from those of the indifferent food consumer. For sake of brevity, I now outline the significant results from these two consumer types.

Case (ii): the informed organic food lover

Exploiting this consume type's preferences as stated earlier in the paper, namely that $U_{1c} < U_{1o}$, $U_{2c} < U_{2o}$, and $A_{jc,k} = A_{jo,k}$, we can see that the informed organic food lover still believes that the nutritional and health content of organic foods is comparable to that of their conventional analogues. This consumer type is informed of the scientific evidence on the matter and adjusts his/her preferences accordingly. The informed organic food lover gains utility from other attributes of organic foods, such as taste preferences, environmental concerns, ethical and moral concerns, or food safety concerns (Dimitri and Lohr, ed. Canavari and Olsen, 2007; Pedersen, ed. Jones et al., 2003; Hughner et al., 2007; Huang, 1995). This consumer type prefers his next unit of purchase of any food type to be organic instead of conventional. The solution to this consumer's problem, equations (1) – (5), will depend on the following inequalities:

$$\frac{p_{1o}-p_{1c}}{p_{1c}} \gtreqless \frac{\varphi(U_{1o}-U_{1c})}{p_{1c}} \quad \textbf{(28)}$$

$$\frac{p_{2o}-p_{2c}}{p_{2c}} \gtreqless \frac{\varphi(U_{2o}-U_{2c})}{p_{2c}} \quad \textbf{(29)}$$

where $\frac{p_{jo}-p_{jc}}{p_{jc}}$ gives the relative markup on the organic version of food type j and $\frac{\varphi(U_{jo}-U_{jc})}{p_{jc}}$ gives the money metric of the marginal gain in utility from consuming an additional unit of the organic version of j in lieu of the conventional version of j, normalized by the price for the conventional version of j. Over a given time frame, as $\frac{p_{1o}-p_{1c}}{p_{1c}}$ and $\frac{p_{2o}-p_{2c}}{p_{2c}}$ vary, the informed organic food lover can optimally switch between organic and conventional food purchases:

If (28) has the sign "≤" then $x^*_{1o} \geq 0$, otherwise $x^*_{1o} = 0$.

If (28) has the sign "≥" then $x^*_{1c} \geq 0$, otherwise $x^*_{1c} = 0$.

If (28) has the sign "=" then $x^*_{1c} \geq 0$ and $x^*_{1o} \geq 0$.

If (29) has the sign "≤" then $x^*_{2o} \geq 0$, otherwise $x^*_{2o} = 0$.

If (29) has the sign "≥" then $x^*_{2c} \geq 0$, otherwise $x^*_{2c} = 0$.

If (29) has the sign "=" then $x^*_{2c} \geq 0$ and $x^*_{2o} \geq 0$.

In general, the informed organic food lover can switch between organic and conventional purchases of both food types over time, but prefers his next unit of food to be organic, all else equal.

Case (iii): the uninformed organic food lover

Exploiting this consumer type's preferences as stated earlier in the paper, namely that $U_{1c} < U_{1o}$, $U_{2c} < U_{2o}$, and $A_{jc,k} \leq A_{jo,k}$, we can see that the uninformed organic food lover believes that the nutritional and health content of organic foods is higher than that of their conventional analogues (Yiridoe et al., 2005; Crinnion, 2010). This consumer type is not aware of the scientific evidence on the matter and or does not incorporate it into his/her preferences, and adjusts his/her preferences accordingly. We also see that the organic food lover still gains utility from other attributes of organic foods, such as taste preferences, environmental concerns, ethical and moral concerns, and/or food safety concerns (Dimitri and Lohr, ed. Canavari and Olsen, 2007; Pedersen, ed. Jones et al., 2003; Hughner et al., 2007; Huang, 1995). This consumer type prefers his next unit of purchase of any food type to be organic instead of conventional, even more so than the informed organic food lover. The solution to this consumer's problem, equations (1) – (5), will depend on the following inequalities:

$$\frac{p_{1o}-p_{1c}}{p_{1c}} \gtreqless \frac{\varphi(U_{1o}-U_{1c})+\lambda_1(A_{1o,1}-A_{1c,1})+\lambda_2(A_{1o,2}-A_{1c,2})}{p_{1c}} \quad \textbf{(30)}$$

$$\frac{p_{2o}-p_{2c}}{p_{2c}} \gtreqless \frac{\varphi(U_{2o}-U_{2c})+\lambda_1(A_{2o,1}-A_{2c,1})+\lambda_2(A_{2o,2}-A_{2c,2})}{p_{2c}} \quad \textbf{(31)}$$

The solution is similar to that of the informed organic food lover, except the uninformed organic food lover is *more likely* to buy organic foods at any given price ratio $\frac{p_{jo}-p_{jc}}{p_{jc}}$ because $\lambda_1(A_{jo,1}-A_{jc,1})+\lambda_2(A_{jo,2}-A_{jc,2}) \geq 0$. In general, the uninformed organic food lover can switch between organic and conventional purchases of both food types over time, but prefers their next unit of food to be organic, all else equal, *even more so* that the informed organic food lover, since he/she believes that the nutritional and health content of organic foods is higher than that of their conventional analogues. This consumer purchases organics at even higher organic/conventional price ratios than the informed organic food lover.

To sum up the theoretical results, an indifferent consumer does not believe organic foods are healthier or more nutritious than their conventional analogues and does not gain extra utility from consuming organic foods, so he/she does not buy any organic food. An informed organic food lover does not believe that organic foods are healthier or more nutritious than their conventional analogues but does gain extra utility from consuming organic foods, so he/she can switch optimally between purchasing conventional and organic foods. Finally, an uninformed organic food lover *does* believe that organic foods are healthier or more nutritious than their conventional analogues and gains extra utility from consuming organic foods, so he/she can also switch optimally between purchasing conventional and organic foods. However, an uninformed organic food lover is more likely than an informed organic food lover to buy organic varieties of foods.

A study has provided empirical evidence of these model implications. Aschemann-Witzel et al. (2013) researched how a sample of German consumers reacted to purchase options of foods that claimed to have both organic (utility) and "functional" (nutritional and health) attributes. They conclude that organic consumers tend to buy organic foods with nutritional and health benefit claims; their more interesting conclusion, however, is that occasional organic consumers in particular were more likely to buy organic products if the products boasted nutritional or health benefits. In other words, occasional organic buyers were more influenced by claims of health and nutritional value in organics. This result suggests that less dedicated consumers or infrequent purchasers more frequently or strongly believe that organic foods do not contain nutritional attributes and are surprised when organic products are advertised as such. In terms of the theoretical model, these findings provide some preliminary evidence that indifferent consumers and informed organic food lovers are not only types of "switchers," but also that they do not believe in the nutritional/health attributes of organic products.

4. Empirical Approach

Harkening back to the motivating questions of this paper, at this point question (1) has been answered, namely which types of consumers buy organic food. I have started to answer question (2) by incorporating prices of organic and conventional food varieties, p_{jo} and p_{jc}, into the consumer model. However, we cannot yet determine how consumer engagement fluctuates as prices of organic foods relative to conventional foods change. My assumption in the model, that $p_{jc} < p_{jo}$, is a static assumption that does not take price fluctuations into account. Such fluctuations could have implications for consumer behavior – as predicted by the theoretical model, consumer behavior in the organic food market is driven in a large part by relative prices of organic and conventional food varieties. I estimate these effects with price elasticities of demand. As prices of organic foods relative to their conventional analogues decreases, the model predicts increasing consumption of organic foods by both informed and uninformed organic food lover consumer types. In the unlikely event that an organic food type is strictly less expensive than its conventional analogue, the model predicts that even indifferent consumers will participate in the organic food market. I now empirically investigate consumer behavior in the organic food market, considering changing prices as well as household characteristics. I first provide broad empirical evidence on prices, expenditures on organic fruit, and ounces of organic fruit bought as relative prices of organic and conventional fruits change. I then implement a Heckman model regression technique to investigate 1) the effect of household characteristics on organic fruit expenditures and 2) the effect of household characteristics and prices on ounces of specific organic fruit (apples, blueberries, strawberries, and oranges) bought. To wrap up the cross-sectional analysis, I show how average household characteristics change as their frequencies of organic purchases change. As a slight departure from my cross-sectional analysis, I end by investigating the difference in contributions made by households on the extensive and intensive margin to the increase in nationwide organic fruit expenditures from 2011 to 2012 using a differenced OLS regression technique. In this last section, I also summarize the average household characteristics in each of four subsamples defined by the four possible types of engagement in the organic fruit market across 2011 and 2012.

5. Data

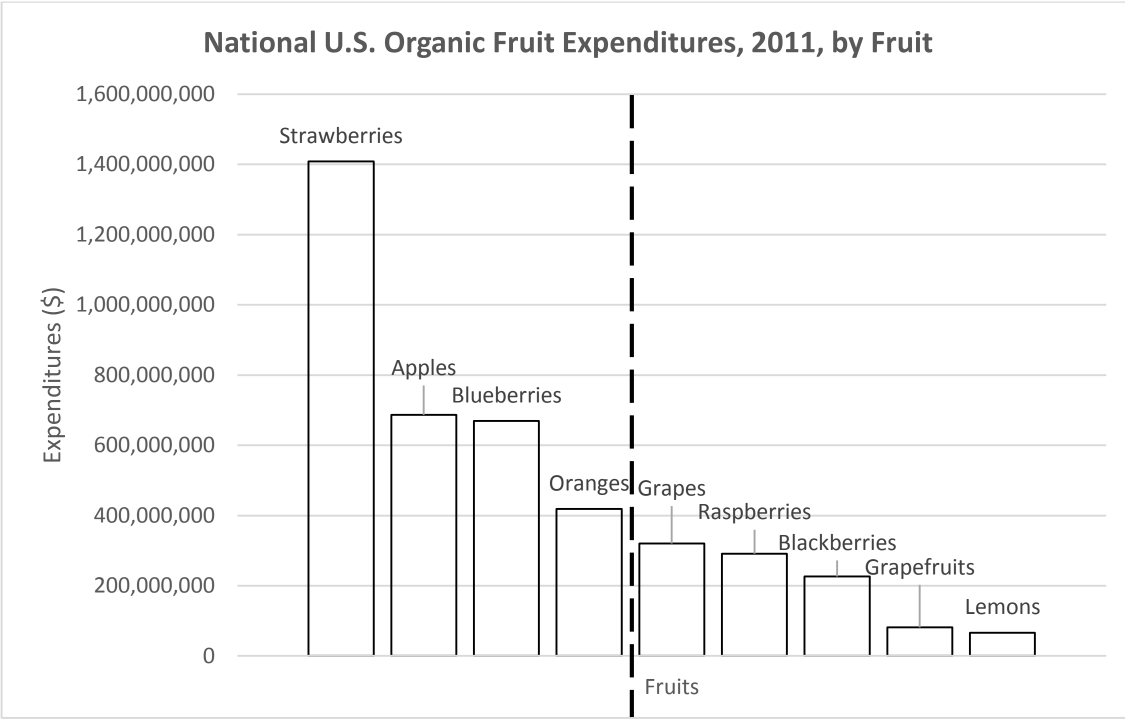
I draw my data from the Nielsen Consumer Panel Dataset, which contains nationally representative household purchases of organic and conventional fruits in 2011 and 2012, in addition to all other Nielsen-tracked categories of food and non-food items located across all retail outlets in the United States (The Nielsen Company, 2014). The dataset represents a longitudinal panel of approximately 60,000 U.S. households (62,092 households in 2011 and 60,538 households in 2012) who use in-home product scanners to record all purchases bought from any retail outlet that are intended for personal, in-home use. Inputted scanner data provides information to Nielsen about the panelist's household characteristics, what products are bought at which price, and when and where purchases are made. Each panelist is assigned a projection factor that projects the weighted sample of households to the total household population (i.e. number of households) in the United States.

6. Descriptive Results

6.1. Prices

For most of my analysis, I restrict my analysis to the four fruits that consumers buy the most of – apples, blueberries, strawberries, and oranges – as can be seen in Figure 2 below. These expenditures have been projected to the population (e.g. national) level using projection factors supplied in the Neilsen dataset.

Figure 2.



***Note: Calculated based on data from The Neilsen Company (US), LLC and provided by the Marketing Data Center at The University of Chicago Booth School of Business.**

As the relative prices of organic and conventional foods are the main driving forces behind the theory of this paper, we should have a good understanding of the prices of both organic and conventional fruits and how they move over time. Figures 3-6 depict the prices faced by organic consumers for each month in 2011 and 2012, broken down fruit by fruit, where the price of a fruit variety (organic or conventional) in each month is the population weighted average of prices faced by panelists. These are average national prices presented in the following figures, obtained by weighting the price faced by each household as a national projection and then dividing cumulative projected prices by the estimated number of households in the United States. It is plausible that each organic fruit's *real* population weighted average price for each month is biased downwards, since we are unable to observe and incorporate the prices faced by panelists who chose not to buy organic fruit. Nonetheless, it is still evident that prices of organic fruits are higher than those of conventional fruits. It varies by fruit as to whether organic prices increase from 2011 to 2012. For example, organic apples and blueberries were largely more expensive in 2012 compared to 2011. However, organic strawberries were cheaper in 2012 and orange prices seem to have remained relatively constant. We can also see seasonal variation in prices. For example, blueberries and strawberries, which are traditionally more seasonal fruit, are noticeably cheaper in the summer months. Comparing prices of each fruit, strawberries, especially organic strawberries, are significantly more expensive than the other fruits.

Figure 3.

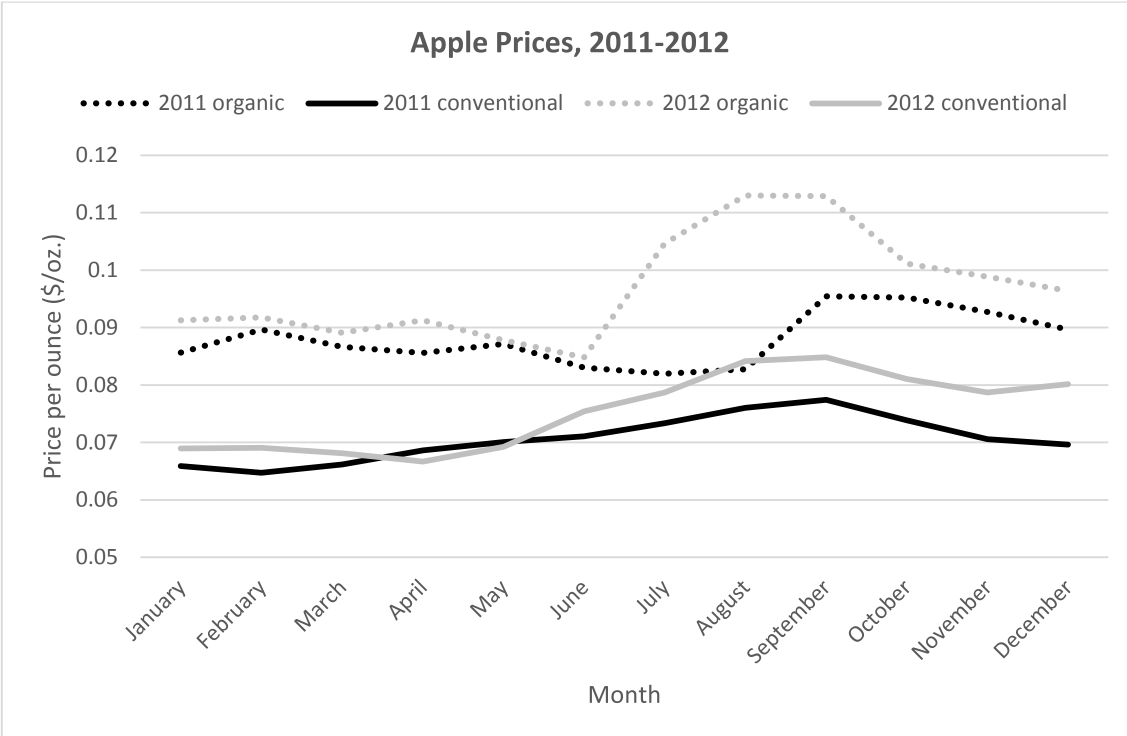


Figure 4.

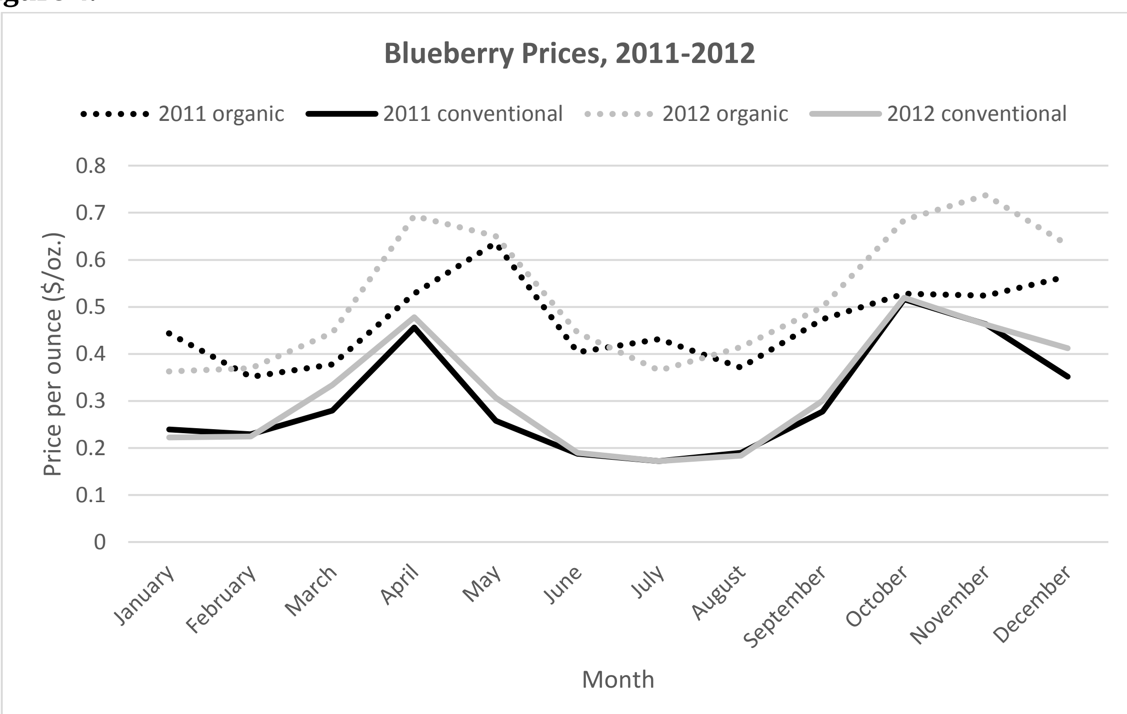


Figure 5.

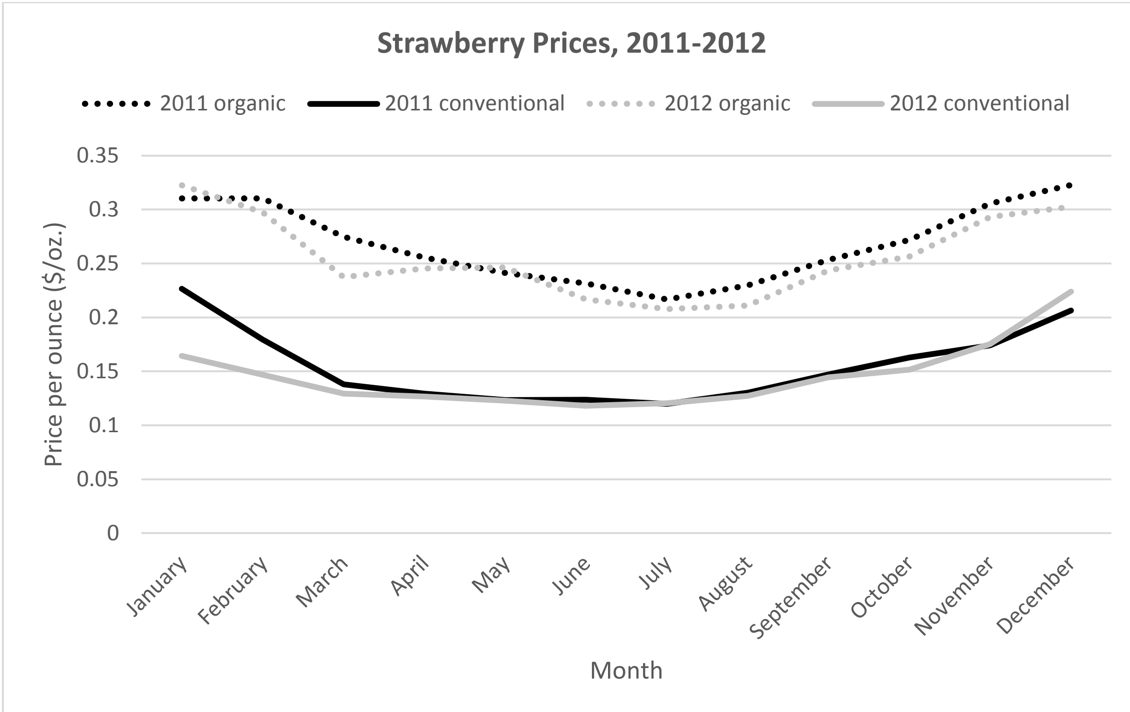
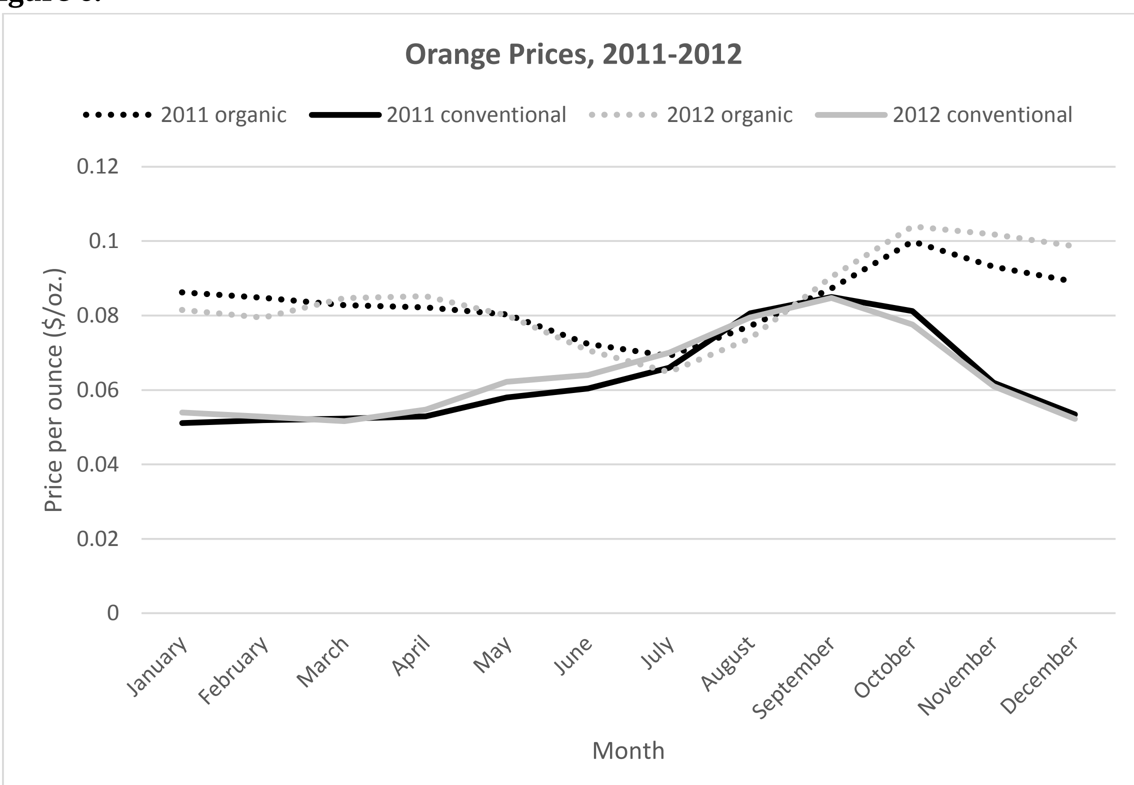


Figure 6.



In general, the theoretical assumption that $p_o > p_c$ is borne out by the data. Both organic and conventional prices vary seasonally and have changed somewhat from 2011 to 2012, all of which could impact consumer expenditures on organic fruit, specifically the expenditure shares that consumers allot to organics.

One might ask if changes in the organic/conventional price ratio from 2011 to 2012 could cause a predictable change in respective consumer expenditures. However, from inspecting these price graphs, it generally appears that price ratios for organic fruits are not more favorable for organic consumers in 2012 compared to 2011. For example, while the price ratio for strawberries appears to have improved across the two years (i.e. the price of organic strawberries relative to conventional strawberries improved), the price ratio for blueberries appears to have gotten more unfavorable. From this observation, one would expect that, in general, expenditures on organic fruits would remain relatively constant from 2011 to 2012.

However, looking at nationwide population-weighted expenditures on all organic fruits from 2011 and 2012 in Table 2 below, the data estimates a whopping 15.1 percent increase in nationwide organic fruit expenditures across these two years. This increase is compared to just a 2.3 percent estimated increase in population-level conventional fruit expenditures, so the increase in organic purchases cannot be attributed simply to the possibility that U.S. food consumers have started to buy more fruit overall, although the data shows that this is also the case. A critical reader might postulate that the 15.1 percent increase in organic expenditures could also be due to population growth in the U.S. Considering that the population of the U.S. is estimated to have increased by just 0.14 percent from 2011 to 2012, this explanation is unsatisfactory as well. These across-year results suggest that multivariate analysis is required to parse out effects on expenditures on organic fruit and ounces of organic fruit bought.

Table 2. Expenditures on Organic Fruits, 2011-2012

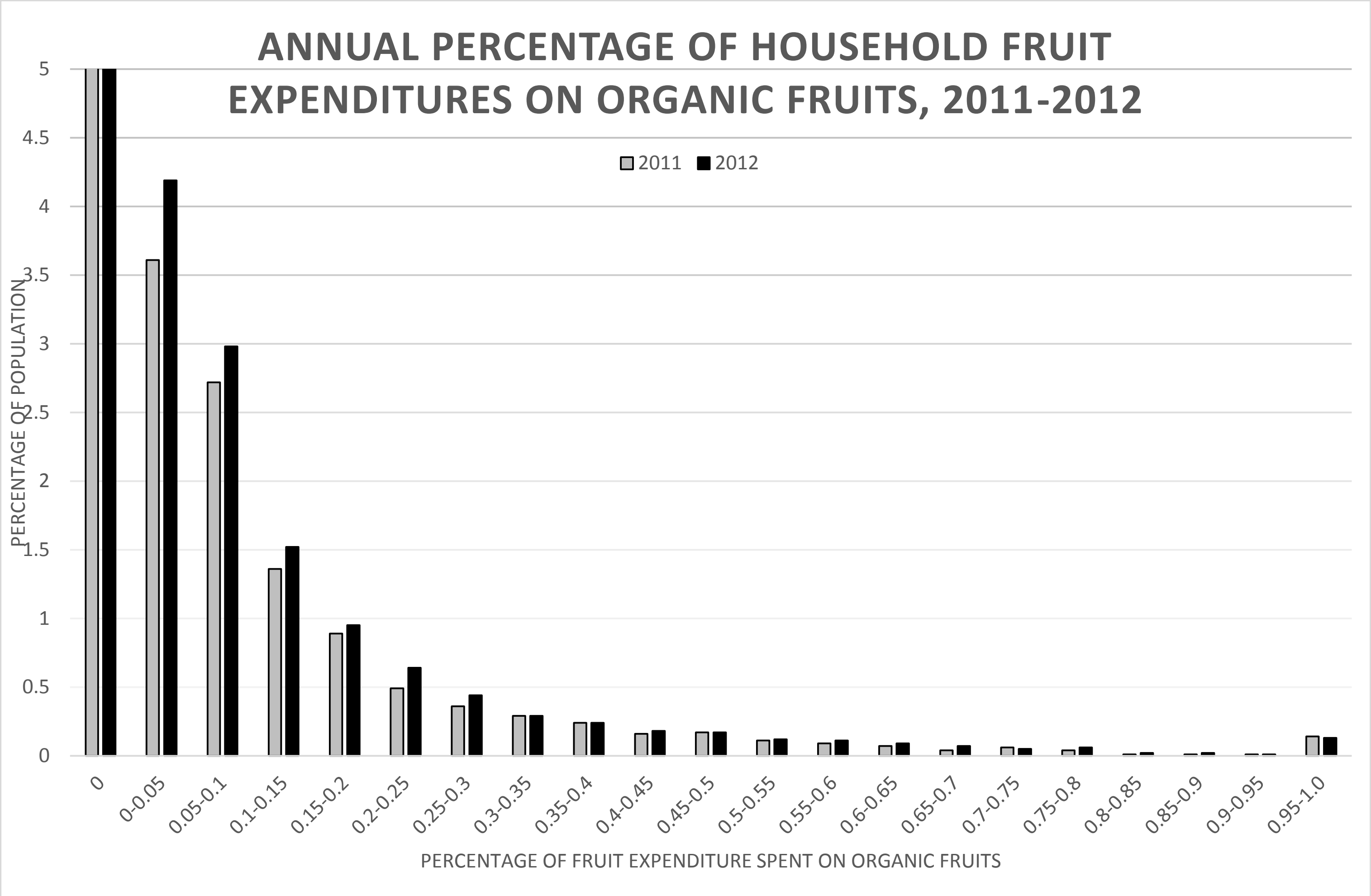
		2011	*2012*	*Percent Change*
Organic	Sample (2011: N=62,092 2012: N=60,538)	$84,282	$94,597	12.20%
	Projected Population	$1.436 mil	$1.653 mil	**15.13%**
Conventional	Sample (2011: N=62,092 2012: N=60,538)	$3.236 mil	$3.244 mil	0.26%
	Projected Population	$5.417 bil	$5.543 bil	2.33%

***Note: Calculated based on data from The Neilsen Company (US), LLC and provided by the Marketing Data Center at The University of Chicago Booth School of Business.**

6.2. Participation vs. Consumption

Another relevant question is whether these increased expenditures are due to the intensive or extensive margins of consumer participation. Using Figure 7 on the following pages, which looks at the annual percentage of household fruit expenditures, not only did the proportion of households who bought organic fruit at least once during the year increase from 2011 to 2012 (from 10.8 percent to 12.3 percent), but also that, in general, the proportion of households who allotted some portion of their fruit expenditure to organics in 2011 increased in 2012. An example or two might clarify this phenomenon. The percentage of organic-buying households who allotted less than five percent of their total fruit expenditures to organics increased from 3.61 percent to 4.19 percent across the two years, likely indicating decisions made on the extensive margin (i.e. to participate in the organic fruit market). Similarly, the percentage of households who allotted between 20 and 25 percent of their total fruit expenditures to organics increased from 0.49 percent in 2011 to 0.64 percent in 2012, likely indicating decisions made on the intensive margin (i.e. to buy more organics). These two examples illustrate the major implication of this specific analysis, namely that the behavior of organic consumers likely is relevant at both the extensive and intensive margin. More households participated in the organic market in 2012, but it appears that existing organic consumers also increased organic expenditures. Pearson, Henryks, and Jones (2011) claim that most consumers only buy organic food intermittently; for them, the factors explaining the extensive margin of engagement in the organic fruit market are more relevant than the factors explaining the intensive margin.

Figure 7.



***Note: Calculated based on data from The Neilsen Company (US), LLC and provided by the Marketing Data Center at The University of Chicago Booth School of Business.**

Figure 7 (cont'd)

PERCENTAGE	2011	2012
0%	89.15	87.73
0-5%	3.61	4.19
5-10%	2.72	2.98
10-15%	1.36	1.52
15-20%	0.89	0.95
20-25%	0.49	0.64
25-30%	0.36	0.44
30-35%	0.29	0.29
35-40%	0.24	0.24
40-45%	0.16	0.18
45-50%	0.17	0.17
50-55%	0.11	0.12
55-60%	0.09	0.11
60-65%	0.07	0.09
65-70%	0.04	0.07
70-75%	0.06	0.05
75-80%	0.04	0.06
80-85%	0.01	0.02
85-90%	0.01	0.02
90-95%	0.01	0.01
95-100%	0.14	0.13

***Note: Calculated based on data from The Neilsen Company (US), LLC and provided by the Marketing Data Center at The University of Chicago Booth School of Business.**

Organic consumer behavior is likely determined by different factors at the extensive and intensive margins, namely differentiated with respect to access (whether retail, seasonal, or other). Therefore, not only is a multivariate analysis required, but also an analysis and estimation technique that incorporates the potentially different factors affecting the participation and consumption decisions in the organic food market.

6.3. Expenditures

To begin to explain how consumers react to the difference in prices of organic and conventional fruits, I look at a simple static, cross-sectional relationship between weighted ounces of organic fruit purchased by the typical consumer and the organic/conventional price ratio (Figure 6). I have calculated price ratios for each specific fruit and categorized them in order to enable consolidation across different fruits. In addition, the ounces of organic fruit purchased are weighted by the number of opportunities a consumer might have had to buy organic fruit at each price ratio. Below are an illustrative methodology and graphs detailing such a relationship for 2011 and 2012 for organic buyers only. The estimated trendlines are just meant to be visual aids with no mathematical or computational significance.

1. Generate $pricecategory_j$ for $j = [1,10]$, with $pricecategory_5$ encompassing the mean price ratio faced by consumers.

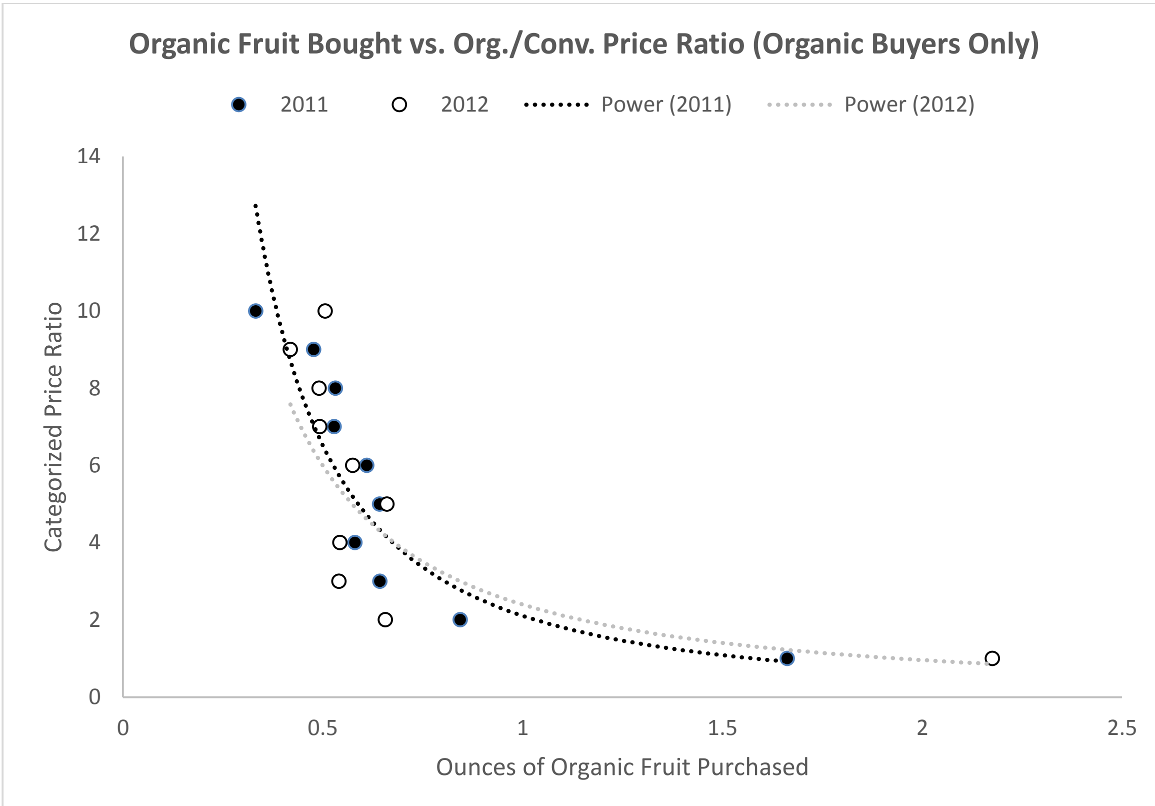
2. Tabulate the ounces of organic fruit, $totweight_j$, purchased in each $pricecategory_j$.

3. Weight $totweight_j$ by one divided by the number of times consumers faced each price ratio, $occurrences_j$.

4. Weighted ounces of organic fruit purchased by the typical consumer at each price ratio ($ounces_j$) is then given by:

$$ounces_j = \frac{totweight_j}{occurrences_j}$$

Figure 8.



***Note: Calculated based on data from The Neilsen Company (US), LLC and provided by the Marketing Data Center at The University of Chicago Booth School of Business.**

From this graph, we can deduce that all consumers tend to buy more organic fruit as the price of organic fruits relative to conventional fruits decreases. In other words, the demand for organic fruit is downward-sloping, as expected. The two points far out to the right are not outliers, but simply illustrate the tendency of organic consumers to buy the greatest amount of organic fruit, on average, as the price ratio of organic fruits relative to conventional fruits is the lowest. This static, cross-sectional analysis of the relationship between ounces of organic fruit purchased by the typical consumer and the relative prices of organic fruits relative to conventional fruits is informative in this regard, but it does little to tell us about behavioral responses of consumers over time. A time-trend analysis will give us a better look at how consumer might make decisions based on relative prices.

In Figures 9-12, as in the price graphs displayed previously, I use nationally-averaged price ratios for each specific fruit, since I am interested in month-by-month analysis and can therefore break down different time trends by fruit. With the exception of late summer/early fall months in the organic apple market, the monthly pattern of price ratios seems to be similar in 2011 as in 2012. Having observed a relatively time-invariant seasonal pattern in price ratios for each organic fruit, a useful investigation is comparing the fluctuations in prices to fluctuations in ounces of organic fruit purchased. We might expect ounces of organic fruit purchased to negatively track these seasonally varying price ratios, all else constant – for example, an increase in the price ratio of organic blueberries relative to conventional blueberries would theoretically cause a typical consumer to substitute his expenditures into conventional blueberries in lieu of organic blueberries, all else constant, and vice versa. The following graphs depict the relationship between the organic/conventional price ratio and monthly ounces of organic fruit purchased for the four organic fruits in 2011 and 2012.

Figure 9.

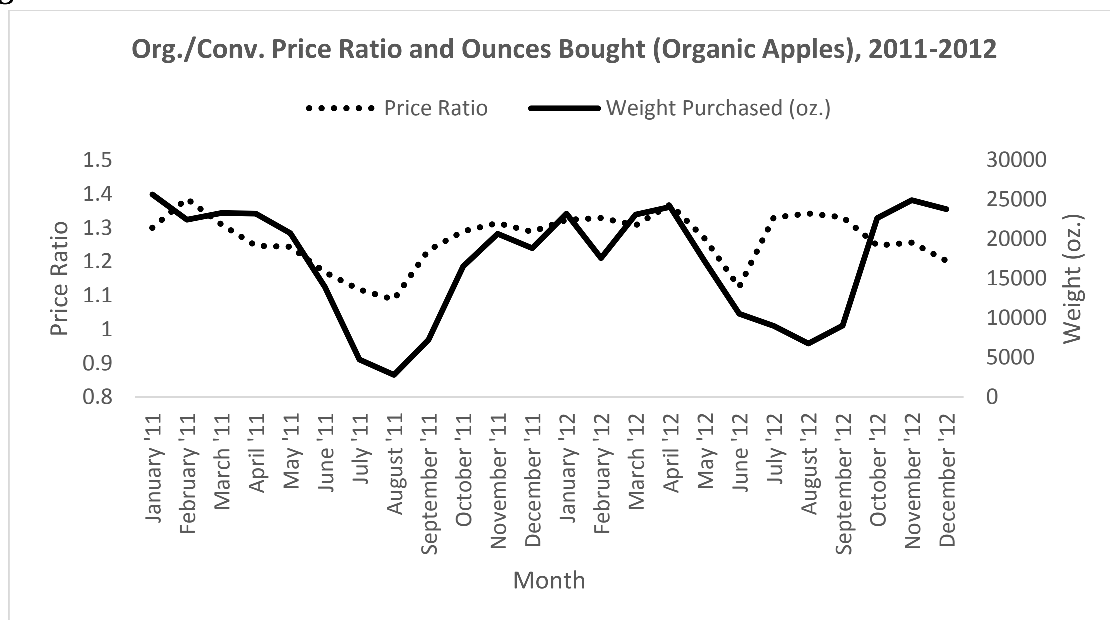


Figure 10.

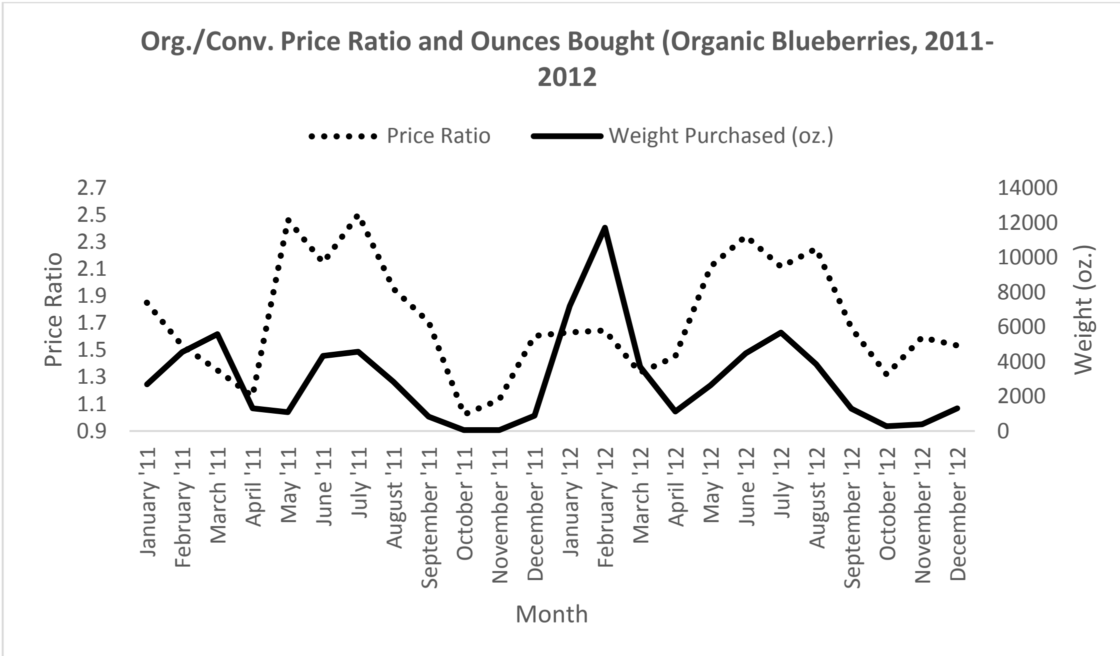


Figure 11.

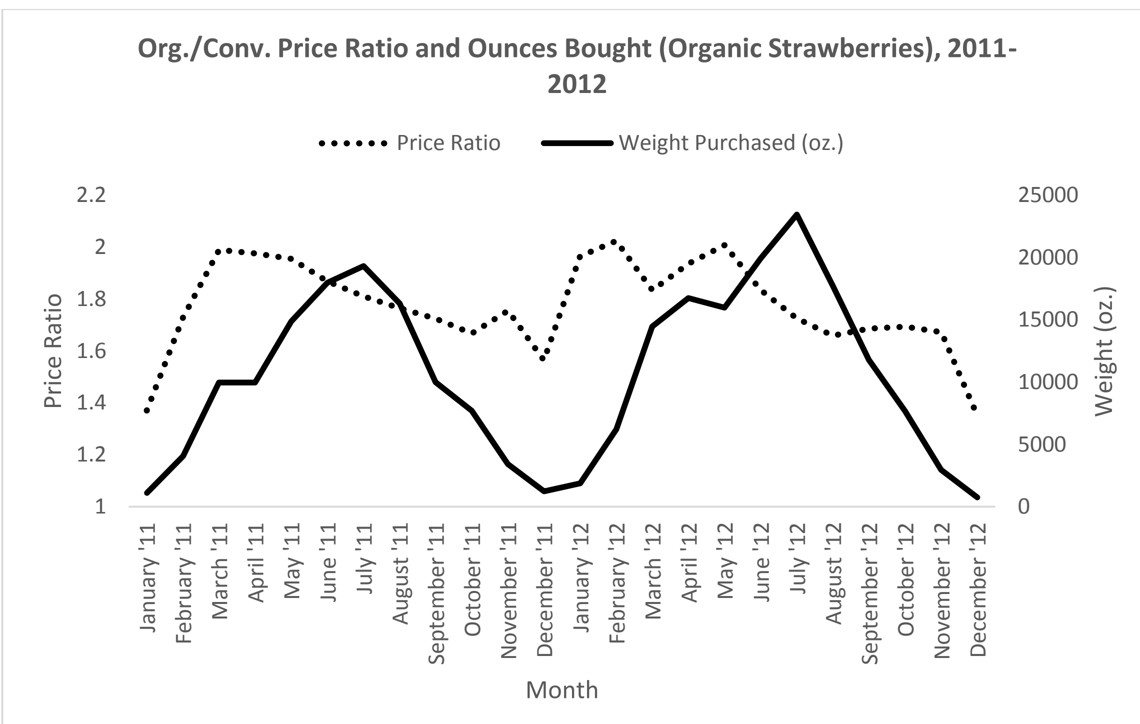
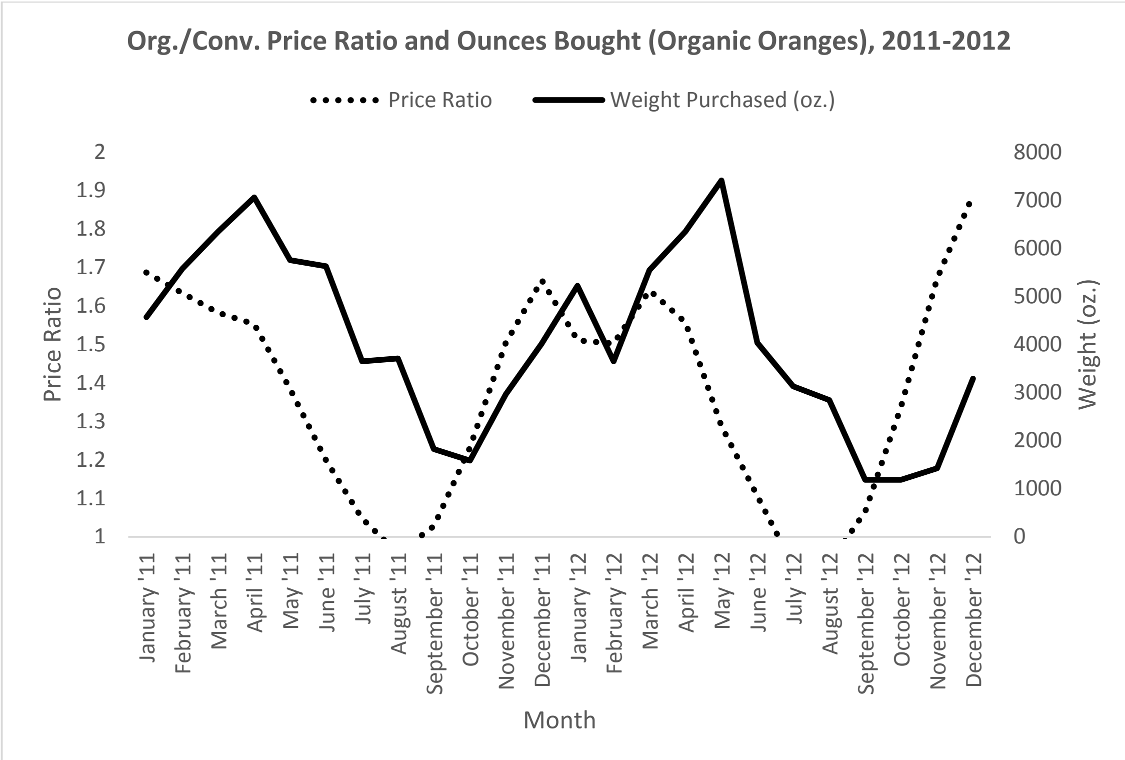


Figure 12.



As one can see from observing these different graphs, ounces of organic fruit purchased does not oppositely track seasonally-varying price ratios of organic to conventional foods in any general sense. In fact, ounces of organic fruit bought tends to fluctuate in tandem with changes in prices. For example, when the price ratio of organic oranges to conventional oranges drastically improves in the late spring and summer months in both 2011 and 2012, and organic oranges in fact actually command cheaper overall prices than conventional oranges (i.e. the organic/conventional price ratio is less than 1) in August of both years, one would expect ounces of organic oranges to increase substantially, all else constant. However, ounces of organic oranges bought do not increase during these time periods. In fact, ounces of organic oranges bought continue a downward trend in both years, fluctuating in tandem with the organic/conventional price ratio. When observing trends for all four organic fruits, it becomes clear that, in general, ounces of organic fruit purchased fluctuates in the same direction as price ratios of organic to conventional fruit.

Organic food consumers do not appear to respond to changes in the relative price of organic and conventional fruits as though prices are the only factor affecting their decision. Clearly organic food consumers do not make their expenditure decisions based on price alone; in fact, these within-year results suggest that there are multiple other factors explaining organic food purchasing. Seasonality is likely the most important factor explaining how prices and amounts of organic fruit bought move together over time. In recognition of this fact, it would be ideal to control for seasonality in a multivariate regression in order to accurately identify price effects over time. Overall, these within-year results also suggest that multivariate analysis is required to parse out effects of expenditures on organic fruit and ounces of organic fruit bought.

7. Cross-Sectional Statistical Analysis

Before presenting my empirical approach, it is useful to summarize existing models seeking to predict organic consumer behavior. Loureiro and Hine (2001) present a maximum likelihood framework, where a consumer's WTP for organic foods can be modelled as $\boldsymbol{WTP_i = X_i\beta} + \mathcal{E}_i$, where X is a vector of explanatory variables and WTP is a survey response recording how much a consumer would be willing to pay over and above a theoretical baseline price. This equation can be used in conjunction with payment card data or similar data to estimate a consumer's true WTP for organic foods. Batte et al. (2007) use a similar approach by modelling a consumer's WTP as strictly positive, where $\boldsymbol{WTP_i} = \boldsymbol{e^{X_i\beta+\mathcal{E}_i}}$. Discrete choice models can also be used in conjunction with revealed preference to yield estimates of consumer WTP (Griffith and Nesheim, 2008). Finally, the Lancaster consumer demand model can be used in the specific case of organic foods, since the model assumes that a consumer's utility for organics depends on product attributes instead of the product itself (Gracia and Magistris, 2008). In practice, the model begins with the assumption that the consumer chooses the product that possesses the combination of attributes that maximizes his/her utility, then proceeds to a random utility discrete-choice model. My study does not estimate WTP; rather, it uses income and price elasticities of demand to estimate the response of organic consumers to the relative prices of organic and conventional foods.

A couple of studies on organic food purchases by households have incorporated both the participation and consumption decisions of organic consumers into their empirical models. Zhang et al. (2008) employ an approach most similar to that of this paper. They utilize Cragg's (1971) double hurdle model to separate the participation and consumption decisions of consumers. In such a modelling framework, the effects of explanatory variables on participation (extensive margin) and amount consumed (intensive margin) can differ in terms of sign, magnitude, and/or statistical significance.

7.1. Heckman model

My study uses the two-step Heckman selection model to explain the extensive and intensive margins. While the Nielsen dataset records every shopping trip its participants make, I have collected all expenditures at the monthly level. Therefore, each household has twelve observations per year. The main implication of this structure is that it creates heteroscedasticity. To mitigate this problem, I cluster households when explaining monthly expenditures. Clustering the errors in this way solves the non-independence of errors across each household's set of observations.

As an alternative I also summarize household expenditures at the annual level. In this case each household is only represented in the database once and no clustering is necessary when explaining extensive and intensive margin levels.

A key feature of the two-step Heckman model is the calculation of the inverse Mills ratio in the selection equation (the extensive margin) and subsequent inclusion as a regressor in the second-stage equation (the intensive margin).The inverse Mills ratio controls for potential correlation of error terms between the first hurdle (participation decision) and second hurdle (consumption decision), or the sample selection bias that comes from ignoring the selection criteria in the second-stage decision (Kasberg and Stevens, 2013). The selection bias, or the bias that would occur from estimating the model with OLS instead of the Heckman method, can be tested by looking at the statistical significance of the inverse Mills ratio coefficient in the consumption equation. All model specifications include the calculation of the inverse Mills ratio in the selection equation and its incorporation as a regressor in the second-stage equation.

In the remainder of Section 7 I do the following. First, I use the annually-aggregated data to explain annual household annual organic expenditures in 2011 and 2012. Next, I use the monthly expenditure data to investigate the determinants of monthly household expenditures on organic fruit in 2011 and 2012. A shortcoming of these first two methods is a lack of price data, although in the monthly expenditure data, seasonal dummy variables are used as proxies for prices, as we can see that prices of each organic fruit are periodic. For the monthly data, each observation is a household-month. For each household, only prices and expenditures change each month, as household variable values remain constant throughout the entire year.

To wrap up regression results, I use the monthly data to explain the ounces bought of specific organic fruit, including apples, blueberries, strawberries, and oranges. In this last set of analyses I explicitly control for the prices of organic fruits and their conventional counterparts. This last set of analyses allows estimation of price elasticities of demand for the various organic fruits. In the monthly data it should be noted that the analyses seeking to explain expenditures do not include prices as explanatory variables, whereas the analyses seeking to explain ounces of organic fruit bought do include prices.

To provide more interpretable evidence of the first-stage estimated non-price effects, which are economically uninterpretable, I calculate first-stage marginal effects in Section 7.4. I also calculate elasticities (income, price, and cross-price), which are conditional on participation in the market, in Section 7.5. To finish Section 7, I show how average household characteristics change as household frequency of organic purchases changes.

In Section 8, I slightly extend my analysis by investigating the difference in contributions made by households on the extensive and intensive margin to the increase in nationwide organic fruit expenditures from 2011 to 2012. I then attempt to parse out the determinants of this increase in expenditures and discover some differential effects between the extensive and intensive margins by conducting more regressions. I also summarize the average household characteristics in each of four subsamples defined by the four possible types of engagement in the organic fruit market across 2011 and 2012.

In general, this more formal econometric methodology seeks to further explain consumer engagement in the U.S. organic food market. What can best explain cross-sectional variation in organic expenditures and ounces of organic food bought? To answer this question, we are interested in the estimated marginal effects of each explanatory variable, as well as estimated elasticities of price and income variables. Perhaps more interestingly, what can best explain increases in nationwide organic expenditures from 2011 to 2012, as previously mentioned? To answer this question, we must investigate what determinants of the change in household organic food expenditures across the two years are positive and significant. Any results would provide nominal evidence as to what drives consumer engagement in the U.S. organic food market.

7.2. Explanatory Variables

Regressions seeking to explain consumer expenditures, whether annual or monthly, do not contain any price variables as regressors. Regressions seeking to explain ounces of organic fruit bought by consumers contain both conventional and organic prices of apples, blueberries, strawberries, and oranges as regressors. These prices are entered as dollars per ounce. All regressions contain some assortment of the following explanatory variables.

The variable *access* is a rough approximation of household access to organic food. It is only contained in the first stage of the two-step estimation, or the participation decision, since it theoretically affects this decision and not the consumption decision. This variable was constructed by gathering data on the number of Whole Foods stores in each state and normalizing the number of stores by the total population in each state, which yields a very rough and likely ill-defined measure of approximate per-household access to organic products. However, this variable still contains useful qualities. First of all, consumers buy the majority of their organic produce from supermarkets (Dimitri and Greene, 2002), so using Whole Foods stores to proxy for supermarket access may correctly reflect the situation that a prospective organic consumer faces, especially since Whole Foods stores are popularly recognized organic food retailers. Secondly, it is likely that the number of Whole Foods stores in a state depends on the existing demand for organic foods and thus at any point in time correlates with the access that a prospective organic consumer experiences. However, we must note that this possible mechanism introduces an endogeneity problem through reverse causation (e.g. higher consumption of organic foods leads to a provision of more access to organic foods, instead of a higher access to organics leading to higher organic food consumption).

The variable *metro* could also retain some explanatory power regarding access, since Zhang et al. (2008) suggest that consumers are more likely to buy organic foods if they live in an urban area. This indicator variable was calculated by matching each household's state and county FIPS code to the Rural-Urban Continuum Codes (RUCC) defined by the USDA, then giving *metro* a value of 1 if the household lived in a metro area as defined by the RUCC.

logincome measures the log of the household's approximate income, which was not originally reported as actual income. Household income was reported as belonging to an income range in gradations of $3,000 to $10,000 up until $100,000, past which a household was categorized as simply a household earning $100,000 or more per year. To incorporate income into my analysis, I recoded a household's income category as the mean income of their categorized income range (i.e. if their income range was $12,000-$14,999, their approximated income value was calculated as $13,500). For households earning over $100,000, I set their approximate income at $150,000.

youngchild is a dummy variable indicating if a household had a child younger than 6 years old. *black* and *asian* are dummy variables indicating if the head of the household is black/African American or of Asian descent, respectively. *college* is a dummy variable indicating whether the household head graduated from college. *married* is a dummy variable with a value of 1 if the household head is married.

Eight dummy variables indicate the region of the country in which the household – New England, Middle Atlantic, East North Central, West North Central, South Atlantic, East South Central, West South Central, and Mountain. The Pacific region is excluded category since the literature has suggested that households are most likely to buy organic food if they are located in the Pacific region of the country (Smith et al., 2009; Lin et al., 2009). Therefore, we might expect most estimated coefficients on the region dummies to be negative.

Finally, in the regressions with monthly data, I include seasonal controls. Dummy variables indicate winter (December/January/February), spring (March/April/May), summer (June/July/August), or fall (September/October/November) as household observations. Winter is the excluded category.

7.3. Regression Results

7.3.1. Annual Organic Expenditures

I first investigate annually-aggregated data for 2011 and 2012 to gain an initial perspective on the determinants of expenditures on total organic fruits. The units of observation are individual households. Looking at Table 3, which includes estimated determinants of annual household organic fruit expenditures in 2011, we can see that the estimated coefficients for *access*, *logincome, youngchild, asian, college, metro,* and *married* are all positive and highly statistically significant in the participation equation. These results support my hypotheses that households are more likely to buy organic fruit if they have a higher income, have a young child, are college-educated, are married, and live in an urban area. The estimated coefficient on *black* is negative, which rejects my hypothesis and previous literature asserting that African-American households are more likely to buy organics. *access* is positive and highly statistically significant, showing not only that it is important to control for access in the participation equation, but also that households are more likely to buy organics if greater access is available, all else equal. Finally, looking at the region coefficients, all except *mtn* are negative and highly statistically significant, which supports my hypothesis that households who live in the Pacific region (or on the West coast) of the country are most likely to buy organic fruit.

Looking at the expenditure equation for 2011 annual expenditures, it is important to note that, out of 62,092 households in the 2011 sample, only 6,739 of them bought any amount of organic fruit in 2011. All the signs of estimated coefficients on the non-regional variables still hold, except for *logincome* and *metro,* which are negative instead of positive. There is a plausible explanation for why the estimated effect of *metro* on annual household expenditures on organic fruit would be negative, namely that once households participate in the organic fruit market, it is easier to spend more (maybe it is more culturally encouraged?) to buy organic fruits in a non-urban area. However, none of the non-regional coefficients are statistically significant. The only statistically significant estimated coefficients in the expenditure equation are *midatl, wncent, soatl,* and *wscent*, which, along with all regional coefficients besides *mtn,* are positive. This result qualifies the result gained from the participation equation, namely that although households are more likely to buy organic fruit in the year if they live on the West coast, they could be more likely to increase their expenditures on organic fruit if they live anywhere *except* the West coast, conditional on participating in the market. For example, in 2011, organic-purchasing households located in the West North Central region of the country are estimated to have spent \$4.31 more per year on organic fruit, on average, than a household in the Pacific region, an estimate that increases to \$5.34 in 2012.

Comparing these 2011 results to 2012 results, located in the neighboring column of Table 3, all results hold in the participation equation except for the estimated coefficient on *mtn*, which is now negative instead of positive and still highly statistically significant. This result suggests that, between 2011 and 2012, it became even more likely that households living in the Pacific region of the country would buy some organic fruit in the year, compared to households living in the Mountain region.

In the expenditure equation for annual expenditures in 2012, all the 2011 results hold. However, the estimated coefficients on *youngchild* and *metro* are now highly statistically significant, suggesting that the effects of these variables on annual household expenditures on organic fruit were more pronounced in 2012 compared to 2011. In 2011, a household is estimated to have spent \$1.54 more per year on organic fruit if a young child was present (all else constant), but is estimated to have spent thirty-six cents less if located in an urban area. In 2012, a household is estimated to have spent $2.41 more per year with a young child present, but is estimated to have spent $2.44 less if located in an urban area. These results are conditional on household participation in the organic fruit market.

In general, while the estimated determinants of annual household organic fruit expenditures retain similarities for the most part between 2011 and 2012, there are some slight differences, mainly with respect to region, urban location, and presence of young children in the house. It is useful to utilize monthly data to check the robustness of these results, especially since the monthly data structure allows us to both control for seasonal access to organic fruit and to provide wider variation in consumer expenditure on organic fruit. A noteworthy point is that the following analyses of monthly organic fruit expenditures still does not incorporate prices as explanatory variables.

7.3.2. Monthly Organic Expenditures

The units of observation for the rest of the regression results are household-months. Starting at the third column of Table 3, which represents monthly household expenditures on organic fruit in 2011, we can see that, in agreement with the annual expenditure results, the estimated coefficients on *access*, *logincome*, *youngchild, asian*, *college*, *metro, and married* in the participation equation are all positive and statistically significant, and that the estimated coefficient for *black* is negative and statistically significant. The regional coefficients, with the exception of *mtn*, are again all negative and statistically significant. An important addition made using the monthly dataset are the seasonal variables *spring*, *summer* and *fall*. All estimated coefficients on these seasonal variables are positive and statistically significant, suggesting that households are more likely to buy some organic fruit in a given month during these seasons, especially summer, than in the winter months.

In the expenditure equation for monthly expenditures in 2011, we can parse out some differences from the annual expenditure results. *youngchild* is estimated to have had a negative effect on the level of a household's monthly expenditures on organic fruit, while *black* is estimated to have had a positive effect, although neither of these estimates are statistically significant. *married* is positive but now statistically significant, which suggests that being married may have had more of an effect on a household's level of organic fruit expenditures in a month than the a household's level of organic fruit expenditures in a year. In 2011, it is estimated that a married household spent about fifty cents per month more on organic fruit, on average. The regional coefficients are all still largely positive again, suggesting that although households were more likely to buy organic fruit in a given month if they live on the West coast, they were more likely to increase their consumption of organic fruit if they lived anywhere *except* the West coast, conditional on participating in the market. It is interesting to note that the estimated coefficients on the seasonal variables are all negative, although not statistically significant. This result is interpreted as, although households were more likely to buy some organic fruit during every month except in the winter, they were most likely to *increase* their consumption of organic fruit in the winter months, conditional on participating in the market. A potential explanation for this could be a matter of supply and availability of organics. Farmers markets supply organic produce exclusively in the warmer months, which provides greater opportunities for non-buyers to participate in the market. However, in the winter months, only dedicated organic buyers continue to participate in the organic market, likely only finding organic fruit products in supermarkets or health food stores.

Comparing these 2011 results to those of the last column in Table 3, which represents monthly household expenditures on organic fruit in 2012, we can see that all results from the participation equation hold. In the expenditure equation, the estimated coefficients for *college*, *married*, *youngchild*, and *logincome* have the expected positive sign. The coefficients on *college* and *married* are both highly statistically significant, suggesting that the effect of these variables may have been more pronounced in 2012 compared to 2011. Married households are now estimated to have spent seventy-two cents more per month on organic fruit than unmarried households on average, a twenty-two cent increase from 2011. The estimated coefficient for *black* is again negative and statistically significant, suggesting that the fact that a household was African-American negatively affected the level of a household's expenditures on organic fruit more so in 2012 than in 2011. The seasonal variables are again estimated as having a negative effect on a household's monthly expenditures, which agrees with the explanation offered previously. Interestingly, the estimated regional coefficients are negative with a few being statistically significant, which casts doubt on the earlier results suggesting that households were more likely to increase their consumption of organic foods in a month if they lived outside of the Pacific region.

From the expenditure analyses we have found empirical evidence of household, access, regional and seasonal variables that determine consumer participation and consumption in the organic fruit market. However, one critical element is still missing: *prices*. The next section presents regression results of determinants of ounces of specific fruit bought, including prices of conventional and organic fruits. In addition to including prices as theoretically relevant variables, conducting a fruit-by-fruit analysis could reveal differential determinants of consumer organic purchases by fruit, results that might highlight the importance of considering the composition of the organic fruit market.

7.3.3. Monthly Ounces of Specific Organic Fruit Purchased

a. Apples

These model specifications are much different from the previous specifications. Firstly, the dependent variable of interest is ounces of specific organic fruit bought by month. As a result, conventional and organic prices of all four fruits (apples, blueberries, strawberries, and oranges) can be included as regressors in both the participation and expenditure equations. Secondly, the estimation procedure did not converge with the full ideal set of explanatory variables in the second-stage equation (the expenditure equation), so in order for the model to yield any results I was forced to cut the model down in size. Race dummy variables are not included in either model equation, and regional and seasonal dummy variables are not included in the expenditure equation of these models, which could very well affect estimation. However, since we already have estimated effects of household characteristics and other descriptive variables on organic expenditures in Table 3, the main concern of the following regression results is the estimated effect of conventional and organic fruit prices on the ounces of specific organic fruit purchased. All other observations will just provide some extra insight on the differential effects of household, regional, and/or seasonal variables on purchases of specific organic fruits compared to total organic fruits. Estimates of the participation equation for all fruits for both years are contained in Table 4, and estimates of the expenditure equation for all fruits for both years are contained in Table 5.

Looking at Table 4, we can see that in the case of monthly ounces of organic apples purchased in 2011, the estimated coefficients on the household and regional variables in the participation equation are similar in sign and significance to the analogous coefficients from the expenditures regressions. However, the estimated coefficients for *summer* and *fall* are negative and statistically significant, which contrasts with the analogous estimated coefficients concerned with total organic expenditures. This result suggests that the case of organic apples is different from the case of total organic fruit when it comes to seasonal participation – for apples, households are less likely to buy organic in the summer and fall months, although in general households are likely to buy *any* organic fruit in those months. The access variable is no longer statistically significant.

In the expenditure equation for monthly ounces of organic apples purchased in 2011, located in the first column of Table 5, the estimated coefficients for *married, college* and *metro* are statistically significant, with *married* and *metro* being positive and *college* being surprisingly negative. The result from the *metro* coefficient is at odds with the expenditures regressions, which largely held that households are less likely to increase their level of organic expenditures if they live in an urban area. Of course, this discrepancy is probably drawing out the difference in behavior for organic apple consumers and organic fruit consumers as a whole. There does not seem to be a ready explanation for why the *college* coefficient is negative.

Looking at the effects of prices, which is the main purpose of these tables, we can see the strong positive and statistically significant effect that conventional blueberry, strawberry, and apple prices have on the purchase of any organic apples in 2011. This points to strong price and cross-price elasticities between organic apples and the conventional versions of apples and close substitutes. The price of organic apples, however, has a statistically significant positive estimated effect on the purchase of any organic apples, which contrasts with traditional economic logic. In the expenditure equation, organic apple prices have the expected negative effect on increased consumption of organic apples, a result that is statistically significant. Specifically, in 2011, a one-dollar increase in the price of organic apples is estimated to have induced a 600 ounce decrease in organic apples purchased by organic-purchasing households per month, on average. This differential participation and consumption response to organic apple prices could mean that consumers of organic apples are initially drawn into the market by higher prices, but are then dissuaded from buying additional quantities of organic apples when the price increases. Overall, except for the estimated effect of organic apple prices on the participation equation, these price estimates support the hypothesis that expenditures on organic fruit increase as the prices of organic fruit relative to conventionally-produced fruit decrease, all else constant.

Moving to the second column of Table 4, which depicts effects on monthly ounces of organic apples purchased in 2012, we can see that the household, regional and seasonal estimates in the participation equation largely align with the 2011 results. In the expenditure equation in Table 5, *logincome, youngchild, college,* and *married* all have the expected positive sign and are statistically significant, which suggest that in 2012, these variables had more of the expected positive effect on monthly expenditures on organic apples than they did in 2011.

Inspecting estimated price coefficients in the second column of Table 4, conventional orange prices and organic strawberry prices both are now estimated to have had a statistically significant positive effect on the ounces of any organic apples bought in a month, suggesting that consumers were more responsive to conventional and organic substitutes in 2012 when considering participation in the market. In the second column of Table 5, organic apple prices retain the statistically significant negative effect on increased expenditures on organic apples, conditional on participating in the market. A one-dollar increase in organic apple price is now estimated to have caused more than a 1300 ounce decrease in organic apples purchased by organic-purchasing households per month, on average, a result that is more than twice as large as the 2011 estimate.

Overall, these results align with those produced in the expenditures regressions, while introducing some seasonal effects and potential urban/rural effects relevant to the organic apple market but not captured in the market for all organic fruits. These results also produce price estimates that correspond nicely to traditional economic logic, although the result that increases in organic apple prices is estimated to increase the likelihood of organic apple consumption needs to be explained. Finally, the coefficient estimates show an increasing importance of several variables, namely *logincome*, *college*, *youngchild*, and prices of conventional and organic substitutes, from 2011 to 2012.

b. Blueberries

Looking at the third and fourth columns of Tables 4 and 5, which show the estimated effects on monthly ounces of organic blueberries bought by households in 2011 and 2012, respectively, the household and regional variables in the participation equation are mostly all of the expected sign (household coefficients being positive and regional coefficients being negative). One interesting difference stands out: in both years, being married is estimated to have negatively affected a household's likelihood of buying organic blueberries (this result is statistically significant only in 2011). No economic explanation seems to be at hand. It is also important to note that the access variable is positive and statistically significant in both years, contrasted to the organic apple results from but in agreement with the expenditures regressions. It appears that seasonal factors affected organic blueberry consumption differently in 2011 and 2012 – in 2011, households were more likely to buy an amount of organic blueberries in the spring and summer and less likely to do so in the fall, but in 2012, households were less likely to buy organic blueberries in all three seasons. This result could be evidence of seasonal supply differences across the two years, or it could be evidence of locational supply differences, where organic blueberries (maybe imported from a different country) were featured more in year-round retail locations such as supermarkets in 2012, instead of just at farmers markets.

In the expenditure equation, *youngchild* and *college* are the only statistically significant household variables in 2011, but *marriage* is the only one in 2012. This difference could hint at the different factors behind increased organic consumption in 2012 versus 2011.

Moving to estimated price factors, the expected price and cross-price elasticities can be observed in the participation equation for both years between ounces of organic blueberries purchased and organic blueberry prices (negative), conventional blueberry prices (positive), and prices of close substitutes (negative). Similarly to the case of organic apples, the overpowering price effect in the expenditure equation for both years is the negative and statistically significant effect of organic blueberry prices. In 2011, a one-dollar increase in organic blueberry price is estimated to have induced an average decrease of 23 ounces of organic blueberries bought per month by organic-purchasing households, an estimate that increases by about an ounce to roughly 24 ounces in 2012. Taken together with the significant price effects in the participation equation, these results suggest that the participation decision of organic blueberry consumers is affected by the prices of multiple items, but their consumption decision is mainly affected by the price of the organic item being purchased. This phenomenon aligns with the observed behavior of organic apple consumers.

c. Oranges

It is worth noting that the sample size for organic orange purchases is much smaller than that for the other organic fruits. Looking at the fifth and sixth columns of Tables 4 and 5, which show the estimated effects on monthly ounces of organic oranges bought by households in 2011 and 2012, the household variables in the participation equation are mostly all of the expected positive sign, except for *metro*, which is negative but statistically insignificant. This estimate suggests that, in contrast to organic apples and blueberries, households were more likely to participate in the organic orange market if they lived in a rural area. In contrast to previous results, the estimated coefficients on the regional variables are almost all positive and a few are statistically significant. These results show that, although households were likely to participate in most specific organic fruit markets and the organic fruit market in general in a given month if they lived on the West coast, they were least likely to buy any organic oranges if they lived on the West coast. This result makes sense, since oranges are largely produced in Florida. Looking at the seasonal variables, the estimated coefficients tell us that households were more likely to buy any organic oranges in the winter and spring, but less so in the summer and fall. This result reminds us, once again, to consider the regional and seasonal composition of the organic fruit market when reaching conclusions regarding the organic fruit market in general.

Switching to the expenditure equation, *metro* is negative in both years and statistically significant in 2011, which shows that living in an urban area decreased the average level of organic orange consumption for a household. The other non-price coefficients are mixed and statistically insignificant except for the estimated coefficient on *youngchild* in 2012, which is negative. Perhaps having a young child started to negatively affect the amount of household organic orange consumption in this year, but we should be wary of that interpretation given the small sample size.

Observing estimated price effects, we can see that a household’s decision to buy any organic oranges was largely driven by prices of conventional oranges and apples, both of which have a positive cross-price elasticity with respect to organic oranges. In the consumption decision, almost no estimated price effects are statistically significant in either year and their signs frequently differ between the two years, so it is difficult to obtain any robust conclusion from them.

d. Strawberries

The sample size for the second-stage equation for strawberries is larger than the sample sizes for any of the previous second-stage equations, which suggests that organic strawberries may be the most popular organic fruit amongst U.S. households. This observation aligns with Figure 2 earlier in the paper, which marks organic strawberries as having the greatest expenditure share of all fruits in the organic fruit market. First inspecting the estimated participation equation results in the seventh and eighth columns of Table 4, we can see that the estimated coefficients of the household and seasonal variables all have the expected positive sign for both 2011 and 2012, and that most of them are strongly statistically significant. One exception to the statistical significance is *married* which, although estimated to have had a positive effect on the likelihood of a household buying organic strawberries in both years, is not statistically significant in either year. An interesting difference arises when looking at the estimated regional coefficients for 2011 compared to 2012. The coefficients are largely positive in 2011 but negative in 2012, suggesting that households were increasingly more likely to participate in the organic strawberry market if they lived in the Pacific region in 2012 compared to 2011.

Looking at the expenditure equation in the seventh and eighth columns of Table 5, *logincome* has an estimated negative albeit statistically insignificant effect for both years, which contrasts with the hypothesis that a household's consumption of organic foods should increase as income increases. *married, college,* and *metro* all have the expected estimated effects. The fact that the household was headed by a married couple appears to have been particularly important in the amount of organic strawberries a household purchased, conditional on participating in the market; *married* has an estimated positive and statistically significant effect in both 2011 and 2012. If organic-purchasing households were married, all else constant, it is estimated that the household bought about 3.4 (2.5) ounces of organic strawberries more in 2011 (2012). The estimated coefficient for *metro* is negative for both years and statistically significant in 2012, suggesting that rural households bought more organic strawberries than urban households.

Considering estimated price effects in the participation equation in Table 4 once more, the estimated own-price elasticity (negative), cross-price elasticity with conventional strawberries (positive), and cross-price elasticities with conventional substitutes (positive) are what we would expect for both years. In the expenditure equation in Table 5, almost none of the price effects are statistically significant; however, they all have the expected signs. The prices of conventional and organic blueberries, as close substitutes, did have statistically significant effects in 2012. A one-dollar increase in the price of conventional (organic) blueberries is estimated to have resulted in a 5.4 (3) ounce increase (decrease) in the ounces of organic strawberries bought by organic-purchasing households per month in that year. The cross-price elasticity with respect to organic blueberries is surprisingly negative; an explanation could be that when a dedicated organic shopper perceives an increase in the price of a close organic substitute (here, organic blueberries), he assumes that the price of the organic fruit of interest will have also increased (here, organic strawberries).

7.3.4. Quick Summary

To wrap up the cross-sectional regression results, we have seen that the household variable hypotheses offered at the outset of the paper largely hold. An exception is the hypothesis that African-American households are more likely to buy organic foods; in these estimates, they are less likely to buy organic fruit than white households. This discrepancy between these empirical findings and previous findings could exist because of the nature of this study, which deals with organic fruits. Perhaps African-American households are more likely to buy other organic products, such as grains or starches.

Interesting points of nuance have been developed with respect to urban and regional location and seasonal effects. Overall, consumers are estimated to be more likely to participate in the organic fruit market if they live in an urban area, live in the Pacific region/on the West coast, and during the spring, summer, and fall months. However, differential effects can be observed when looking at the "consumption decision," or the behavior of households who purchase organic fruit conditional on participating in the market. Households are actually largely estimated to increase their consumption of organic fruits, conditional on buying a positive amount, if they live in a rural area, live anywhere in the country *except* the West coast, and during the winter months. Explanations for these estimated results are provided in the earlier sections.

When it comes to prices, the hypothesis that household expenditures on organic food increases as the prices of organic foods relative to conventionally-produced foods decrease, all else constant, largely holds. One insight gained from two-step estimation, however, is that organic consumers appear to base their participation decision on multiple factors, not only the price of the organic fruit product in question, but also the prices of the product's conventional analogue and close (sometimes not even that close!) substitutes. The consumption decision of organic-purchasing households, on the other hand, appears to be driven largely by the price of the organic fruit product only.

7.4. First-Stage Marginal Effects

To provide more interpretable evidence on the non-price and non-income determinants of a household's participation decision, I calculated first-stage average marginal effects for all household and regional explanatory variables in the regressions summarized in Tables 3 and 4. First-stage marginal effects for household expenditures on total organic fruits, both annual and monthly, are displayed in Table 6. First-stage marginal effects for monthly ounces of specific organic fruit purchased (apples, blueberries, oranges, strawberries) are displayed in Table 7.

One can reach two overarching conclusions by inspecting Table 6. Firstly, the signs of the estimated marginal effects of almost all explanatory variables align with the regression estimates summarized earlier. Secondly, almost all household and regional explanatory variables have estimated marginal effects that are larger in magnitude in 2012 compared to 2011 for both the annual and monthly expenditure analysis. An illustrative example is the variable *college*. In 2011, it is estimated that having a college-educated household head made it 4.01% more likely that a household would have purchased some organic fruit during the year, all else constant. In 2012, the analogous estimated marginal effect was 4.16%, an increase of 0.15%. As an example in the other direction, in 2011, a household located in the Mid-Atlantic region is estimated to have been 0.48% less likely to buy any organic fruit in a month than a household located in the Pacific region. This estimated marginal effect increased in magnitude to 0.71% in 2012.

Table 7 tells a slightly different story in the case of ounces of specific organic fruits bought. Firstly, the signs of the estimated marginal effects align with the regression estimates summarized earlier in that the household variables are almost always positive and the metro and regional variables vary in sign depending on the fruit in question. For example, having a young child is estimated to have increased the likelihood of a household buying some organic strawberries on a month by 0.37% in 2011 and 0.43% in 2012, while living in an urban area increased the likelihood that a household bought some organic apples in both years but decreased the likelihood that a household bought some organic oranges in both years.

Secondly, there is some inconsistency in whether all household and regional explanatory variables have estimated marginal effects that are larger in magnitude in 2012 compared to 2011; some variables have estimated marginal effects that are smaller in magnitude in 2012 compared to 2011, while others' estimated marginal effects have switched sign. In an attempt to parse out which household and/or regional variables may be most important in explaining the increase in nationwide organic expenditures from 2011 to 2012, I conduct "differences regressions" investigating the determinants of changes in organic expenditures on both the intensive and extensive margins from 2011 to 2012 in Section 8.2.

7.5. Elasticities

To provide more interpretable evidence on the price and income determinants of a household's consumption decision, I provide income, own-price, and cross-price elasticities for all four fruits in 2011 and 2012 in Table 8. These elasticities are conditional on participation in the organic fruit market and were calculated using the method proposed by Saha et al. (1997). Income elasticities are almost always positive, which aligns with my hypothesis and the regression results. A one-dollar increase in income is estimated to have increased the chance that a household bought some organic food in the year by 0.058% in 2011 and by 0.083% in 2012, an increase of 43 percent. Own-price elasticities are almost exclusively negative, and cross-price elasticities with respect to both the conventional analogue and a close substitute are almost exclusively positive, affirming my hypothesis and the regression estimates. For example, a one-dollar increase in the actual price of organic apples is estimated to have lessened the likelihood that a household bought any organic apples by 0.7% in 2011 and almost 2 percent in 2012. A one-dollar increase in actual conventional strawberry price is estimated to have increased the probability of a household buying organic strawberries in 2011 by 0.26%. Looking at close substitutes, a one-dollar increase in the actual price of organic strawberries is estimated to have increased the chance of a household buying some organic blueberries by 0.14% in 2012.

Another important result is that consumers' income elasticity of demand is estimated to have been both higher and statistically significant in 2012 in the annual analysis. Consumers were 0.083% more likely to buy some organic fruit in the year in 2012 as a response to a one-dollar increase in income, compared to an estimated effect of only 0.058% in 2011.

7.6. Household Characteristics by Purchase Frequency

To wrap up the cross-section analysis, it is useful to inspect the data in a way that allows us to investigate preliminary evidence for hypothesis 3, which states that households should be more likely to have the hypothesized characteristics (high income, married, young children, college-educated, located in urban areas on the West coast) as they purchase organics more frequently. I summarize average household characteristics by purchase frequency in Table 9; purchase frequencies of zero months in the year, one to three months, four to six months, seven to nine months, and ten to twelve months are considered for 2011 and 2012. This approach also provides an initial mechanism through which we can connect our empirical results to the theoretical consumer types.

The initial aspect of Table 9 to note is that the sample size is heavily concentrated at a purchase frequency of zero months and decreases as purchase frequency in the year increases; this phenomenon reflects the fact that households are overwhelmingly likely to not buy any organics in the year and, when they do buy some, they are more likely to only buy some a few months of the year as opposed to many months of the year. Another illustrative component of the analysis is how the variable *organicsum* behaves as purchase frequency changes. Specifically, as purchase frequency increases, *organicsum*, which is the average dollar amount of organic fruit bought in a month by a household in the subsample under consideration, also increases. This phenomenon means that, as households buy organic fruit during more months in the year, they also buy more organic fruit *per month*, on average. The mean values of *income*, *married*, *youngchild*, *college* and *metro* all increase as purchase frequency increases, lending strong support to the hypothesis that households with these characteristics, on average, buy organics more frequently. Households who buy organics most frequently, in general, are likely located in the Pacific region, although this likelihood drops off somewhat at the highest purchase frequency of 10-12 months.

Tying the empirical results back to the theoretical consumer types, the analysis contained in Table 9 also shows that households who have lower income, are not married, do not have a young child, are not college-educated, and do not live in an urban area on the West coast are least likely to buy organic fruits and thus could be a composite representation of the indifferent consumer type. Correspondingly, informed and uninformed organic food lovers could be increasingly described by these characteristics, on average, since informed organic food lovers are predicted to switch to organic purchases somewhat frequently and uninformed organic food lovers are predicted to switch to organics even more frequently.

As a final note on this section, we must bear in mind that all estimates thus far are cross-sectional; they have no definitive causal interpretation. These estimates, when considered in isolation, reflect variation across different households and do not provide insight into behavioral changes of households over time. Although evidence supporting most of my hypotheses has been provided, a second shorter look at the possible determinants of changes in organic expenditures between 2011 and 2012 is useful to investigate changes in household behavior over time. At this point it is valuable to revisit the claim made by Pearson, Henryks, and Jones (2011) that most organic consumers are infrequent purchasers or "switchers" (i.e. they are not organic-purchasing households or, in the terms of the theoretical model, organic food lovers). A plausible extension of this theory is the hypothesis that the 15% nationwide increase in organic expenditures from 2011 to 2012 was largely driven by these "switchers"; in other words, most of the increase occurred at the extensive margin instead of the intensive margin.

8. Time Trend Statistical Analysis

8.1. Revisiting the Intensive vs. Extensive Margins

To roughly test this hypothesis, I calculate the expenditures on organic food in 2012 contributed by consumers on the extensive margin, or by consumers that bought no organic fruit in 2011 but bought some in 2012. I compare this number to the difference in organic expenditures contributed by consumers on the intensive margin, or by consumers who bought organic fruit in both years and increased their expenditures in 2012. In order to accurately follow unique households across the two years, I merge my annually-aggregated datasets from both years, yielding 50,620 households who participated in the survey across both years. Once again, household-level expenditures are projected to the nationwide population level.

The results displayed in Table 10 are noteworthy. It is estimated that consumers contributing on the extensive margin of the organic fruit market were responsible for roughly sixty percent of the increase in organic expenditures from 2011 to 2012, whereas consumers contributing on the intensive margin were responsible for about forty percent of the increase. However, there is a considerable difference in sample size. About 3,800 households contributed to the increase in organic expenditures from 2011 to 2012 on the *extensive* margin, but only about 1,300 households contributed to the increase on the *intensive* margin. The implication of this difference in expenditure concentration is shown in the bottom row, where the per-household average contribution to the increase in organic expenditures from 2011 to 2012 is estimated to be a little less than seven dollars for households on the extensive margin and over fourteen dollars for households on the intensive margin. In other words, households contributing to the increase in organic fruit expenditures on the intensive margin were responsible, on average, for about twice as much of the increase in organic fruit purchases from 2011 to 2012 as the households contributing on the extensive margin.

These results show the importance of investigating the question of how characteristics of households contributing on the extensive margin, or "infrequent switchers/indifferent consumers," differ from characteristics of households contributing on the intensive margin, or frequent switchers/dedicated organic fruit buyers/lovers. To implement this type of analysis, I conduct "differences" regressions investigating the determinants of changes in organic expenditures on both the intensive and extensive margins from 2011 to 2012.

These results also introduce the marketing question: to which segment of consumers, those who participate infrequently in the organic fruit market (extensive margin) or those who participate frequently (intensive margin) should stakeholders concentrate marketing resources? This paper does not concern itself with policy, but some general insights can still be gathered. Households on the extensive margin are estimated to be responsible for the absolute majority of organic fruit purchases between two time periods, but households on the intensive margin are estimated to be more responsible for the average per-household increase in organic purchases. A marketing strategy would arguably necessitate a tradeoff in targeting these two consumer segments.

8.2. "Differences" Regressions

These regressions were implemented using the sample of households who were retained by The Nielsen Company for both 2011 and 2012, a total of 50,620 households. Annual expenditures are thus the outcome being considered, and observations are at the household level. Households contributing to the nationwide increase in organic fruit expenditures on the extensive margin, as in the previous section, are households who did not buy any organic fruit in 2011 but did so in 2012. Households contributing to the increase on the intensive margin are households who bought organic fruit in both years but bought more in 2012. Sample sizes for each margin are the same as in the previous section. All household explanatory variables were calculated so as to reflect changes across the two years. For example, *gainyoungchild* has a value of 1 if the household had one or more young children in 2012 than it did in 2011. *ruralswitch* has a value of 1 if the household moved from a metropolitan area to a non-metropolitan area from 2011 to 2012. Table 11 details the estimated determinants of changes in household annual organic expenditures from 2011 to 2012 for households contributing at both the extensive and intensive margins. Each regression is estimated with OLS.

Looking at determinants of the intensive margin of consumer engagement, the only positive statistically significant effect is the situations in which a household moved into a metropolitan area from a non-metropolitan area. The estimated coefficient on *somekidstonokids* is negative and statistically significant, which provides evidence that household with young children, on average, increased their existing organic expenditures across the two years more so than households who lost children. All regional coefficients are negative, suggesting that households increasing their existing organic expenditures from 2011 to 2012 are likely located on the West coast.

For the determinants of the extensive margin of consumer engagement, the only statistically significant estimated coefficients are those of the regional variables. All coefficients are negative, once again suggesting that households contributing to the increase in organic fruit expenditures on the extensive margin are likely located in the Pacific region.

Altogether, these "differences" regressions provide evidence that households contributing to the increase in nationwide organic expenditures from 2011 to 2012 lived on the West coast, probably in metropolitan areas. Households contributing at the intensive margin that retained young children across the two years are estimated to have increased their organic expenditures more so than households who lost children. Income is not a statistically significant factor for households contributing at either the extensive or intensive margins. This finding could strengthen the position that, for households who increase organic purchases over time, organic fruits (and likely other organic foods as well) are not luxury goods but are part of a lifestyle choice.

The following analysis, which breaks down households into subsamples based on their engagement in the organic fruit market from 2011 to 2012 and outlines the mean, minimum, and maximum values for each characteristic for each subsample, does not have the same causal interpretation as the differenced regressions. However, these subsample comparisons provide a second mechanism through which we can connect our empirical results to the theoretical consumer types.

8.3. Household Characteristics by Market Engagement, 2011-2012

As a final empirical analysis, Table 12 provides descriptive statistics of household subsamples defined by engagement in the organic fruit market engagement from 2011 to 2012, where engagement refers to the combination of participation and/or non-participation in the market in 2011 and 2012. The categories of engagement read from the left side (2011) to the top (2012) of Table 12. For example, if a household bought some organic fruit in 2011 but bought none in 2012, the household is represented in the [YES, NO] category (YES corresponding to 2011 and NO corresponding to 2012), which is the top-right section of the table. In contrast, a household who did not buy organic fruit in 2011 but bought some in 2012 is part of the [NO, YES] category in the bottom-left portion of the table. A household who bought organic fruit in both years is represented in the [YES, YES] category in the top-left part of the table. Similarly, a household that did not buy organic fruit in either 2011 or 2012 is represented in the [NO, NO] category in the bottom-right section. Annual expenditures are the dependent variable once again, so observations are households. This breakdown of household engagement in the organic fruit market over time is meant to provide both some additional evidence of household characteristics most associated with organic purchasing and some connection of these characteristics with the theoretical consumer types.

The first thing to notice in Table 12 is the preponderance of households in the [NO, NO] category. Out of 50,280 households retained in the Neilsen dataset from 2011 to 2012, 41,166 of them, or about 82 percent, did not buy organic fruit in *either* year. It is thus illustrative to determine this subsample's average set of characteristics. The mean income level is about $60,000, far below the average values of the other three subsamples. Only 50 percent of these households have a college-educated head, compared to over 60 percent for the households who bought some organic fruit in one of the two years and almost 75 percent for households in the [YES, YES] category. A smaller percentage of households in the [NO, NO] category have a young child, live in an urban area, and live in the Pacific region than households in the other three categories. These households might typify the indifferent consumer, since they did not buy organic fruit in either year. These findings corroborate those from the end of Section 7.

Looking at average household characteristics for the [YES, NO], [NO, YES], and [YES, YES] categories, we can see that mean values for *income, married, youngchild, college, metro,* and *pacific* increase from [YES, NO] to [NO, YES] to [YES, YES]. The interpretation to gain from this trend is that households who bought organic fruit in 2011 but bought none in 2012 were less likely to have these characteristics than households who bought no organic fruit in 2011 but bought some in 2012, who in turn were less likely to have these characteristics than households who bought organic fruit in both years. Having a higher income, being married, having a child less than six years old, being college-educated, and living in a metropolitan area on the West coast is associated with more dedication to the organic fruit market over time. These results provide plausible evidence of characteristics associated with the theoretical consumer types. Informed organic consumers are likely to have all of these characteristics, but uninformed organic consumers (who we might think of as households in the [YES, YES] category who buy organic fruit in both years) are even more likely to be accurately described in this way.

A final note from this descriptive analysis concerns the variable *orgsumchange*. Households in the [NO, YES] category, since they contributed an average of $6.88 in new organic fruit purchases across the two years, barely offset the average $6.78 in expenditure losses caused by households in the [YES, NO] category. These two categories represent the extensive margin of consumer engagement. Households in the [YES, YES] category, regardless of whether they increased or decreased their organic purchases from 2011 to 2012, on average increased their expenditures by a little more than one dollar. Faced with these simple calculations, we should conclude that the sample of households engaging in the *net* intensive margin (i.e. households that bought organic fruit in both years but either decreased or increased their expenditures across the two years), on average, are significantly more responsible for the increase in organic fruit expenditures than are households engaging in the *net* extensive margin (i.e. households that bought organic fruit in only one of the two years). This finding aligns with and strengthens the result of Section 8.1.

9. Conclusion

Statistical analysis in Section 7 substantiated almost every hypothesis asserted at the outset of the paper, all of which are most valid in a cross-sectional, static context across households, although some conclusions require that some qualification or nuance be added to the hypotheses. Households are most likely to participate in the organic fruit market if they have a white or Asian head of household, are located in a metropolitan area on the West coast, are well-educated, have higher income, have young children, are married, and are making decisions in the spring, summer, or fall months. Estimated first-stage marginal effects and income elasticities corroborate most of these findings and provide numerically interpretable results. However, differential effects can be observed when looking at the "consumption decision," or the behavior of households who purchase organic fruit conditional on participating in the market. Households are actually largely estimated to purchase more organic fruits, conditional on buying a positive amount, if they live in a rural area, live anywhere in the country *except* the West coast, and during the winter months. I consider this distinction to be the first seminal finding of this paper. Of course, these average effects vary by fruit type being purchased.

The hypothesis that household expenditures on organic food increases as the prices of organic foods relative to conventionally-produced foods decrease, all else constant, largely holds. One insight gained from Heckman's two-step estimation, however, is that consumers appear to base their participation decision on multiple factors, on not only the price of the organic fruit product in question, but also on the prices of the product's conventional analogue and close (sometimes not even that close!) substitutes. Estimated price elasticities support these findings and provide numerically interpretable results. The consumption decision of organic-purchasing households, on the other hand, appears to be driven largely by the price of the organic fruit product only. I consider this distinction to be the second seminal finding of this paper.

From analyzing organic purchase frequency, it was also found that households who have lower income, are not married, do not have a young child, are not college-educated, and do not live in an urban area on the West coast are least likely to buy organic fruits and thus could be a composite representation of the indifferent consumer type. Correspondingly, informed and uninformed organic food lovers could be increasingly described by these characteristics, on average, since informed organic food lovers are predicted to switch to organic purchases somewhat frequently and uninformed organic food lovers are predicted to switch to organics even more frequently.

I extended the analysis in Section 8 to investigate what determinants of organic fruit purchases might be relevant in a dynamic context for households over time, differentiating between households at the extensive and intensive margins of the organic fruit market. This analysis showed also that although the majority of households who increased their organic fruit expenditures from 2011 to 2012 contributed on the extensive margin (about 75 percent), these households were only responsible for about 60 percent of the nationwide increase in expenditures. Households who contributed on the intensive margin, representing about 25 percent of total households who increased their organic expenditures across the two years, were responsible for about 40 percent of the nationwide increase in expenditures. These results translate to roughly, on average, a seven dollar per household increase in organic fruit expenditures for households on the extensive margin compared to, on average, a greater than 14 dollar per household increase in organic fruit expenditures for households on the intensive margin between 2011 and 2012. When considering *net* household engagement across the two years, however, or including households that decreased their organic expenditures across the two years, the average contribution of households on the intensive margin to the increase in organic expenditures ($1.05) significantly surpassed the average contribution of households on the extensive margin (between $0.10 and $0.20). I consider the set of numerical results contained in this paragraph to be the third seminal finding of this paper.

The time-trend regressions provide evidence that households who contributed to the increase in nationwide organic expenditures from 2011 to 2012 likely lived in metropolitan areas on the West coast. Households contributing at the intensive margin that retained young children across the two years are estimated to have increased their organic expenditures more so than households who lost children. Income was not a statistically significant factor, strengthening the theory that, for households who increase organic purchases over time, organic fruits (and likely other organic foods as well) are not luxury goods but are part of a lifestyle choice.

Finally, an analysis of average household characteristics in subsamples defined by organic fruit market engagement in 2011 and 2012 revealed that having a higher income, being married, having a child less than six years old, being college-educated, and living in a metropolitan area on the West coast is associated with more dedication to the organic fruit market over time. These results also provided plausible evidence of characteristics associated with the theoretical consumer types. Informed organic consumers might be likely to have all of these characteristics, while uninformed organic consumers (who we might think of as households in the [YES, YES] category who buy organic fruit in both years) might be even more likely to be accurately described in this way. Indifferent consumer types might not be able to be accurately described by these characteristics.

Directions for further research might include conducting a more comprehensive longitudinal panel study of a similar nature to this study. In my opinion, the most interesting and insightful findings from studying consumer engagement in the organic fruit market come from behavioral changes of households over time. This paper's inspection of a two-year time period is relevant, but falls woefully short of a more meaningful and robust longitudinal analysis. Perhaps future research will be able to utilize data similar in content but longer in tenure to that of The Neilsen Company, in order to harness and extract household characteristics and behaviors that have a validated causal impact on increases in purchases of organic fruit in the U.S. over time.

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Appendix A. Tables

Table 3. Expenditures on Total Organic Fruit, Heckman Model

	Annual 2011	Annual 2012	Monthly 2011	Monthly 2012
Participation Equation	**N = 62,092**	**N = 60,538**	**N = 745,104**	**N = 726,456**
access	0.833*** (0.135)	0.858*** (0.124)	0.618*** (0.133)	0.753*** (0.118)
logincome	0.190*** (0.011)	0.199*** (0.011)	0.145*** (0.012)	0.158*** (0.012)
youngchild	0.165*** (0.026)	0.119*** (0.026)	0.169*** (0.025)	0.153*** (0.025)
black	-0.169*** (0.026)	-0.158*** (0.025)	-0.163*** (0.025)	-0.157*** (0.024)
asian	0.062* (0.037)	0.09*** (0.035)	0.058* (0.033)	0.064** (0.031)
college	0.228*** (0.015)	0.218*** (0.015)	0.208*** (0.014)	0.196*** (0.014)
metro	0.172*** (0.021)	0.201*** (0.021)	0.149*** (0.021)	0.134*** (0.021)
married	0.059*** (0.016)	0.087*** (0.016)	0.042*** (0.015)	0.058*** (0.015)
neweng	-0.354*** (0.038)	-0.313*** (0.036)	-0.266*** (0.036)	-0.255*** (0.034)
midatl	-0.235*** (0.029)	-0.266*** (0.028)	-0.133*** (0.027)	-0.177*** (0.026)
encent	-0.13*** (0.026)	-0.223*** (0.026)	-0.076*** (0.024)	-0.133*** (0.024)
wncent	-0.183*** (0.034)	-0.362*** (0.034)	-0.088*** (0.033)	-0.199*** (0.033)
soatl	-0.358*** (0.026)	-0.383*** (0.025)	-0.257*** (0.025)	-0.263*** (0.023)
escent	-0.285*** (0.039)	-0.363*** (0.038)	-0.159*** (0.038)	-0.234*** (0.037)
wscent	-0.154*** (0.031)	-0.229*** (0.029)	-0.067** (0.029)	-0.125*** (0.027)
mtn	0.027 (0.029)	-0.071** (0.028)	0.001 (0.024)	-0.051** (0.024)
spring	---	---	0.163*** (0.01)	0.122*** (0.01)
summer	---	---	0.295*** (0.01)	0.256*** (0.01)
fall	---	---	0.074*** (0.011)	0.089*** (0.01)
_cons	-3.526*** (0.116)	-3.543*** (0.113)	-4.1*** (0.131)	-4.123*** (0.131)
Expenditure Equation	**N = 6,739**	**N = 7,428**	**N = 12,384**	**N=14,122**
logincome	-0.881 (0.868)	-1.125 (0.82)	-0.537 (0.619)	0.33 (0.41)
youngchild	1.544 (1.31)	2.413** (1.165)	-0.313 (0.69)	0.651 (0.441)
married	0.706 (0.8)	0.287 (0.768)	0.499* (0.3)	0.718*** (0.234)
college	---	---	-0.684 (0.821)	0.974*** (0.345)
metro	-0.37 (1.247)	-2.437** (1.197)	-0.454 (0.732)	0.198 (0.387)
black	-0.452 (1.442)	-0.975 (1.266)	0.357 (0.761)	-0.947** (0.389)
asian	2.315 (1.623)	0.528 (1.441)	0.874 (0.693)	0.516 (0.463)
neweng	0.815 (2.014)	0.565 (1.701)	0.498 (0.863)	-0.846* (0.512)
midatl	3.038** (1.528)	2.441* (1.439)	0.871 (0.725)	-0.416 (0.541)
encent	0.035 (1.245)	1.423 (1.308)	-0.233 (0.513)	-0.908* (0.52)
wncent	4.313*** (1.66)	5.339*** (1.883)	1.521 (1.015)	-0.291 (0.674)
soatl	3.15* (1.657)	3.335** (1.558)	1.651 (1.222)	-0.502 (0.641)
escent	2.406 (2.102)	2.334 (2.071)	0.287 (0.866)	-1.381* (0.763)
wscent	5.059*** (1.46)	2.968** (1.437)	1.934*** (0.753)	-0.224 (0.575)
mtn	-1.752 (1.291)	-1.588 (1.167)	-0.6* (0.363)	-0.875*** (0.282)
spring	---	---	-0.23 (0.613)	-0.26 (0.257)
summer	---	---	-1.523 (1.063)	-0.574 (0.456)
fall	---	---	-0.486 (0.302)	-0.978*** (0.222)
invmills	-9.517*** (3.626)	12.453*** (3.408)	-4.774 (4.109)	1.709 (1.979)
_cons	35.927** (14.942)	45.025*** (13.882)	24.888 (17.856)	-1.424 (9.129)

Table 4. Ounces of Organic Fruit Purchased, Participation Equation from Heckman Model

	Apples 2011	Apples 2012	Blueb. 2011	Blueb. 2012	Oranges 2011	Oranges 2012	Strawb. 2011	Strawb. 2012
N	**745,104**	**726,456**	**745,104**	**726,456**	**745,104**	**726,456**	**745,104**	**726,456**
access	-0.243 (0.2)	0.112 (0.196)	0.965*** (0.201)	1.272*** (0.155)	0.807 (0.536)	0.139 (0.365)	1.068*** (0.169)	0.728*** (0.158)
logincome	0.105*** (0.018)	0.092*** (0.019)	0.109*** (0.02)	0.166*** (0.02)	0.034 (0.024)	0.063** (0.025)	0.141*** (0.018)	0.144*** (0.017)
youngchild	0.264*** (0.035)	0.257*** (0.037)	0.167*** (0.042)	0.087** (0.041)	0.12** (0.057)	0.101* (0.057)	0.189*** (0.034)	0.189*** (0.033)
college	0.156*** (0.025)	0.135*** (0.024)	0.242*** (0.023)	0.229*** (0.022)	0.018 (0.036)	0.058 (0.037)	0.219*** (0.02)	0.24*** (0.019)
metro	0.086*** (0.033)	0.09*** (0.034)	0.166*** (0.036)	0.191*** (0.032)	-0.067 (0.051)	-0.037 (0.048)	0.228*** (0.031)	0.155*** (0.031)
married	0.13*** (0.026)	0.143*** (0.027)	-0.051** (0.024)	-0.035 (0.023)	0.071* (0.038)	0.116*** (0.038)	0.001 (0.021)	0.02 (0.021)
neweng	-0.406*** (0.069)	-0.252*** (0.06)	-0.215*** (0.064)	-0.3*** (0.053)	0.142 (0.089)	0.351*** (0.087)	-0.125*** (0.047)	-0.054 (0.044)
midatl	-0.269*** (0.045)	-0.081* (0.044)	-0.027 (0.046)	-0.064 (0.04)	0.234*** (0.076)	0.174** (0.071)	0.023 (0.041)	-0.104*** (0.038)
encent	-0.173*** (0.038)	0.007 (0.041)	0.011 (0.04)	-0.048 (0.036)	0.321*** (0.068)	0.325*** (0.067)	0.084** (0.035)	-0.079** (0.034)
wncent	-0.284*** (0.054)	-0.069 (0.058)	-0.100* (0.057)	-0.085** (0.045)	0.168* (0.099)	0.131 (0.091)	0.123*** (0.044)	-0.121*** (0.046)
soatl	-0.242*** (0.039)	-0.123*** (0.04)	-0.160*** (0.043)	-0.28*** (0.038)	0.195*** (0.071)	0.193*** (0.068)	-0.164*** (0.036)	-0.2*** (0.033)
escent	-0.25*** (0.063)	-0.13** (0.06)	-0.145** (0.073)	-0.139** (0.071)	0.059 (0.097)	0.016 (0.092)	0.02 (0.052)	-0.124** (0.051)
wscent	-0.194*** (0.046)	-0.128*** (0.049)	-0.027 (0.051)	-0.084** (0.042)	0.186* (0.099)	0.145* (0.081)	0.135*** (0.042)	0.046 (0.036)
mtn	0.053 (0.036)	0.055 (0.039)	0.059 (0.040)	-0.042 (0.035)	-0.036 (0.077)	0.145** (0.073)	-0.069** (0.034)	-0.098*** (0.033)
cbluebp	0.407*** (0.065)	0.464*** (0.075)	0.487*** (0.126)	0.623*** (0.13)	0.465*** (0.136)	0.116 (0.142)	0.526*** (0.071)	0.741*** (0.082)
obluebp	0.001 (0.032)	-0.023 (0.033)	-0.095* (0.058)	-0.238*** (0.053)	-0.073 (0.061)	-0.033 (0.058)	0.056* (0.029)	-0.149*** (0.028)
cstrawp	0.843*** (0.179)	0.38*** (0.095)	1.540*** (0.250)	0.269** (0.133)	0.334 (0.364)	0.095 (0.215)	1.915*** (0.247)	0.694*** (0.127)
ostrawp	-0.093 (0.13)	0.301** (0.125)	-0.187 (0.158)	0.174 (0.138)	-0.432* (0.25)	-0.19 (0.223)	-1.904*** (0.222)	-0.768*** (0.204)
capplep	0.552*** (0.14)	1.008*** (0.129)	0.327** (0.153)	-0.033 (0.381)	0.576*** (0.179)	0.854*** (0.155)	0.424*** (0.126)	0.386*** (0.142)
oapplep	1.605** (0.641)	1.747*** (0.331)	-0.690 (0.421)	0.389* (0.215)	0.108 (0.708)	0.376 (0.4)	-1.171*** (0.309)	-0.036 (0.164)
corangep	0.146 (0.339)	0.83*** (0.194)	-1.292* (0.663)	0.655*** (0.22)	0.767** (0.344)	1.179*** (0.232)	0.345 (0.264)	1.142*** (0.127)
oorangep	-0.062 (0.508)	0.039 (0.465)	-0.094 (0.528)	-1.818*** (0.465)	-1.757 (1.074)	0.391 (0.963)	0.926** (0.411)	-0.667* (0.373)
spring	0.032 (0.022)	-0.026 (0.021)	0.079*** (0.030)	-0.167*** (0.025)	0.049 (0.043)	0.107*** (0.037)	0.529*** (0.029)	0.48*** (0.023)
summer	-0.248*** (0.03)	-0.246*** (0.027)	0.266*** (0.036)	-0.014 (0.028)	-0.07 (0.055)	-0.102** (0.048)	0.748*** (0.033)	0.643*** (0.028)
fall	-0.174*** (0.024)	-0.099*** (0.02)	-0.616*** (0.048)	-0.563*** (0.029)	-0.332*** (0.047)	-0.417*** (0.049)	0.299*** (0.029)	0.176*** (0.024)
_cons	-4.267*** (0.212)	-4.432*** (0.203)	-4.521*** (0.242)	-4.813*** (0.228)	-3.663*** (0.32)	-4.246*** (0.295)	-4.993*** (0.21)	-4.849*** (0.194)

Table 5. Ounces of Organic Fruit Purchased, Expenditure Equation from Heckman Model

	Apples 2011	Apples 2012	Blueb. 2011	Blueb. 2012	Oranges 2011	Oranges 2012	Strawb. 2011	Strawb. 2012
N	**2,713**	**2,591**	**1,844**	**2,545**	**711**	**625**	**4,507**	**5,159**
logincome	0.772 (2.551)	16.263*** (5.704)	-0.224 (0.585)	-1.08 (1.046)	-0.489 (2.849)	1.725 (3.044)	-0.583 (0.703)	-0.343 (0.76)
youngchild	-1.139 (5.851)	61.234*** (20.445)	2.842*** (1.046)	1.205 (1.245)	1.202 (9.636)	-10.775** (4.392)	-0.242 (1.575)	1.256 (1.616)
married	9.146*** (3.097)	20.687*** (5.798)	-0.449 (0.864)	2.708*** (0.958)	-4.379 (8.546)	5.039 (7.036)	3.429*** (1.013)	2.488** (1.062)
college	-7.857** (3.882)	26.163*** (6.992)	2.166*** (0.804)	0.556 (0.9)	-3.697 (5.915)	-5.611 (5.626)	0.354 (0.941)	2.17* (1.194)
metro	5.315* (3.102)	10.66 (12.143)	1.37 (1.153)	1.099 (1.149)	-24.735** (10.926)	-15.708 (10.436)	-0.956 (1.347)	-4.637* (2.781)
cbluebp	-2.732 (9.115)	70.893*** (20.91)	1.157 (2.155)	-1.079 (2.002)	-7.588 (19.606)	-8.543 (16.734)	1.732 (2.127)	5.419** (2.665)
obluebp	-0.15 (4.753)	-4.67 (6.228)	-23.145*** (1.26)	-23.987*** (1.442)	-1.346 (9.446)	5.329 (7.044)	0.599 (1.498)	-2.972** (1.434)
cstrawp	0.126 (27.934)	27.074** (13.089)	-2.114 (7.435)	-0.173 (1.622)	-47.904 (46.867)	-69.054 (45.899)	33.756 (27.121)	8.582 (18.246)
ostrawp	14.124 (22.46)	67.916** (33.978)	8.000** (4.214)	4.228 (4.081)	30.044 (35.737)	4.432 (19.831)	-1.988 (6.775)	-15.56 (9.904)
capplep	31.64 (71.392)	228.189*** (45.494)	-10.665 (25.337)	-3.731 (13.692)	78.003 (105.676)	107.207* (57.415)	36.462 (47.017)	63.283 (67.994)
oapplep	-600.206*** (118.401)	-1345.33*** (218.34)	19.25 (17.316)	1.679 (8.778)	95.891 (118.186)	105.012 (98.771)	-13.425 (13.933)	-8.677 (8.972)
corangep	33.578 (24.89)	196.796*** (63.191)	2.947 (17.211)	3.928 (10.49)	-4.342 (17.734)	24.087 (20.499)	-3.898 (9.227)	15.628 (22.417)
oorangep	81.002 (57.935)	-93.089 (106.684)	18.56 (17.554)	21.891 (15.238)	208.371 (176.866)	-117.486 (76.618)	2.376 (23.439)	-14.748 (24.223)
invmills	-13.442 (11.672)	159.21*** (38.158)	2.711** (1.277)	-3.177** (1.575)	-28.186 (29.66)	1.669 (10.208)	-6.685*** (1.79)	-4.231** (1.909)
_cons	136.966** (60.802)	-549.241*** (165.549)	12.798 (8.206)	43.371*** (14.053)	169.888* (96.945)	60.207 (47.471)	41.808*** (13.82)	41.023*** (15.33)

Table 6. First-Stage Marginal Effects, Expenditures on Total Organic Fruit

	Annual		*Monthly*	
	2011	2012	2011	2012
logincome	7.73E-05	8.78E-05	1.23E-05	1.51E-05
youngchild	3.198	2.441	0.787	0.797
black	-0.442	-0.590	-0.111	-0.132
asian	0.448	0.602	0.095	0.118
college	4.013	4.165	0.797	0.861
metro	2.851	3.595	0.532	0.556
married	1.045	1.650	0.167	0.260
neweng	-5.197	-5.151	-0.836	-0.933
midatl	-3.787	-4.61	-0.481	-0.712
encent	-2.206	-3.998	-0.288	-0.562
wncent	-2.979	-5.897	-0.326	-0.773
soatl	-5.602	-6.528	-0.876	-1.032
escent	-4.362	-5.834	-0.551	-0.871
wscent	-2.558	-3.999	-0.254	-0.520
mtn	0.484	-1.334	0.005	-0.2223

***Note**: all numbers interpreted as percentages. E.g. the marginal effect of *college* on the likelihood of participation in the organic fruit market at least once during the year was 4.01% in 2011 and 4.17% in 2012. Its effect of the likelihood of participation in the market at least once during the month was 0.80% in 2011 and 0.86% in 2012.

Table 7. First-Stage Marginal Effects, Monthly Ounces of Organic Fruit Purchased

	Apples		*Blueberries*		*Oranges*		*Strawberries*	
	2011	**2012**	**2011**	**2012**	**2011**	**2012**	**2011**	**2012**
logincome	2.34E-06	2.06E-06	1.70E-06	3.23E-06	2.79E-07	4.23E-07	4.69E-06	5.48E-06
youngchild	0.371	0.355	0.148	0.096	0.045	0.033	0.370	0.425
college	0.157	0.135	0.164	0.212	0.006	0.016	0.334	0.418
metro	0.084	0.086	0.103	0.159	-0.023	-0.011	0.302	0.252
married	0.129	0.138	-0.038	-0.035	0.022	0.031	0.002	0.037
neweng	-0.272	-0.196	-0.123	-0.217	0.055	0.168	-0.178	-0.095
midatl	-0.225	-0.078	-0.019	-0.060	0.100	0.062	0.039	-0.177
encent	-0.161	0.008	0.009	-0.046	0.142	0.132	0.146	-0.139
wncent	-0.225	-0.067	-0.065	-0.078	0.067	0.045	0.226	-0.200
soatl	-0.217	-0.116	-0.103	-0.225	0.077	0.068	-0.233	-0.324
escent	-0.201	-0.116	-0.089	-0.119	0.020	0.005	0.034	-0.204
wscent	-0.170	-0.117	-0.019	-0.077	0.076	0.050	0.249	0.090
mtn	0.059	0.060	0.046	-0.041	-0.011	0.051	-0.105	-0.167

***Note**: all numbers interpreted as percentages. E.g. the marginal effect of *married* on the likelihood of buying organic strawberries at least once in a month was 0.002% in 2011 and 0.037% in 2012. The marginal effect of living in New England as opposed to the Pacific region increased the likelihood that a household would buy organic oranges by 0.05% in 2011 and 0.17% in 2012.

Table 8. Elasticities (Income, Own-Price, Cross-Price), 2011-2012

			Prices											
			2011	2012	2011	2012	2011	2012	2011	2012	2011	2012	2011	2012
			Apple		Blueberries		Oranges		Strawberries		Monthly		Annual	
Price elasticities	Org.	Apple	-0.692*** (0.155)	-1.953*** (0.332)	0.113 (0.092)	0.016 (0.049)	0.116 (0.142)	0.137 (0.128)	-0.07 (0.044)	-0.032 (0.032)				
	Conv.	Apple	0.037 (0.067)	0.071*** (0.022)	-0.052 (0.113)	-0.016 (0.059)	0.091 (0.107)	0.112* (0.061)	0.109 (0.13)	0.182 (0.19)				
	Org.	Blueberries	-0.001 (0.031)	-0.008 (0.04)	-0.647*** (0.035)	-0.667*** (0.036)	-0.02 (0.063)	0.038 (0.05)	0.018 (0.027)	-0.067*** (0.026)				
	Conv.	Blueberries	0.012 (0.033)	-0.001 (0.059)	-0.003 (0.036)	0.016 (0.035)	0.02 (0.051)	-0.037 (0.074)	0.06** (0.024)	0.1*** (0.029)				
	Org.	Oranges	0.092 (0.066)	-0.105 (0.114)	0.096 (0.09)	0.075 (0.068)	0.176 (0.153)	-0.134 (0.087)	0.027 (0.075)	-0.052 (0.07)				
	Conv.	Oranges	0.029 (0.021)	0.055 (0.041)	0.024 (0.065)	0.022 (0.037)	0.014 (0.019)	0.02 (0.017)	-0.004 (0.023)	0.051 (0.056)				
	Org.	Strawberries	0.048 (0.086)	0.071 (0.103)	0.142** (0.07)	0.071 (0.061)	0.066 (0.115)	0.017 (0.069)	-0.137*** (0.047)	-0.161** (0.079)				
	Conv.	Strawberries	0.025 (0.056)	-0.059*** (0.015)	-0.063 (0.076)	0.006 (0.014)	-0.081 (0.092)	-0.137 (0.091)	0.259* (0.15)	0.059 (0.093)				
Income elasticities			0.029 (0.028)	0.027 (0.048)	-0.033 (0.036)	-0.032 (0.056)	0.006 (0.042)	0.022 (0.041)	0.014 (0.027)	0.01 (0.027)	0.018 (0.035)	0.011 (0.036)	0.058 (0.041)	0.083** (0.036)

Table 9. Mean Values of Household Characteristics by Organic Purchase Frequency, 2011-2012

	2011					2012				
# months	**0**	**1 to 3**	**4 to 6**	**7 to 9**	**10 to 12**	**0**	**1 to 3**	**4 to 6**	**7 to 9**	**10 to 12**
N	**664,236**	**72,156**	**5,952**	**2,136**	**624**	**637,320**	**78,588**	**7,080**	**2,496**	**972**
income	60,912	77,397	83,332	82,652	95,596	61,043	77,911	85,319	91,726	91,148
yesmonths	0.00	1.35	4.73	7.83	10.63	0.00	1.35	4.72	7.82	10.57
organicsum	0.00	0.60	2.90	6.72	15.18	0.00	0.59	2.73	6.22	13.42
organicyes	0.00	0.11	0.39	0.65	0.89	0.00	0.11	0.39	0.65	0.88
youngchild	0.06	0.08	0.11	0.14	0.19	0.06	0.08	0.11	0.13	0.21
married	0.61	0.69	0.70	0.74	0.77	0.63	0.72	0.74	0.75	0.84
college	0.51	0.66	0.75	0.77	0.77	0.52	0.66	0.74	0.77	0.77
black	0.10	0.07	0.06	0.05	0.06	0.10	0.07	0.05	0.06	0.05
asian	0.03	0.05	0.06	0.06	0.06	0.03	0.05	0.05	0.07	0.06
neweng	0.05	0.04	0.03	0.01	0.06	0.05	0.05	0.05	0.04	0.02
midatl	0.13	0.11	0.13	0.16	0.12	0.13	0.12	0.12	0.11	0.14
encent	0.18	0.18	0.18	0.19	0.15	0.18	0.17	0.15	0.19	0.16
wncent	0.09	0.07	0.08	0.11	0.10	0.09	0.06	0.06	0.09	0.09
soatl	0.21	0.14	0.11	0.12	0.21	0.21	0.16	0.14	0.12	0.21
escent	0.06	0.04	0.05	0.06	0.02	0.06	0.04	0.03	0.03	0.06
wscent	0.10	0.10	0.12	0.11	0.19	0.10	0.10	0.11	0.09	0.10
mtn	0.07	0.12	0.10	0.07	0.06	0.07	0.10	0.12	0.11	0.05
pacific	0.12	0.19	0.20	0.17	0.10	0.11	0.20	0.22	0.22	0.17
metro	0.83	0.89	0.91	0.93	0.94	0.83	0.90	0.90	0.90	0.88

Table 10. Disaggregation of Organic Fruit Expenditure Increase from 2011-2012

	Extensive Margin *(N = 3,836)*		***Intensive Margin*** *(N = 1,280)*		**Total**
Year	*2011*	*2012*	*2011*	*2012*	
Expenditures	$0	$26,397	$18,364	$36,349	
Difference	$26,397		$17,985		$44,382
Percent of Total Change	**59.48%**		**40.52%**		100.00%
Per Household Average	**$6.88**		**$14.05**		

Table 11. Changes in Household Annual Organic Expenditures, 2011-2012 (OLS)

	Extensive Margin	*Intensive Margin*
N	**3,836**	**1,280**
accesschange	1.098	0.27
	(1.409)	(6.755)
incomechange	2.220E-06	6.19E-06
	(5.960E-06)	(2.63E-05)
gainyoungchild	0.256	-1.146
	(1.31)	(5.128)
somekidstonokids	0.013	-8.248**
	(0.746)	(3.859)
malegrad	-1.013	-0.187
	(1.125)	(4.477)
femgrad	0.605	-1.916
	(0.969)	(5.001)
married	-0.398	-2.48
	(0.688)	(3.032)
notmarried	-0.925	-2.408
	(1.371)	(6.235)
ruralswitch	-0.533	0.972
	(0.439)	(2.292)
metroswitch	-0.098	3.083*
	(0.349)	(1.683)
neweng	-1.754***	-3.734
	(0.612)	(3.211)
midatl	-1.302***	-2.419
	(0.458)	(2.273)
encent	-2.024***	-4.196**
	(0.432)	(2.017)
wncent	-1.56***	0.558
	(0.588)	(2.878)
soatl	-1.025**	-0.239
	(0.418)	(2.152)
escent	-2.358***	-2.435
	(0.706)	(3.462)
wscent	-1.14**	-3.446
	(0.502)	(2.296)
mtn	-0.141	-7.008***
	(0.494)	(2.19)
_cons	8.013***	16.258***
	(0.306)	(1.368)

Table 12. Descriptive Statistics of Households by Organic Market Engagement, 2011-2012

2011	2012 →	YES			NO		
YES		**N**	**Total $**	**$/HH**	**N**	**Total $**	**$/HH**
		2,527	2,646	1.05	3,091	-20,951	-6.77
		Mean	**Min**	**Max**	**Mean**	**Min**	**Max**
	orgsumchange	1.05	-549.09	206.65	-6.78	-384.18	-0.01
	married	0.04	0	1	0.03	0	1
	income	84691	2500	150000	72793	2500	150000
	youngchild	0.07	0	1	0.05	0	1
	college	0.74	0	1	0.62	0	1
	black	0.05	0	1	0.08	0	1
	asian	0.06	0	1	0.04	0	1
	metro	0.91	0	1	0.88	0	1
	pacific	0.22	0	1	0.17	0	1
	neweng	0.04	0	1	0.04	0	1
	midatl	0.12	0	1	0.12	0	1
	encent	0.17	0	1	0.18	0	1
	wncent	0.06	0	1	0.09	0	1
	soatl	0.12	0	1	0.15	0	1
	escent	0.04	0	1	0.04	0	1
	wscent	0.11	0	1	0.10	0	1
	mtn	0.12	0	1	0.10	0	1
NO		**N**	**Total $**	**$/HH**	**N**	**Total $**	**$/HH**
		3,836	26,397	6.88	41,166	0	0
		Mean	**Min**	**Max**	**Mean**	**Min**	**Max**
	orgsumchange	6.88	0.09	148.57	0	0	0
	married	0.03	0	1	0.03	0	1
	income	75575	2500	150000	60017	2500	150000
	youngchild	0.06	0	1	0.04	0	1
	college	0.63	0	1	0.50	0	1
	black	0.08	0	1	0.10	0	1
	asian	0.05	0	1	0.02	0	1
	metro	0.89	0	1	0.82	0	1
	pacific	0.20	0	1	0.11	0	1
	neweng	0.05	0	1	0.05	0	1
	midatl	0.13	0	1	0.13	0	1
	encent	0.17	0	1	0.18	0	1
	wncent	0.06	0	1	0.09	0	1
	soatl	0.17	0	1	0.21	0	1
	escent	0.04	0	1	0.06	0	1
	wscent	0.10	0	1	0.10	0	1

Appendix B. Theoretical Model

B.1. Kuhn-Tucker first-order conditions

$$\frac{\partial L}{\partial x_{1c}} = p_{1c} - \lambda_1 A_{1c,1} - \lambda_2 A_{1c,2} - \varphi \frac{\partial U}{\partial x_{1c}} \geq 0 \tag{7}$$

$$x_{1c}\left[p_{1c} - \lambda_1 A_{1c,1} - \lambda_2 A_{1c,2} - \varphi \frac{\partial U}{\partial x_{1c}}\right] = 0 \tag{8}$$

$$\frac{\partial L}{\partial x_{2c}} = p_{2c} - \lambda_1 A_{2c,1} - \lambda_2 A_{2c,2} - \varphi \frac{\partial U}{\partial x_{2c}} \geq 0 \tag{9}$$

$$x_{2c}\left[p_{2c} - \lambda_1 A_{2c,1} - \lambda_2 A_{2c,2} - \varphi \frac{\partial U}{\partial x_{2c}}\right] = 0 \tag{10}$$

$$\frac{\partial L}{\partial x_{1o}} = p_{1o} - \lambda_1 A_{1o,1} - \lambda_2 A_{1o,2} - \varphi \frac{\partial U}{\partial x_{1o}} \geq 0 \tag{11}$$

$$x_{1o}\left[p_{1o} - \lambda_1 A_{1o,1} - \lambda_2 A_{1o,2} - \varphi \frac{\partial U}{\partial x_{1o}}\right] = 0 \tag{12}$$

$$\frac{\partial L}{\partial x_{2o}} = p_{2o} - \lambda_1 A_{2o,1} - \lambda_2 A_{2o,2} - \varphi \frac{\partial U}{\partial x_{2o}} \geq 0 \tag{13}$$

$$x_{2o}\left[p_{2o} - \lambda_1 A_{2o,1} - \lambda_2 A_{2o,2} - \varphi \frac{\partial U}{\partial x_{2o}}\right] = 0 \tag{14}$$

$$\frac{\partial L}{\partial \lambda_1} = \mathbf{A_1 x} \geq b_1 \tag{15}$$

$$\lambda_1^*[b_1 - \mathbf{A_1 x}] = 0 \tag{16}$$

$$\frac{\partial L}{\partial \lambda_2} = \mathbf{A_2x} \geq b_2 \tag{17}$$

$$\lambda_2^*[b_2 - \mathbf{A_2x}] = 0 \tag{18}$$

$$\frac{\partial L}{\partial \varphi} = U(\mathbf{x}) \geq \overline{U} \tag{19}$$

$$\varphi^*[\overline{U} - U(\mathbf{x})] = 0 \tag{20}$$

$$\lambda_1^* \geq 0\,;\ \lambda_2^* \geq 0;\ \varphi^* \geq 0 \tag{21}$$