Is gluten-free worth the price? A study on consumer willingness to pay a principal on certified versus non-certified gluten-free food

An honors thesis for the Department of Economics

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Abstract

With approximately 24% of Americans consuming or living with someone who consumes gluten-free products, whether due to wheat allergy, wheat or gluten intolerance, Celiac Disease, a perceived healthier diet, or other reasons, the $10.5 billion gluten-free market is one that is attaining an increasing pervasive influence in the United States. Due to uncertainties surrounding the stringency and adherence to labeling regulations for gluten-free status, four major gluten-free certification programs have emerged in the U.S.

The objective of this study was to answer two questions: (1) whether or not consumers of gluten-free bread are willing to pay a premium for certification, and (2) if so, how much of a premium they are willing to pay. To this end, a contingent valuation survey using the payment card method was used, along with Tobit and logit analyses. Results indicated a 55% probability of paying a premium and an average magnitude of $1.12 over the mean $6.00 price tag for gluten-free bread. Shopping venue, income, frequency of purchase, number of children, area of residence, and purchasing decision factors such as certification status, price, and consideration of the use of a dedicated facility during manufacturing processes had significant influences on both the probability of paying a premium and the size of such a premium.

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Introduction

"The Gluten-Free Certification Program alliance means consumers with Celiac Disease and gluten sensitivity will have more choices, greater assurance, and an easier way to identify gluten-free products that are trusted and safe." – Alice Bast, President of the National Foundation for Celiac Awareness

According to The Gluten-Free Agency (2012), consumers have defined the gluten-free diet as "a mainstream sensation, embraced both out of necessity and as a personal choice toward achieving a healthier way to live." Conditions such as Celiac Disease, wheat allergy, wheat intolerance, and non-Celiac gluten sensitivity are being diagnosed in increasing numbers, and combined with accounts of a gluten-free diet being healthier and mitigating symptoms of a variety of medical ailments, demand for gluten-free food products is mounting. However, although more and more gluten-free products are appearing on store shelves, certification of these gluten-free claims is not mandated by law. This subsequently creates a feeling of uncertainty in purchasing these products and allows for the existence of poor manufacturing practices and false advertising that, even if unknown, could negatively impact the health of consumers.

The value consumers place on certification for products asserting gluten-free status is therefore of interest. This study aims to answer two fundamental questions: (1) whether or not consumers of gluten-free bread are willing to pay a premium for certification, and (2) if so, how much of a premium are they willing to pay. In accordance with these questions, this thesis sets out to test the following hypotheses:

H1: Consumers that are newly gluten-free are willing to pay higher premiums.

H2: Infrequent gluten-free bread consumers are willing to pay higher premiums.

H3: Consumers with Wheat Allergy, Wheat Intolerance, or Celiac Disease are willing to pay higher premiums than those purchasing as part of a healthy diet.

H4: Individuals purchasing gluten-free bread for members of their household are willing to pay higher premiums than those purchasing solely for themselves.

H5: Consumers who are knowledgeable about and/or consider certification status when purchasing gluten-free bread are willing to pay higher premiums.

H6: Consumers purchasing gluten-free bread from specialty gluten-free establishments are likely to pay a higher premium than those shopping at regular supermarkets.

H7: Consumers that regularly bake gluten-free bread at home are willing to pay little to no premium.

H8: Consumers primed with a gluten-free fraud story are likely to pay a higher premium than those not exposed to the story.

Although there has been previous research on consumer willingness to pay for various food-related attributes, no studies could be found that examined consumer willingness to pay for certified versus non-certified gluten-free foods. Thus, this study looks to apply contingent valuation methods and Tobit and logit regression analyses in order to uncover novel information regarding the gluten-free market.

The remainder of this paper will begin with an overview of the conditions afflicting the gluten-free consumer base: wheat allergy, Celiac Disease, wheat intolerance, non-Celiac gluten sensitivity, and a variety of medical diagnoses. The next subsections provide information about the gluten-free diet and the gluten-free market. The paper then leads into a discussion of food labeling and third-party certification. The third chapter details the conceptual and empirical

models used as a basis for the analyses of this thesis, while the fourth describes the methodology employed. The fifth chapter then describes the data, the sixth provides the results from the regressions, and the seventh discusses these results and their implications. The paper ends with some concluding remarks and potential avenues for future research, followed by a list of references and appendices that include survey materials and additional tables and figures.

Background

Wheat Allergy

A food allergy is a hypersensitivity, or an abnormal, exaggerated response, to a dietary protein that involves immunologic mechanisms (Johansson et al., 2004). Wheat allergy (WA), as defined by the Asthma and Allergy Foundation of America (AAFA), is the adverse reaction of immunoglobulin E (IgE) antibodies to any wheat protein including, but not limited to albumin, globulin, gliadin, and glutenin, commonly referred to as gluten (Asthma and Allergy Foundation of America (AAFA) Editorial Board, 2005). WA varies on an individual basis, contingent upon IgE reactionary mechanisms and the method of protein exposure. In that way, WA has come to be subdivided into the following categories: classic food allergy affecting the skin, gastrointestinal tract, or respiratory tract, wheat-dependent, exercise-induced anaphylaxis (WDEIA), occupational asthma (baker's asthma) and rhinitis, and contact urticaria (Sapone, et al., 2012). The two most studied adverse wheat reactions are baker's asthma and WDEIA. WA has been reported to affect up to 1% of children (Poole et al., 2006), with about half outgrowing their allergy by age 6 ½ and 65% outgrowing it by age 12 (Keet et al., 2009). In North America, prevalence of WA is estimated at 0.4% of children and 0.3% of adults (Sicherer and Sampson, 2010).

Baker's Asthma

Baker's asthma is a specific form of what is known as occupational asthma: a respiratory disorder "characterized by variable airflow limitation and/or airway hyperresponsiveness due to causes and conditions attributable to a particular occupational environment and not to stimuli encountered outside the workplace" (Houba, Doekes, and Heederik, 1998). Baker's asthma can

manifest itself in various ways, ranging from rhinitis to conjunctivitis, and on the extreme end of the spectrum, even death. This type of occupational asthma has been prevalent since the time of the Roman Empire during which records testify that slaves were required to wear masks when dealing with the substance (Shewry, 2009). The first scientific documentation of the disease appeared in Ramazzini's 1700 publication of Ramazzini's "De Morbis Artificium Diatriba," but it was not until 1929 that the realization was made by de Besche that these adverse responses in employees of wheat-associated industries could be the result of an allergic reaction (Shewry, 2009). Studies have determined that the most common wheat proteins responsible for a baker's asthma reaction are a class of α-amylase inhibitors know as CM proteins, although numerous others have been found to bind with IgE from susceptible individuals' sera , including gliadins, glutenins, serpins, thioredoxin, agglutinin, and enzymes such as α- and β-amylases, peroxidase, acyl CoA oxidase, glycerinaldehyde-3-phosphate dehydrogenase and triosephonsphate isomerase (Shewry, 2009 and Sapone et al., 2012).

Wheat-Dependent Exercise-Induced Anaphylaxis

As its name implies, wheat-dependent exercise-induced anaphylaxis (WDEIA) is an adverse response to wheat ingestion in which subsequent physical activity results in an anaphylactic reaction (Shewry, 2009). Like baker's asthma, many wheat proteins can be involved in WDEIA, among these being gliadins, glutenin subunits, and similar barley and rye proteins, but the most common are a group of ω-gliadins, specifically, ω5-gliadins, encoded by genes on chromosome 1B (Shewry, 2009). Of these gliadins, omega-5 gliadin has been found to cause the strongest reaction among WDEIA sufferers (Morita, Kunie, and Matsuo, 2007). Although the exact pathogenesis of WDEIA has yet to be concretely determined, it is likely that the biochemical effects of exercise initiate mast cell degranulation and the subsequent allergic

reaction (Miller, Guha, Krishnaswamy, 2008). Those affected by WDEIA suffer from a variety of symptoms, including skin and respiratory reactions, such as urticaria, angioedema, erythema, and dyspnea, abdominal discomfort, fatigue, and loss of consciousness (Morita, Kunie, and Matsuo, 2007).

Celiac Disease

Celiac Disease (CD) is defined as an immune-mediated enteropathy characterized by a chronic inflammation of the small intestinal mucosa that is caused by ingestion of the gluten protein found in substances such as wheat, barley, and rye (Shewry, 2009 and Sapone et al., 2012). Atrophy of intestinal villi potentially ensues from this inflammation, which can lead to malabsorption of vitamins and nutrients, as well as other health ailments (Worosz and Wilson, 2012). Such ailments include increased risks of conditions such as anemia, edema, osteoporosis, infertility, compromised function of the spleen, neurological disorders, ulcerative jejunoileitis, and cancer, of which T-cell lymphoma and adenocarcinoma are rare (Fasano et al., 2003; Boye and Godefroy, 2010, pg. 333). Unlike classical food allergies that can cause immediate reactions, the symptoms of CD do not manifest until a period of months or years after the introduction to gluten and subsequently, the aforementioned damage is gradual. In this respect, a gluten-free diet is not only beneficial in alleviating gastrointestinal discomfort associated with CD, but also in preventing irreversible intestinal damage (Worosz and Wilson, 2012).

The disorder is believed to affect nearly 1% of the world-wide population and in the United States, and studies have found a prevalence of about 1:133 in subjects not at risk for the disease (Fasano et al., 2003). Occurrences of CD are significantly more common in individuals with afflicted relatives or associated symptoms. Although diagnoses are becoming more

common with serologic tests to screen for CD, it appears that the disease is still significantly undiagnosed (James, 2005).

Wheat Intolerance or Non-Celiac Gluten Sensitivity

Wheat intolerance or non-Celiac gluten sensitivity (NCGS) is defined as an adverse reaction to wheat or gluten that does not satisfy the diagnostic criteria of CD or WA, and is instead diagnosed only by a positive clinical response to the adherence to a gluten-free diet (Mooney, Aziz, and Sanders, 2013). In the United States, NCGS is estimated to affect 0.548% of the population, about half the frequency of CD (DiGiacomo, Tennyson, Green, and Demmer, 2013). While some of the associated gastrointestinal symptoms of NCGS parallel those of CD, individuals suffering from NCGS would test negative for antibodies such as the tTG antibodies associated with CD and the IgE antibody associated with wheat allergy (O'Rourke, 2013). Also in contrast with CD and WA is the incidence of extraintestinal symptoms experienced with NCGS. Some of these symptoms include behavioral changes, mind "fogginess," headache, bone or joint pain, leg, arm, or finger numbness, muscle cramps, weight loss, and chronic fatigue (Sapone et al., 2012).

Other Gluten-Free Consumers

While wheat-allergic and gluten-intolerant or sensitive patients need to adhere to strict gluten-free diets for medical reasons, there are a variety of other reasons for which individuals who do not fall into these categories still choose to eat gluten-free. These individuals associate a particular cultural, ecological, civic, historical, ethical, or health-based characteristic to gluten-free food, or a gluten-free diet coincides with a particular interest in one or more of these categories (Worosz and Wilson, 2012).

One notion is that a gluten-free diet is healthier, boosting moods and energy, decreasing weight, and detoxifying the body. This perceived health benefit leads some non-allergic and non-sensitive individuals to convert to a gluten-free regimen in order to benefit their overall health. However, these claims have not been supported by scientific evidence (Gaesser and Angadi, 2012). Cutting gluten out of one's diet can result in vitamin and nutritional deficiencies (Strawbridge, 2013). Gluten-free foods are also often higher in caloric content and lower in whole grains and fiber, which can lead to increasing body mass indexes (BMI) (Gaesser and Angadi, 2012). There have been claims of weight loss after following a gluten-free diet, but this may result from the inclusion of more fruits and vegetables and an avoidance of processed foods, rather than the gluten-free nature of the diet. Moreover, while detrimental to those with allergies or intolerances, gluten can actually prove to be beneficial for the remainder of the population. Studies have shown that lower serum triglyceride and oxidized low-density lipoprotein levels can be accredited to higher gluten consumption (Gaesser and Angadi, 2012). Evidence has also shown that gluten potentially improves the immune system, especially against tumor growth, viral infections, and cancer, and that gliadin, a component protein of gluten, may play a role in lowering blood pressure (Gaesser and Angadi, 2012).

Although there is no data substantiating the claim that gluten-free diets are healthier, some do exist that indicate improvement in gastrointestinal and systemic symptoms in conditions such as systemic lupus erythematosus, dermatitis herpetiformis, irritable bowel syndrome, rheumatoid arthritis, type 1 diabetes, thyroiditis, and psoriasis (Gaesser and Angadi, 2012). In an experiment in which rheumatoid arthritis (RA) sufferers were put on a gluten-free, vegan diet, low-density lipoprotein (LDL) and oxidized low-density lipoprotein (oxLDL) levels decreased, while immunoglobulin A (IgA) and immunoglobulin M (IgM) antibody levels increased (Elkan

et al., 2008). As LDL is atherogenic, oxLDL is pro-inflammatory, and IgA and IgM are inversely related to atherosclerosis development, the evidence indicates that a gluten-free, vegan diet may reduce the risk of cardiovascular disease in RA patients as well as inflammation associated with the condition. Another one-year gluten-free, vegan diet study on RA patients recorded decreased serum levels of IgG antibodies to gliadin and β-lactoglobulin, adding to the evidence in favor of a gluten-free diet's beneficial effects in RA-afflicted individuals (Hafstrom et al., 2001). Clinical research has found that after a six month adherence to a gluten-free diet, patients at risk of diabetes mellitus (DM) experienced an increased insulin response to intravenous glucose tolerance testing (IVGTT) and concluded that the diet may improve insulin secretion in high-risk individuals (Pastore et al., 2003). Another study found that in 93% of AIDS-associated enteropathy patients on a trial gluten-free diet, the number of daily bowel movements and abdominal cramping decreased significantly (Quinones-Galvan, Lifshitz-Guinzberg, and Ruiz-Arguelles, 1990). Researchers concluded that a gluten-free diet may diminish the incidence of diarrhea and abdominal pain in HIV patients. Gluten-free diets have also been among the dietary interventions used as treatment for autism spectrum disorders (ASD), however, there is insufficient evidence as to whether excluding gluten from the diet has a positive impact on these patients (Buie, 2013).

Gluten-Free Diet

The treatment for conditions such as WA, CD, and NCGS is a gluten-free diet (GFD) devoid of wheat, rye, or barley proteins, although if cross-reaction among proteins is not a concern, patients with just WA may choose to only avoid wheat proteins. Table 1 below provides a list of safe gluten-free grains, Table 2 summarizes common gluten-containing ingredients and food products, and Table 3 lists common gluten-containing non-food products.

While the nutritional content of gluten can be replaced with other proteins, common gluten-free diets typically provide inadequate sources of some nutrients, including fibers, iron, calcium, and folate (Boye and Godefroy, 2010, pgs. 338-339). In addition, niacin, vitamin B12, phosphorus, and vitamin D are other possible deficiencies of following a strict GFD (Saturni, Ferretti, and Bacchetti, 2010). A health hazard assessment study reported the tolerable daily intake (TDI) of gluten for CD patients is 0.4 mg gluten per day with respect to adverse morphological effects, but only 0.015 mg per day for clinical effects, or about 0.5 parts per million (ppm) and 0.02 ppm, respectively, where one part per million is equivalent to one milligram per kilogram (U.S. Department of Health and Human Services, Office of Food Safety, Food and Drug Administration, Center of Food Safety and Applied Nutrition, 2011).

Table 1

Gluten-free and gluten-containing grains

Gluten-containing Grains	Gluten-free grains
Atta (Chapatti flour)	Amaranth
Barley	Arrowroot
Barley malt/extract	Buckwheat
Bran	Corn
Bulgur	Fava
Cereal binding	Flax
Couscous	Fours from nuts, beans, seeds
Cracker meal	Hominy
Dinkel	Mesquite flour
Durum	Millet
Einkorn	Montina flour (Indian rice grass)
Emmer	Nut meals
Farina	Oats (uncontaminated)
Faro	Potato flour
Fu	Potato starch
Graham Flour	Quinoa

Kamut	Rice
Malt	Rice bran
Matzo flour/meal	Sago
Oats (if contaminated)	Sorghum
Orzo	Soy
Panko	Tapioca (manioc, cassava, yucca)
Rye	Teff
Seitan	
Semolina	
Spelt	
Triticale	
Udon	
Wheat (bran, germ, starch)	

Table 2

Common gluten-containing ingredients and food products

Ales, beers, lagers	Icing, frosting
Autolyzed yeast	Imitation bacon and seafood
Baked beans	Instant coffee
Baking powder	Licorice
Bouillon cubes	Malted products
Bread, rolls	Matzoh
Breading, croutons, panko	Mayonnaise
Brewer's yeast	Meat and dairy substitutes
Broth	Meat loaf
Brown rice syrup	Miso
Cakes, donuts, muffins, pastries	Modified food starch
Candy	Mono- and di-glycerides
Cereals, cereal extracts	Monosodium glutamate
Cheese spreads, flavored cheeses	Noodles, pastas
Chewing gum	Nuts
Chocolates	Pies
Cocoa drinks	Pretzels
Colors	Processed meat
Communion wafers	Puddings, soups
Crackers	Roux

Dextrins	Salad dressings
Dried fruits	Seasoned rice mixes and chips
Emulsifiers, stabilizers, thickeners	Seasonings
Energy bars and supplements	Self-basting poultry
Flavored alcoholic beverages	Soy sauce
Flavored beverages	Starch
Flavored coffee	Stuffing
Flavoring	Sweeteners
French fries	Textured vegetable proteins
Gravies, sauces, marinades	Trail mixes
Herbal teas	Vegetable gum/protein
Hydrolyzed plant protein	Vegetarian "burgers"
Hydrolyzed vegetable protein	Vitamin and mineral supplements
Ice cream	Waffles, pancakes

Table 3

Common gluten-containing non-food products

Bath salts	Lip moisturizers/lipstick	Soap
Body powder	Make-up	Spray starch
Chapstick	Medications	Stamps
Charcoal briquettes	Mouthwash	Stickers
Envelopes	Non-stick cooking sprays	Suntan lotion
Glue	Paints	Toothpaste
Herbal supplements	Playdough	
Laxatives	Shampoo/Conditioner	

Gluten-Free Market

An August 2012 survey conducted by Packaged Facts revealed that about 18% of adults in the United States purchase or consume gluten-free products, which is an increase from the 15% reported in an October 2010 consumer survey (Packaged Facts, 2012). However, while a GFD is becoming more common, prices for gluten-free alternatives to traditional foods remain

considerably higher. A study on the economic burden of a GFD in the United States found that on average, gluten-free foods are 240% more expensive than their regular counterparts, with gluten-free bread costing about 153.33% more than the wheat-based version (Lee, Ng, Zivin, and Green, 2007). This study also exposed that prices of gluten-free foods vary according to place of purchase, with the internet being the most expensive, followed by health food stores, upscale markets, and regular grocery stores (Lee, Ng, Zivin, and Green, 2007).

Another cost comparison study of gluten-free versus regular foods in Canada confirmed the U.S. study, finding that the average price increase for gluten-free foods was 242% of the price of their regular counterparts (Stevens and Rashid, 2008). All-purpose flour mixes experienced the greatest price discrepancy with the gluten-free version being 1000% more expensive, while bread, multigrain/raisin in particular, was 126% more expensive when purchased gluten-free (Stevens and Rashid, 2008).

A more recent, 2011, study in the United Kingdom found that among the ten cheapest, branded gluten-free and wheat-based food pairs, the average prices of the gluten-free versions ranged from 76% to 518% higher than those of their counterparts (Singh and Whelan, 2011). In this study, the difference in prices between gluten-free and wheat-based bread was 360% the wheat-based price (Singh and Whelan, 2011).

Not only are gluten-free foods more expensive, but their accessibility is also limited. The U.S. study previously mentioned revealed that the availability of gluten-free foods varies throughout the nation, while prices for many products remain consistent (Lee, Ng, Zivin, and Green, 2007). With regards to shopping venue, the internet was found to offer the widest

selection of gluten-free products, while regular grocery stores had the most restricted assortment (Lee, Ng, Zivin, and Green, 2007).

Despite higher prices and limited availability of gluten-free foods, the gluten-free market has grown quickly in recent years and is expected to continue expanding (Packaged Facts, 2012). Mintel (2013) calculated the U.S. market for gluten-free foods and beverages to be $10.5 billion, which constitutes a 44% increase from 2011, and from 2013 to 2016, Mintel predicts that this market will swell to $15.6 billion, a 48% increase. Globally, MarketsandMarkets reported that North America accounted for about 59% of the gluten-free market, with the United States emerging as the leading producer (Food Manufacturing, 2013; MarketsandMarkets, 2013). The same report also found that gluten-free bakery and confectionary products constitute the largest sector of the gluten-free market, amounting to about 46% (Food Manufacturing, 2013).

Regarding the consumer basis, about 24% of U.S. shoppers either consume or live with someone who consumes gluten-free products, and about 75% of these consumers have neither CD, sensitivity, nor allergy, but choose to eat gluten-free under the presumption that a GFD is healthier (Mintel, 2013).

Food Labeling

Labeling is a common way in which information about the various attributes that a product exhibits can be conveyed to its buyers. The three broad categories of attributes that may be highlighted in product labeling are search, experience, and credence attributes. Search attributes are those that can be discerned prior to purchase by inspection or a consultation with available resources. Experience attributes are ones that can be determined after purchase or consumption of the product. Credence attributes are those that are difficult or nearly impossible

to verify, even after consumption. A product can possess attributes from any and all of these categories and each one has a unique effect on consumer's perception and valuation of the good. The types and amount of information to which an individual is exposed concerning a product influence the individual's characterization of and decision to purchase a given product, and in this way, imperfect or lacking information can result in market failures that lead consumers to purchase products misaligned with their particular preferences (Lusk, Roosen, and Shogren, 2011, pg. 473). Product labeling can help to mitigate these market failures by ensuring that correct information is presented to the customer before the point of purchase, allowing for educated decisions to be made.

Since the only treatment for wheat allergies and gluten intolerances is complete avoidance of the offending substance, precise disclosure of the presence of potentially allergenic ingredients is crucial in ensuring safe consumption (Voordouw et al., 2009). In order to maintain the health of these individuals, ingredient labels must be comprehensive, accurate, and presented in an easily readable and understandable manner for consumers at the time of purchase (Cornelisse-Vermaat, Voordouw, Vassiliki, Theodoridis, Frewer, 2007). Surveys of patient groups such as the European Federation of Allergy and Airways Diseases Patients' Associations (EFA) have unveiled four stances that food allergic and food sensitive individuals hold: first, that known allergens be clearly labeled under their familiar name and without exception, second, that ingredients listings be continuously updated as emerging scientific evidence regarding food allergens becomes available, third, that flexibility with respect to labeling "minor" constituents of a finished product be restricted, and finally, that stringent limitations regarding concessions in labeling compound ingredients, or those which comprise a commonly used food component, such as milk chocolate, be implemented (Mills et al., 2004).

Under current labeling laws and with the disparity in labeling practices, some consumers remain skeptical of the information conveyed and its effectiveness in fully informing them of a given food's safety. Cause for concern can stem from the fear of cross-contamination, or cross-contact, which is the unintentional addition of an allergen to product that would otherwise be free of said ingredient, the presence of unlabeled and/or unpackaged goods, the variety of names used for a single ingredient, and labeling formatting and/or terminology that render the food label confusing or incomprehensible for the average allergen-free shopper (Cornelisse-Vermaat et al., 2007). In a study on food-allergic consumers' labeling preferences conducted by Voordouw, et.al. (2009), consumers reported some explicit concerns regarding food labeling practices: the miniscule font used to list ingredients and the diminished readability due to color choices, the inconsistency in location of allergen information, and the generic terminology for ingredients such as "starch," failing to distinguish the source, i.e. corn, potato, wheat, etc., or "flavoring," which reveals no information regarding the derivation of said flavorings (Voordouw et al., 2009). This miscommunication between producers and consumers poses the risk of accidental consumption of offending substances, leading to unpleasant and potentially life-threatening reactions. Therefore, in order to provide consumers with the most precise information, it is paramount that manufacturers have a thorough knowledge of the production processes for their food products as well as the individual ingredients that comprise these items (Mills et al., 2004).

Simons, Weiss, Furlong, and Sicherer (2005) surveyed a group of adult Food Allergy and Anaphylactic Network, now Food Allergy Education and Research (FARE), conference attendees related to their experiences with food allergy labeling and deciphering safe foods for their food-allergic family member to consume. In doing so, they found that 16% credited adverse reactions to misinterpreting a term contained on the food label, while 22% ascribed their

reactions to ingesting a food with an unlabeled allergen, and 86% related that they contacted a product's manufacturer for further ingredient information (Simons et al., 2005). Adding further significance to these numbers is the sample population surveyed. Attendees of FARE conferences are presumably highly conversed in food allergy-related terminology and experienced in avoidance practices. Their reporting considerable difficulties evading allergens based on the information disclosed via labeling suggests that these uncertainties and misguided ingestions may be magnified in the average consumer with a food aversion.

Another cause for concern in food labeling is the use of an extensive array of advisory labels, some of which can be seen in the Table 4 from clinical lecturer Paul J Turner (Turner, Kemp, and Campbell, 2011). Also referred to as precautionary labeling, declarations of this sort are intended to convey the potential for the labeled product to inadvertently contain an allergen that is not incorporated as an ingredient, informing consumers that the product may pose a hazard to their health if they possess a food allergy or sensitivity, and that caution or avoidance should be exercised with respect to consuming the given product (Boye and Godefroy, 2010, pgs. 4-5). What is unclear from these warnings is whether they descend from the potential for unavoidable cross-contact during the cultivation process of ingredients or the production of a processed food, or the manufacturer's desire for a "safety-net" in the event of contamination due to negligent manufacturing practices. In effect, the use of some precautionary labels could simply be a "blanket" statement to relieve the company of legal liability, even if it is not probable that the allergen would ever be introduced into the product (Boye and Godefroy, 2010, pg. 460). While shared equipment and production lines present a risk for cross-contact between "safe" foods and offending ingredients, overuse of precautionary labeling may induce unnecessary dietary restrictions on individuals avoiding specific allergens (Voordouw et al.,

2009). Furthermore, due to the irregularity of such labels across the manufacturing industry, some consumers devalue the warnings conveyed and in this respect, put themselves at risk of allergic or adverse reactions post-ingestion (Boye and Godefroy, 2010, pg. 424).

Table 4

Types of advisory warnings found on food labels

May contain…
May contain traces of…
Produced in a factory which handles…
Produced on shared equipment which also processes…
Made in a production area that also uses…
Made in a factory that also produces…
Not suitable for…allergy sufferers
Packed in an environment where…may be present
Due to the methods used in the manufacture of this product, it may occasionally contain...

United States Labeling Laws

On January 1, 2006, the Food Allergen Labeling and Consumer Protection Act of 2004 (FALCPA) went into effect, setting new criteria for food allergen labels on all foods, domestic and imported, regulated by the United States Food and Drug Administration (FDA) (U.S. Department of Agriculture, Food and Nutrition Service (FNS), 2006). FALCPA mandates that foods containing one of the eight most common food allergens, i.e. milk, eggs, fish, Crustacean shellfish, tree nuts, peanuts, wheat, and soybeans, be listed on food labels following the word 'Contains,' that the commonly known name is used in ingredient lists, and that any flavoring, coloring, or additive containing one of these major allergens is also subject to the aforementioned labeling requirements (Food Allergen Labeling and Consumer Protection Act (FALCPA) of 2004). In all of these cases, FALCPA obliges manufacturers to disclose the food

source from which the allergen is derived. However, if the major food allergen appears as a highly refined oil or an ingredient derived from such an oil, FALCPA does not require declaration (FALCPA, 2004). Meat, poultry, and eggs that are regulated by the United States Department of Agriculture's (USDA) Food Safety and Inspection Service (FSIS) are also exempt from these labeling laws (FNS, 2006). On April 30, 2013, FSIS issued a notice entitled "Targeted Verification of Product Formulation and Labeling for the Eight Most Common ("Big 8") Food Allergens." This notice dictates that all ingredients must be accurately stated in the product label's ingredient list; that this, declaration must be in the ingredients' "common or usual" names and appear in descending order based on the amount present in the final product. In contrast to the FDA's FALCPA, FSIS's notice only requires that spices and flavoring included in a product be listed under the general titles "spices" or "flavoring" and does not necessitate the inclusion of proceeding aids or incidental additives on labels (U.S. Department of Agriculture Food and Safety Inspection Service, Food and Safety Inspection Service (FSIS), 2013). A problem arises with respect to consumers adhering to a gluten-free diet since gluten is not only found in wheat, but also rye and barely. While the FSIS notice helps consumers find sources of wheat in a product's ingredient label, rye and barley can still remain "hidden" behind other terminology and are not required to be explicitly stated in their common name.

On August 2, 2013, the Food and Drug Administration issued a set of requirements for the voluntary use of the term "gluten-free" in food labeling (U.S. Department of Health and Human Services, Food and Drug Administration (FDA), 2013). Namely, a food must either not contain a gluten-containing grain or derivative of such a grain as an ingredient, or not contain such ingredients that result in 20 ppm or more of gluten in the final product, including any unavoidable gluten from production exposures such as cross-contact (FDA, 2013). Some

manufacturers may opt to utilize processes to remove the gluten from gluten-containing grains that they wish to use as ingredients in their products, but if such removal processes are not conducted, these grains may not appear in a "gluten-free" labeled good, even if the finished product contains less than 20 ppm of gluten (FDA, 2013).

Third-Party Certification

One manner of product labeling that can be of significant assistance in purchasing decisions is third-party certification (TPC). Third-party certifiers are organizations independent of the producers and consumers that assess, evaluate, and endorse a particular claim based on a set of standards and compliance methods (Hatanaka, Bain, and Busch, 2005). This degree of separation between the third party certification agency and the producers and consumers imparts a greater level of credibility to the certified claims by eliminating or greatly reducing the chances of biases. Additionally, the potential for a TPC agency to be accredited by an accreditation body such as the American National Standards Institute Accreditation Board (ANAB) also enhances its perceived creditability (Boye and Godefroy, 2010, pg. 473). Due to the competitive nature of markets, manufacturers look to distinguish their products from comparable alternatives. A common practice is to affirm a product's desirable attributes on the label or packaging, regardless of whether these assertions are substantiated by testing, nutritional analysis, or other mechanisms (Boye and Godefroy, 2010, pg. 484). TPC becomes useful in verifying such claims, ensuring that they are accompanied by the necessary manufacturing practices.

In the study by Voordouw et.al. (2009), participants revealed their preference for symbolic labeling to indicate the presence or lack of presence of a particular allergen, claiming such representations, in addition to standard ingredient labels, made finding "safe" foods

quicker and easier (Voordouw et al., 2009). However, with the use of such emblematic labeling practices, it is essential that universal standards be set for their interpretation in order to maintain their usefulness.

Gluten-Free Certification

Ideally, a GFD would be completely eliminate gluten, but Collin, Thorell, Kaukinen, and Mäki (2004) uncovered that even naturally gluten-free products can contain trace amounts of gluten, making this ideal unattainable. This realization makes verification of gluten-free claims all the more vital. Although in 2013, the FDA officially defined the term "gluten-free" with regards to product labeling, they did not establish requirements for ensuring that products contain less than 20 ppm of gluten. Products exceeding this upper limit, if detected, can be deemed "misbranded," but the FDA does not mandate that manufacturers test their ingredients or final products for gluten before labeling them as gluten-free (FDA, 2013). Instead, manufacturers are just held responsible for their compliance with this standard should the FDA ever decide to test one of said company's "gluten-free" items. While the ruling on the "gluten-free" definition is a step forward in ensuring food safety for the gluten-avoiding population, this caveat in the labeling laws leaves room for misperceptions about food safety and may also be a cause for apprehension among those trying to maintain gluten-free diets. Furthermore, even when foods meet the FDA definition of "gluten-free," manufacturers are not obliged to label the product as such and if they do, there is no standardized label or symbol (FDA, 2013). Thus, even though the term "gluten-free" has been given a clearer meaning, its labeling is merely a recommendation, rather than a government-enforced regulation. Conversely, the FDA also allows manufacturers to label naturally gluten-free foods as gluten-free. This can mislead consumers into questioning the gluten-free status of other, unlabeled brands of these products,

causing undue anxiety and bewilderment at the hands of the consumer (Layton 2011). In the case of labeling, the lack of a consistent marking allows for much variation amongst manufacturers and may exacerbate the confusion of consumers.

For these reasons, some organizations have developed third-party gluten-free certification programs as an attempt to ensure that foods being labeled "gluten-free" are held to strict manufacturing, packaging, and transportation practices and enable consumers to be confident in the safety of the foods they purchase. There are currently four commonly used gluten-free certifications present in the United States market: the Celiac Sprue Association's Recognition Seal Program, the Gluten Intolerance Group's Gluten-Free Certification Organization (GFCO), the Canadian Celiac Association's Gluten-Free Certification Program (GFCP), and the National Foundation for Celiac Awareness' Gluten-Free Certification Program (NFCA), each of which lasts for a one year period. Table 5 compares some of the standards for certification between the different organizations and Figure 1 depicts their respective logos appearing on food labels.

Table 5

Comparison of the four gluten-free certification programs

Standards for certification	CSA	GIG	CCA	NFCA
Upper limit for gluten	<5ppm	≤10ppm	<20ppm	≤10ppm
Inclusion of oats	No	Yes, if ≤10ppm gluten	No	Yes, if ≤10ppm gluten
Inclusion of wheat, barley, and rye that has been processed to remove gluten	Only if absence of toxic amino acid sequences	Yes, if ≤10ppm gluten	Some, not wheat starch	Yes, if ≤10ppm gluten
Final product tested by certifying organization	Yes	Yes	Yes	Yes
Possible gluten-containing ingredients tested by certifying organization	Yes	Yes	Yes (all ingredients)	Yes (all ingredients)

Dedicated gluten-free facility	No	No	No	No
Dedicated gluten-free production line	No	No	No	No
Manufacturers test product throughout year	Not required, but recommended	Yes	Yes	Yes
Manufacturers test product in-house	Not required, but recommended	Yes	Yes	Yes
Regularly submit product to third party lab for testing	Yes	Yes	No	Yes

Figure 1. Logos for the four most common gluten-free certification programs in North America. From left to right, the logos depict the Celiac Sprue Association's Recognition Seal Program, the GFCO, the GFCP, and the NFCA.

Naturally, applying for such certification gives rise to additional manufacturing costs. However, as reported by the GFCO, GFCP, and NFCA, the flat-rate application and/or auditing cost is about $500 (Gluten-Free Certification Program, 2014; Gluten Intolerance Group, 2014), while the Celiac Sprue Association's Recognition Seal Program has a fee of $150 (Celiac Sprue Association, 2013). Some programs also charge additional inspector, licensing, and other third-party fees, but according to the GFCO, the percentage of total manufacturing costs attributable to certification is trivial (Gluten Intolerance Group, 2014). That being the case, it is unlikely that the cost of certification would substantially impact product prices, if at all. In fact, Udi's, which has become the top gluten-free brand in America, made $60.9 million in sales of its gluten-free products, all of which are certified by the GFCO, in the one-year period ending in March 2012 (Boulder Brands, Inc., 2012; Udi's, 2013). Based on the product prices listed in their website's catalogue, Udi's gluten-free products range from $4.50 to $7.00 in their online store. The average price is about $5.72. Although the proportion of total sales for each product is unknown, simply using the average price as a baseline, the $60.9 million in sales equates to approximately 10.6 million products sold in the twelve month period. This would then correspond to about a $0.00005 per product increase in price to cover the $500 base rate that the GFCO charges, far less than one cent. Thus, this result supports the notion that assuming a company has already accounted for adjustments in manufacturing processes to ensure a product meets gluten-free regulations, applying for certification will not require a sizable premium in order to cover the extra cost.

Model

Conceptual Model

According to Lancaster (1966), utility of a good is not derived from the good itself, but rather from the package of characteristics that it possesses. In this way, a consumer's consumption decision is based on the satisfaction provided by a good's intrinsic properties. This makes Lancaster's characteristics demand model an appropriate framework for food studies since the focus is placed on how consumers are valuing a product based on the presence of a particular characteristic, in this case, gluten-free certification.

The consumer's WTP can be equated to their compensating variation (CV) in income, which, according to Hicks (1946), is the monetary amount of income that if lost, would precisely offset a decrease in the price of a good. Thus, the CV, or WTP, is the amount that will keep the consumer on the same indifference curve before and after a given drop in price.

We can write the demand for a product, X, by the following equation:

$$q_X = d(M, p_1, \ldots, p_n)\ X = 1, \ldots, n,$$

where q_x is the demand for X, M is individual's income level, and $p_1, \ldots, p_n$ are the prices of $X_1, \ldots, X_n$. If we have two goods, X_1 and X_2, we can express the indirect utility function by:

$$V(M, p_1, \ldots, p_n).$$

Since the CV is the monetary amount needed to remain on the original indifference curve after a price decrease, we can express this number via the following equation (Sanders, Moon, Kuethe, 2007):

$$V(p_1^1, p_2, M) = V(p_1^2, p_2, M - CV) = U_0,$$

where the price of X_1 exhibits a decrease from p_1^1 to p_1^2 and U_0 is the utility from the original bundle.

Incorporating Lancaster's theory that utility is derived from product attributes, the previous equation can be adapted to a single product case:

$$V(p_1^0, C_0, M) = V(p_1^1, C_1, M - CV) = U_0.$$

This equation can be further modified into one that reflects the consumer's willingness to pay for a change in a particular attribute, such as the presence or absence of said attribute (Sanders, Moon, Kuethe, 2007):

$$WTP = (p_1^1 - p_1^0) \times X_1^0,$$

where p_1^1 is the price ascribed to X_1 when it possesses a level, C_1, of a specified characteristic, p_1^0 is the price ascribed to X_1 when it possesses a another level, C_0, of the same characteristic, and the quantity of X_1 does not change.

Alternatively, this WTP expression can be written in an analogous form presented by Lusk and Hudson (2004):

$$WTP = m(p, U_0, C_0) - m(p, U_0, C_1),$$

where m(p,U,C) is the indirect expenditure function with variables *U* and *C* defined as above.

Econometric Model

The survey used in this contingent valuation study asks respondents two distinct questions regarding their willingness to pay a premium for gluten-free certification, allowing for the estimation of two separate decisions: (1) whether or not they are willing to pay a premium and (2) how much of a premium they are willing to pay.

Sanders, Moon, and Kuethe (2007) took Fishbein's multi-attribute model, which expresses attitude towards a behavior or object as a function of an individual's beliefs about the behavior or object and the evaluative aspects of these beliefs, and modified it to write WTP a premium for certified pork as a function of its salient attributes and price (Mazis, Ahtola, and Klippel, 1975):

$$WTP_{ij} = f\begin{pmatrix} Price, Juiciness, Tenderness, Marbling, Leannness, \\ PorkPremium, BeefPremium, Cheaptalk, No\ Agency, \\ IPPA, KnowledgeofMarbling, Health\ Concerns, \\ demographic\ profile \end{pmatrix}.$$

This model specification can be adapted to the question of WTP for gluten-free certification by expressing WTP as:

$$WTP_i = x_i\beta + \varepsilon_i,$$

where WTP_i denotes an individual's unobserved, true WTP value, x_i is a vector of variables that explain the magnitude of an individual's WTP amount, such as knowledge of certification guarantees, reasons for purchasing gluten-free bread, and demographics, and ε_i is a standard normal error term with zero mean and variance σ^2.

The decision of whether a consumer will pay a higher price for certification can then be estimated via logit regression methods and expressed by the following equation:

$$d_i = \begin{cases} 1 \; if \; x_i\beta + \varepsilon_d > 6 \\ 0 \; otherwise \end{cases},$$

where d_i is a binary variable such that $d_i = 1$ represents the decision to pay a premium, and the average price for gluten-free bread is $6.00.

The logit, or log-odds ratio is defined as (Brannick):

$$logit(p) = ln\left(\frac{p}{1-p}\right),$$

where p is the probability of paying a premium, i.e. $d_i = 1$, and the accompanying logistic regression model is written (Brannick):

$$ln\left(\frac{p}{1-p}\right) = a + \beta x_j,$$

for some constant, a, and a vector of explanatory variables x_j. Thus, the probability of paying a premium can be expressed as:

$$p = \frac{e^{a+\beta x_j}}{1+e^{a+\beta x_j}}.$$

As can be seen from the previous equation, the coefficients, β_j, cannot be interpreted as the change in the probability of paying a premium due to a single unit change in the variable x_j, as ordinary least squares (OLS) coefficients are interpreted. Instead, as the initial equation, $ln\left(\frac{p}{1-p}\right) = a + \beta x_j$, shows the coefficients represent the change in the log-odds ratio due to a

single unit change in the associated variables. Therefore, marginal effects can be used to decipher the change in probability due to a one unit change in a given independent variable.

Since the contingent valuation survey method employed attempts to decipher the relationship between a non-negative variable, WTP_i, and a vector of independent variables, X_i, the Tobit model can be used to estimate respondents' true WTP by rewriting the earlier specification in the following form (Kim and Cho, 2002):

$$WTP_i^{Tobit} = X_i'\beta + e_i,$$

where WTP_i^{Tobit} denotes the unobserved, continuous variable associated with consumers' WTP. As in the previous model, the error term, e_i, is assumed to be independent and identically distributed with zero mean and variance σ^2.

Using this formulation, the observed WTP variable can be expressed in the piecewise functional form:

$$WTP_i^{Tobit} = \begin{cases} X_i'\beta + e_i \; if \; WTP_i^{Tobit} > 0 \\ 0 \; if \; WTP_i^{Tobit} \leq 0 \end{cases}.$$

One variation of this specification is when the model is censored at a value other than zero. Naming such a value w_l, the WTP expression becomes:

$$WTP_i^{Tobit} = \begin{cases} X_i'\beta + e_i \; if \; WTP_i^{Tobit} > w_l \\ 0 \; if \; WTP_i^{Tobit} \leq w_l \end{cases}.$$

Yet another variation is when the model is censored from both above and below. Naming these values w_u and w_l, respectively, the WTP expression is transformed into the following:

$$WTP_i^{Tobit} = \begin{cases} X_i'\beta + e_i \; if \; w_l < WTP_i^{Tobit} < w_u \\ w_l \; if \; WTP_i^{Tobit} \leq w_l \\ w_u \; if \; WTP_i^{Tobit} \geq w_u \end{cases}.$$

In contingent valuation survey analysis that utilizes the payment card method, this two-limit Tobit model can be employed in order to account for the censoring that occurs due to the restricted WTP choices. In this way, w_l represents the lowest WTP choice presented and w_u represents the highest WTP choice.

The log-likelihood function for this Tobit model variation is (Henningsen, :

$$logL = \sum_{i=1}^{N} \left[I_i^{w_l} log\Phi\left(\frac{w_l - x_i'\beta}{\sigma}\right) + I_i^{w_u} log\Phi\left(\frac{x_i'\beta - w_u}{\sigma}\right) + \left(1 - I_i^{w_l} - I_i^{w_u}\right)\left(log\phi\left(\frac{WTP_i - x_i'\beta}{\sigma}\right) - log\sigma\right)\right],$$

where $\phi(.)$ signifies the probability density function of the standard normal distribution, $\Phi(.)$ represents the cumulative distribution function, and $I_i^{w_l}$ and $I_i^{w_u}$ are indicator functions such that:

$$I_i^{w_l} = \begin{cases} 1 \; if WTP_i = w_l \\ 0 \; if WTP_i > w_l \end{cases}$$

and

$$I_i^{w_u} = \begin{cases} 1 \; if WTP_i = w_u \\ 0 \; if WTP_i < w_u \end{cases}.$$

Once estimates for β and σ have been found via maximum likelihood estimation, the marginal effect of a given dependent variable, X_k, can be calculated. Tobit coefficients differ from those of OLS regressions in that they do not directly describe the extent to which a given

explanatory variable affects the dependent variable. Instead, these coefficients account for both the probability that a respondent will pay a premium for gluten-free certification and the magnitude of the premium they are willing to pay. The marginal effect is therefore given by (Fernandez-Cornejo, Daberkow, McBride, 2001):

$$\frac{\partial E(WTP|X)}{\partial X_k} = E\left(WTP\middle|X, w_l < WTP^{Tobit} < w_u\right) \cdot \left[\frac{\partial\left[\Phi\left(z_{w_u}\right) - \Phi\left(z_{w_l}\right)\right]}{\partial X_k}\right]$$

$$+ \left[\Phi\left(z_{w_u}\right) - \Phi\left(z_{w_l}\right)\right] \cdot \left[\frac{\partial E\left(WTP\middle|X, w_l < WTP^{Tobit} < w_u\right)}{\partial X_k}\right] + \frac{\partial \Phi\left(-z_{w_u}\right)}{\partial X_k}$$

where

$$z_l = \frac{w_l - \beta X}{\sigma}$$

and

$$z_u = \frac{w_u - \beta X}{\sigma}.$$

Thus, the marginal effect of one of the dependent variables on the independent variable is the sum of (1) the change in the probability of paying a premium, weighted by the conditional expected WTP, given that the respondent pays a premium, (2) the change in WTP of respondents paying a premium, weighted by the probability of paying a premium, and (3) the change in the probability of paying the highest WTP payment card option.

This marginal effects expression can eventually be simplified into the following (Fernandez-Cornejo, Daberkow, McBride, 2001):

$$\frac{\partial E(WTP|X)}{\partial X_k} = \beta_k\left[\Phi\left(z_{w_u}\right) - \Phi\left(z_{w_l}\right)\right].$$

Methodology

Contingent Valuation

One way to measure a consumer's willingness to pay (WTP) for a good or service in the marketplace is through a technique known as the contingent valuation method (CVM). This method estimates the value a consumer places on a given product by eliciting stated preferences in a hypothetical market (Economic and Social Development Department, 2000). As the name suggests, these WTP responses are contingent upon the way in which the market is constructed and presented (Portney, 1994). For this reason, it is imperative that the survey used in a CVM experiment clearly describes the product or service in question. In a typical implementation of the CVM, survey respondents are presented with information regarding the product, service, or policy at hand and the benefits that would ensue from the use of the given product or service or the enactment of the proposed policy (Arrow et al., 1993). Respondents are then asked a question or series of questions geared towards extracting the maximum economic tradeoff they would be willing to make in exchange for said product, service, or policy, i.e. their WTP, or the minimum compensation they would require to forgo, i.e. their willingness to accept (WTA) to give up, the product, service, or policy (Carson and Haneman, 2005).

What differentiates the CVM from other valuation techniques is that it allows the researcher to estimate passive use, or non-use, values (Carson, Flores, and Meade, 2001). Non-use values, as the name suggests, are those values that are not related to the consumer's past, present, or future use of a product. These values may arise from sympathy for or empathy with people, animals, or environments affected by use of a given product or service or the implementation of a certain policy (Harpman, Welsh, and Bishop, 1993). There are three main

categories of non-use values: (1) those related to an individual's own use of a given resource, ie. good, service, or policy, (2) those related to use of the resource by others, and (3) those not related to use of a given resource (Hausman, 1993, pg. 6).

Non-use values related to an individual's own use of a given resource are known as option values and measure the satisfaction gained by knowing that the ability to make use of the resource in the future will be preserved (Hausman, 1993, pg. 7). With relation to gluten-free certification, the gratification a gluten-free consumer feels in response to the ability to purchase certified food products is an example of an option value. A slight variation on the option value is the quasi-option value, which represents the value gained from potential informational gains (Hausman, 1993, pg. 7). The major non-use value related to others' use of a resource is the bequest value, or the value placed upon the knowledge that a give resource be available to future generations (The Economics of Ecosystems and Biodiversity (TEEB), 2012). The satisfaction with the fact that certified gluten-free foods will be available for one's offspring and future consumers, in general, can be characterized as a bequest value.

The second type of non-use value is known as an "externality" and is the value added or subtracted by each additional individual's use of the resource (Hausman, 1993, pg. 8). In regards to certification, an externality would be the value, positive or negative, that is attained by an individual when other consumers purchase certified gluten-free foods. Lastly is the altruist value, or the value placed upon the knowledge that a given resource will benefit people other than one's self (TEEB, 2012). Analogously, an altruist value, in our instance, is the value obtained by knowing that certified gluten-free foods are available to those in need of them.

The third type of non-use values, or those unrelated to human use, are considered to be the most significant and include values such as the existence value, or the value placed upon the knowledge that a given resource exists (TEEB, 2012). Likewise, for certification, this is the value placed on knowing that gluten-free certification exists.

Since these values are not characterized by consumer behaviors, they cannot be measured by revealed preference valuation techniques. The CVM measures a consumer's WTP or WTA via stated preferences, and therefore it measures the total value that a consumer places on a resource (Carson, Flores, and Meade, 2001).

The nature the CVM subjects it to biases. By the nature of the CVM technique, both the presence of and payment for the good whose value is being estimated are suppositional, and since this valuation technique relies on stated, rather than revealed preferences, the accuracy of these assertions is indeterminate (Murphy and Stevens, 2004). This allows for hypothetical bias in CVM surveys, or the existence of a discrepancy between what an individual reports that they would pay versus what they would pay in the actual market. In surveys with hypothetical bias, it is common for WTP or WTA to be overstated since without the pressures of an actual purchasing situation, a greater reported WTP may induce an upsurge in a product's availability and an elevated WTA statement may diminish its chances of being discontinued or withdrawn from the market (Harrison and Rutström, 1999).

Two techniques used to palliate hypothetical bias in the CVM are certainty questions and cheap talk, both of which were used in our study. Certainty questions are follow-up questions that ask a survey participant to rate their level of confidence in their WTP or WTA response and cheap talk is a brief script that urges participants to envision that they are engaging in an actual

purchasing decision and asks that they answer as honestly and realistically as possible. Cummings and Taylor (1999) confirmed through several studies that cheap talk scripts successfully divest CVM results of potential hypothetical bias and that this elimination of bias is robust across changes is the script and experimental design.

Other potential biases in the CVM include strategic bias, starting point bias, vehicle bias, mental account, or scope, bias, and informational bias. Nonetheless, past studies have established that the careful formulation of the CVM study can purge results of biases (Tolley, Kenkel, and Fabian, 1994).

Four variations of the CVM estimating WTP are open-ended questions, referendum questions, also known as dichotomous choice questions, payment cards, and bidding. An open-ended question asks participants to report their highest WTP via a question of the general form: "What is the maximum you would be willing to pay for…?" Referendum questions ask participants to imagine the possible implementation of a given policy and the costs that such a policy would entail. Participants are asked whether or not they would vote in favor of the proposed policy via a question of a form similar to: "Requiring certification for all gluten-free foods in Massachusetts will increase your sales taxes by $3 a year for the foreseeable future. Would you vote in favor of such a proposal?" The payment card methods presents participants with a card consisting of various dollar amounts or ranges and asks them to choose their WTP. The bidding question is of a similar vein in that it asks participants whether or not they would pay a particular amount via a question of the form: "Would you pay $X for…?" Respondents answer "yes" or "no." Typically, if respondents answer "no," payment questions terminate, but if they answer "yes," they are prompted with another dollar amount. In terms of an individual's WTP, open-ended questions evaluate WTP, referendum questions determine whether WTP is

greater/less than the amount presented, and both payment cards and bidding questions determine a range on WTP (Morey, 2012).

Research Method

Utilizing a quantitative research method, this research study was conducted via a CVM payment card questionnaire generated from the hypotheses stated in the introduction. Although the CVM is commonly used for valuations of environmental policies, it has become increasingly useful in evaluating WTP for a variety of food-related characteristics (Sanders, Moon, and Kuethe, 2007). For instance, Sanders, Moon, and Kuethe (2007) revealed that consumers are willing to pay a premium for fresh pork certified to have higher quality juiciness, leanness, marbling, and tenderness than the average USDA-inspected retail pork, and Hu, Woods, Bastin, Cox, and You (2011) arrived at the same conclusion with respect to value-added blueberry products through payment card studies. Another payment card study by Batte, Hooker, Haab, and Beaverson (2007), found that consumers are willing to pay a premium price for multi-ingredient organic foods, even if these foods are not produced with 100% organic ingredients. Relatedly, two studies, a dichotomous choice survey by Carpio and Isengildina-Massa (2009) and a payment card survey by Burnett, Kuethe, and Price, uncovered that consumers were willing to pay premiums on locally grown food products. By means of both closed-ended and payment card elicitation methods, Moon and Balasubramanian (2003) demonstrated that consumers in both the United States and the United Kingdom are willing to pay premiums ranging from 10% – 12% and 19 – 35%, respectively, for breakfast cereals made from non-biotech ingredients. Furthermore, Lusk and Hudson (2004) applied the CVM to agribusiness and determined that the method was rigorous and advantageous in evaluating consumer WTP for

novel food products. In light of these studies, the CVM was deemed an appropriate estimation tool for the WTP for certified gluten-free bread.

The questionnaire used for this gluten-free certification study was developed using the web-based survey-building software, Qualtrics. This allowed for easy distribution during data collection. Survey participants were presented with the questionnaire in an electronic form in one of the following ways: (1) via an email link, (2) via a link posted on social media or gluten-free support websites, or (3) via word of mouth.

For response solicitation method (1), email addresses were collected at the Food Allergy Research and Education (FARE) Walk for Food Allergy Boston on Sunday, October 6, 2013, via gluten-free groups at universities such as Tufts University, and through online support groups by providing individuals with a brief summary of the research aims and asking if they were interested in participating. These addresses were then compiled and the survey was sent out with an email asking recipients to take a few minutes to provide their answers. For the FARE walk, permission to solicit email addresses was obtained prior to the start of the event and on October 6, walk individuals were approached as they took part in the festivities of the day and asked if they would be interested in participating in a short survey on gluten-free purchases in the near future. With regards to the universities, both Tufts University and the University of Pittsburg have gluten-free support groups among their students. Leaders of these groups were contacted and requested to pass along information about the survey to their club members. Some students then expressed their interest in the survey by sending their email addresses. The final method of online postings consisted of publicizing a short summary of the research aims on various online gluten-free support groups and allowing interested individuals to send their email addresses to be added to a list of individuals to receive the survey.

Lastly, for response solicitation method (3), links to the survey were posted directly onto social media websites such as Facebook and numerous gluten-free blogs, informing members and readers of the research study and asking for their participation in the survey. This method made participation easy for the partakers because they could instantly click on the provided link, which directed them to the online survey. In this way, interested individuals were likely more prone to participate since they could do so at that moment, rather than receiving an email, which they may put off until another time and subsequently forget.

Moreover, since the survey was internet-based, it could easily be dispersed electronically by the participants, themselves, to other gluten-avoiding acquaintances. Thus, this electronic surveying method was chosen for its far-reaching availability, or its capability of obtaining a large respondent pool, and for its ease in compiling data, eliminating data entry by hand.

The questionnaire also provided participants with a user-friendly survey format, displaying one question per page in an effort to avoid overwhelming participants and to maintain their focus on the specific question at hand. As for length, every effort was made to keep the survey as short as possible. As can be seen in Appendix C, the survey begins with seven questions inquiring about the participant's gluten-free shopping habits and preferences and their familiarity with gluten-free certification. Then, half the participants are primed with a news story about a Durham, North Carolina man who fraudulently sold gluten-containing products as gluten-free, resulting in negative health consequences for several individuals. This is followed by four questions regarding the participant's willingness to pay a premium for certification. The survey ends with eight simple demographic questions, but participants were not asked any identifying information and in effect, could complete the survey with confirmation of anonymity.

Data

Altogether, 1,271 responses were gathered via the three aforementioned solicitation techniques over a one month period. While the survey was open and accessible for a month, the vast majority of these responses came in within a couple days' time. The rapid turnaround on these surveys is likely the result of the gluten-free community consisting of highly engaged individuals that are not overly studied and thus eager to participate in research both to spread awareness for their condition and for the potential benefits that could emerge. After the survey was shut down, responses were imported into Excel spreadsheets and screened for validity. Once all responses were verified and all variables were appropriately labeled in the spreadsheets, the data was imported into Stata for statistical analysis. The sample population was then filtered, dropping observations corresponding to participants who failed to complete the entire questionnaire and those who answered that they were not consumers of gluten-free bread. After this was done, 1,056 usable survey responses remained, a completion rate of about 83%.

Descriptive Statistics

Of those 1,056 gluten-free bread consumers that completed the survey, 692, or 65.53%, were willing to pay the average $6.00 price of a loaf of gluten-free bread, while 579, or 52.83%, would pay a premium for a certified gluten-free loaf. In an effort to obtain a preliminary understanding of the survey response data, descriptive data analyses were run in Stata and data reports were generated using Qualtrics' reporting feature. Survey respondents came from varied backgrounds and encompassed an array of demographic characteristics. These characteristics are summarized in Table 6.

Table 6

Survey participant demographics

Demographic Characteristics	Respondents	Percentage
Gender		
Male	71	6.72
Female	985	93.28
Ethnicity		
White/Caucasian	993	94.03
African American	3	0.28
Asian/Pacific Islander	9	0.85
Hispanic	13	1.23
Indigenous or Aboriginal	1	0.09
Latino	1	0.09
Multiracial	20	1.89
Other	16	1.52
Age		
18 – 24	98	9.28
25 – 34	252	23.86
35 – 44	313	29.64
45 – 54	247	23.39
55 – 64	101	9.56
65 and over	45	4.26
Location		
Urban	234	22.16
Suburban	603	57.10
Rural	219	20.74
Education		
Some high school	7	0.66
High school graduate or equivalent	46	4.36
Vocational/technical school	41	3.88
Some college	256	24.24
College graduate	406	38.45
Postgraduate/professional	300	28.41
Children		
None	488	46.21
One	197	18.66
Two	241	22.82
Three	96	9.09
Four or more	34	3.22
Employment		
Student	94	8.90
Full-time	456	43.18
Part-time	175	16.57

Homemaker	214	20.27
Unemployed	27	2.56
Retired	90	8.52
Income		
Under $25,000	91	8.62
$25,001 - $49,999	168	15.91
$50,000 - $74,999	180	17.05
$75,000 - $99,999	160	15.15
$100,000 - $149,999	162	15.34
$150,000 and over	134	12.69
Prefer not to answer	161	15.25

At about 93%, the sample population was composed almost entirely of females. Race and ethnicity-wise, the white/Caucasian category accounted for the majority of participants, and as for age, about 77% of the participants fell between the ages of 25 and 54, with the mean being the 35 to 44 age group.

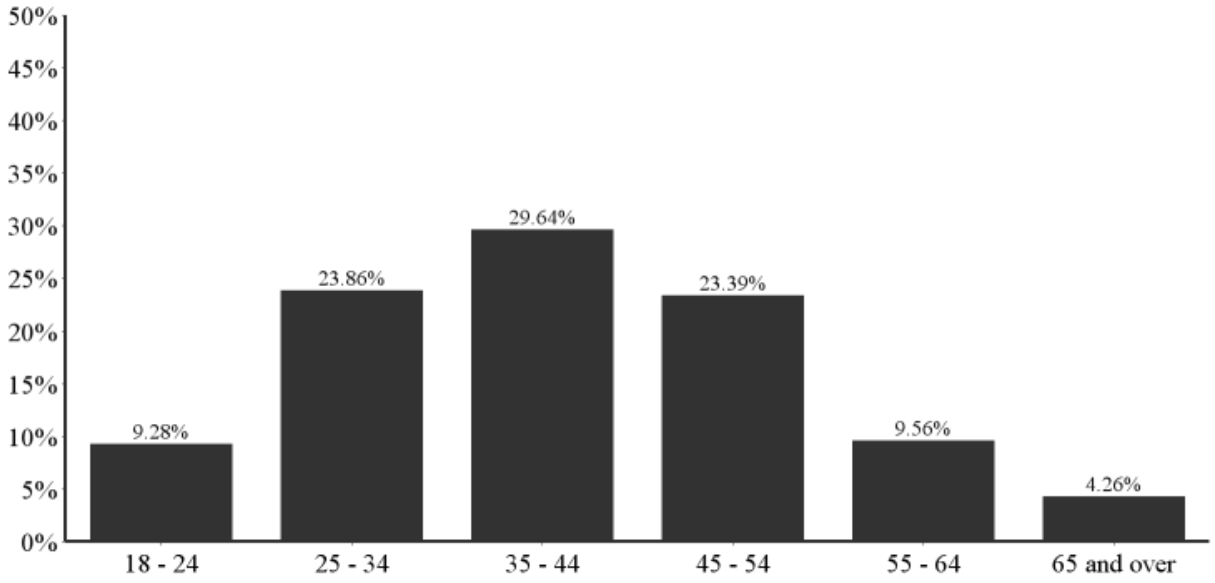

Figure 2. Participants' age

When interpreting Age as a continuous variable, the average age of the participants was about 41 years old. Approximately 57% of the respondents resided in suburban areas and the rest were nearly evenly split between urban and rural regions.

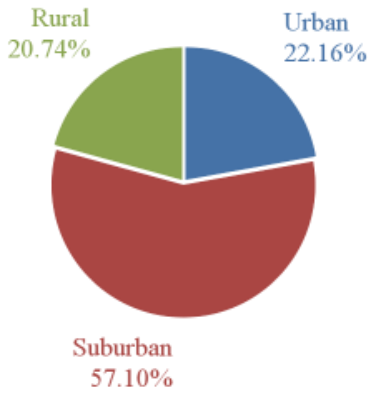

Figure 3. Participants' location of residence

About 67% of the participants held some sort of college degree and about 43% work full-time. Among those that reported their income, the mean range was $75,000 to $99,999, and when interpreted as a continuous variable, Income had a mean of $79,204.99.

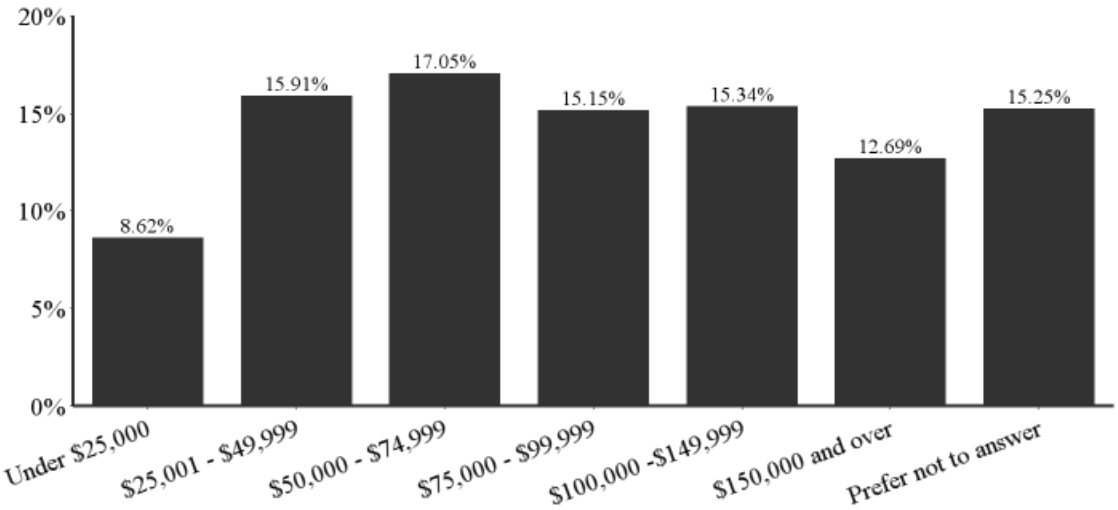

Figure 4. Participants' household income

As for household composition, about 46% of the participants had no children under the age of 18 living in their home, while the mean was one child.

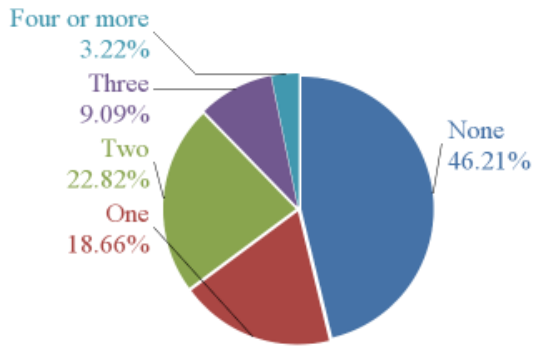

Figure 5. Number of children under age 18 in participants' household

Hypotheses

Based on the hypotheses listed in the introduction, predictions were made regarding the signs of the variable coefficients. Table A.1 in Appendix A provides a description of the major variables and Table A.2 in Appendix A describes the associated sub-variables. The coefficient on Length is hypothesized to be negative size since this continuous variable considers lengths of time purchasing gluten-free bread in ascending order. It is expected that the shorter the time period for which an individual has been shopping for gluten-free bread, the newer they are to the gluten-free diet and the less knowledgeable they are about non-gluten-based bread alternatives or baking at home, whereas people who have been shopping for this bread longer are more accustomed to the diet and possible substitutes.

The coefficient on Frequency is hypothesized to be negative since the survey question associated with this variable provides frequency of purchase choices in ascending order. It is expected that consumers can dedicate a certain amount of their budget to gluten-free bread purchases, and so the more frequently they purchase the bread, the less they can afford to spend on each loaf. Accordingly, an occasional shopper would be capable of spending a steeper price for their bread purchases.

Regarding the coefficients on the sub-variables for Condition, it is expected that participants with allergies and intolerances necessitating gluten-free bread will be willing to pay higher prices than those that chose to buy gluten-free for other personal reasons. Since WA and CD are the conditions in which a strict gluten-free diet is most necessary, it is expected that condition_WA and condition _CD will have the largest, positive coefficients, with that for condition _WI following. It is expected that the coefficients on condition _diet and condition _other will be much smaller and that the coefficient on condition _none will be the smallest since that option is not generally applicable to a gluten-free bread consumer.

It is expected that a shopper would be more willing to pay a larger amount for certified gluten-free bread if they were buying for someone else, such as a child, than they would be if buying for themselves. Furthermore, the Recipient sub-variable recipient_both represents participants shopping for someone else in their household as well as themselves, and is therefore expected to have the largest coefficient since we hypothesized that WTP would increase when participants were shopping for those other than themselves and this variable combines the need to shop for a household member as well as one's self.

Because different types of food retailers vary in price points, customers that typically shop at a certain type are expected to be willing to pay those prices. Specialty stores and bakeries frequently have higher prices than mainstream, chain supermarkets, and so purchase_location_regular is hypothesized to have the smallest, positive coefficient, followed by purchase_location_specialty, and purchase_location_bakery. Since online retailers are often specialty shops and will likely charge shipping costs, purchase_location_online is hypothesized to have the largest, positive coefficient. On the other hand, the purchase_location_bake represents the choice of participants to bake their own gluten-free bread at home and thus, since they do not usually shop for such bread, this variable is hypothesized to have a negative coefficient. In fact, the choice to bake gluten-free bread at home may be the result of an aversion to paying the high price tag.

As for the Knowledge sub-variables, it is expected that willingness to pay for certification will increase with an individual's understanding of what such certification guarantees and also their familiarity with the certification's logo. Ergo, the variable knowledge_both is hypothesized to have the highest, positive coefficient since it relays that consumers are familiar with both the label and its guarantees. The coefficients on knowledge_label and knowledge_guarantees are also hypothesized to be positive. The coefficient on knowledge_neither, however, is hypothesized to be negative since lack of knowledge about the benefits of certification and what to look for in order to recognize a product's certification is expected to decrease a consumer's valuation of certification and subsequently their willingness to pay for such a quality.

The coefficient on Priming is hypothesized to be positive since it is expected that exposure to a story about fraudulent gluten-free claims will cause participants to be wary of

gluten-free assertions and be more willing to pay a higher price for the guarantees that certification provides.

Necessity and Purchasing Conditions

The survey questioned participants why they purchase gluten-free bread and inquired about a variety of purchasing conditions and considerations. First, respondents indicated the length for which they have been purchasing gluten-free bread. At 52%, the majority has been buying this product for three or more years, but when interpreted as a continuous variable, Length had a mean of about 26 months, or just over two years.

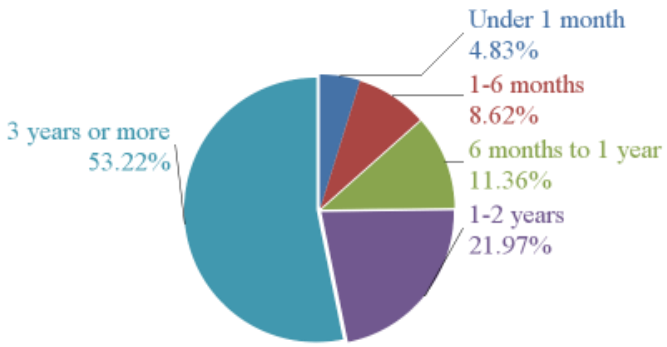

Figure 6. Length participant has been purchasing gluten-free bread

As for frequency of purchase, 77% buy gluten-free bread at least once a month, with the mean being two to three times a month. When interpreted continuously, Frequency had a mean of about 26 purchases per year, or roughly twice a month.

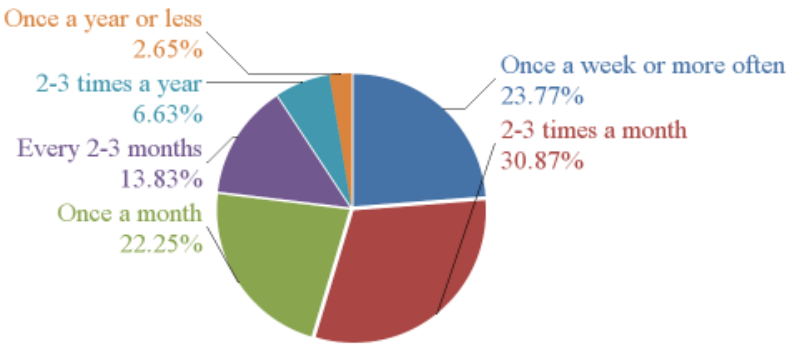

Figure 7. Frequency of gluten-free bread purchases

While 57% of the participants purchased gluten-free bread due to a member of the household having CD, a combined 94% purchased due to either WA, CD, or WI/NCGS.

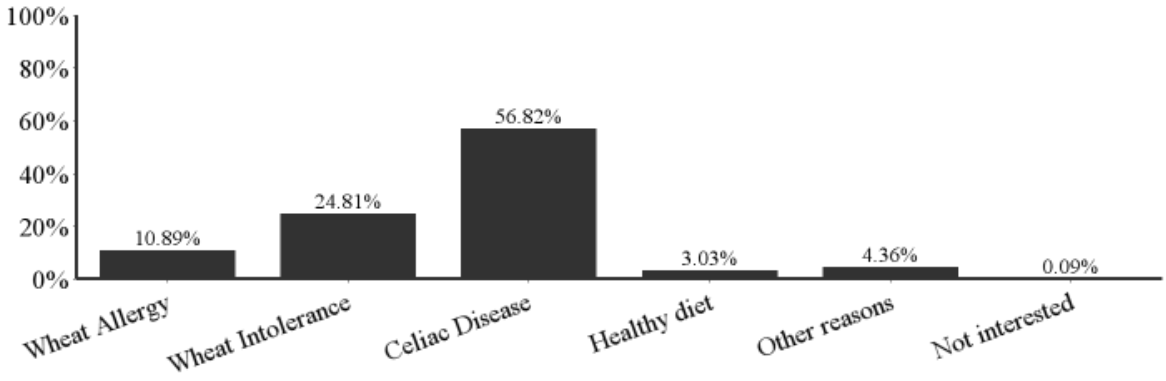

Figure 8. Participants' reason for purchasing gluten-free bread

Furthermore, a majority 53% of participants bought gluten-free bread for solely themselves and 15% bought solely for someone else in their household, 32% purchased gluten free bread for both themselves and someone else.

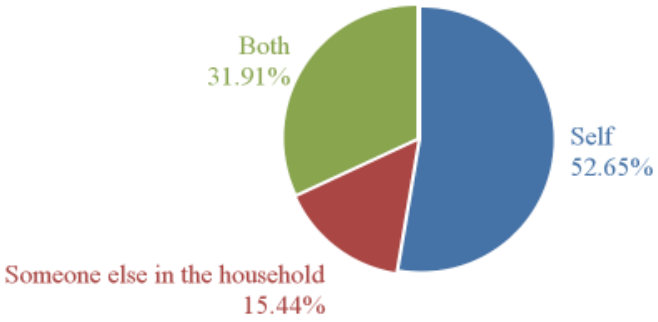

Figure 9. Recipient of gluten-free bread purchases

As for shopping venue, 55% of respondents most often bought their gluten-free bread from regular supermarkets and 8% preferred to bake at home.

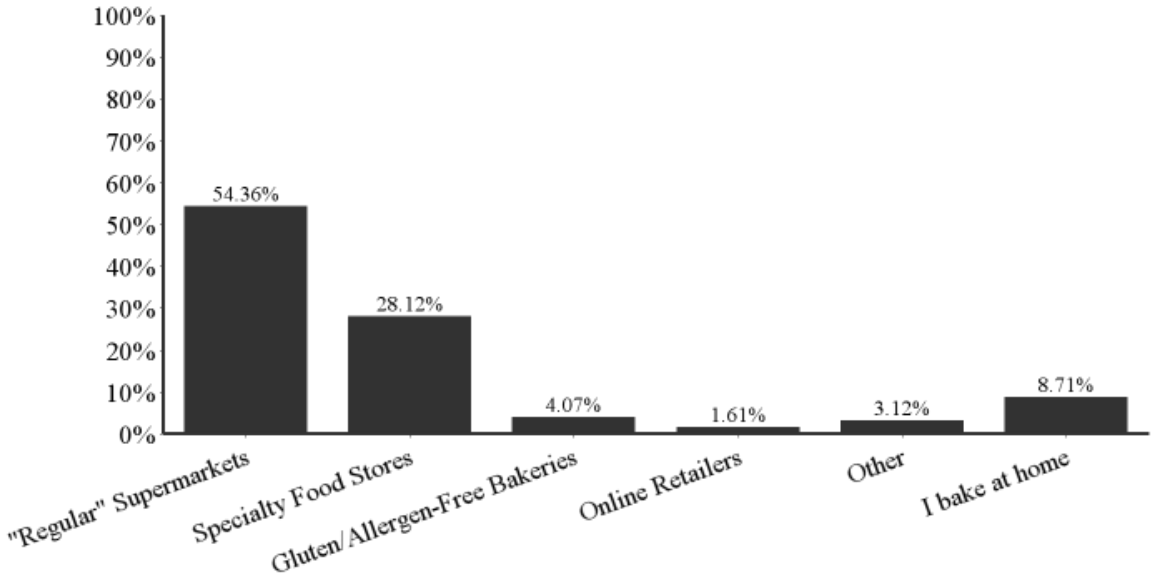

Figure 10. Participants' most frequent shopping venue

The questionnaire also asked participants to indicate their level of familiarity with the "Certified Gluten-Free" label and what it guarantees. A majority of 76% claimed that they were familiar with both the label and what it guarantees, while 5% where familiar with neither.

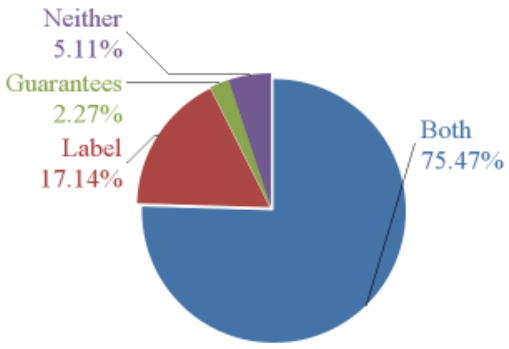

Figure 11. Participants' familiarity with gluten-free certification label and its guarantees

When asked whether they were willing to pay the average price of $6 a loaf for gluten-free bread, 66% of participants responded in the affirmative. When asked to select the maximum price they would be willing to pay for a loaf of certified gluten-free bread, respondents indicated a mean of $6.67. Half of the surveys distributed were primed with the gluten-free fraud story and among those participants that completed the survey, about 49% received this treatment story. The mean maximum WTP price was $6.65 and $6.70 for those primed and unprimed, respectively.

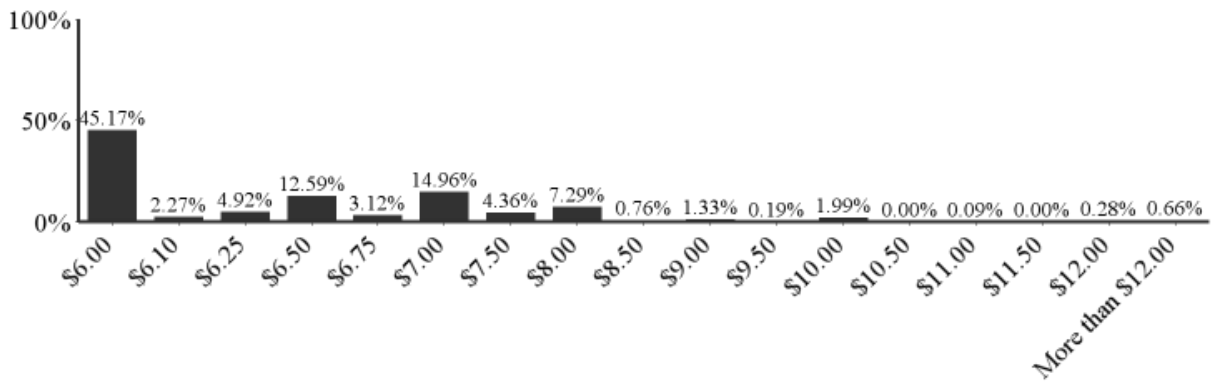

Figure 12. Participants' stated maximum willingness to pay for a certified loaf of gluten-free bread

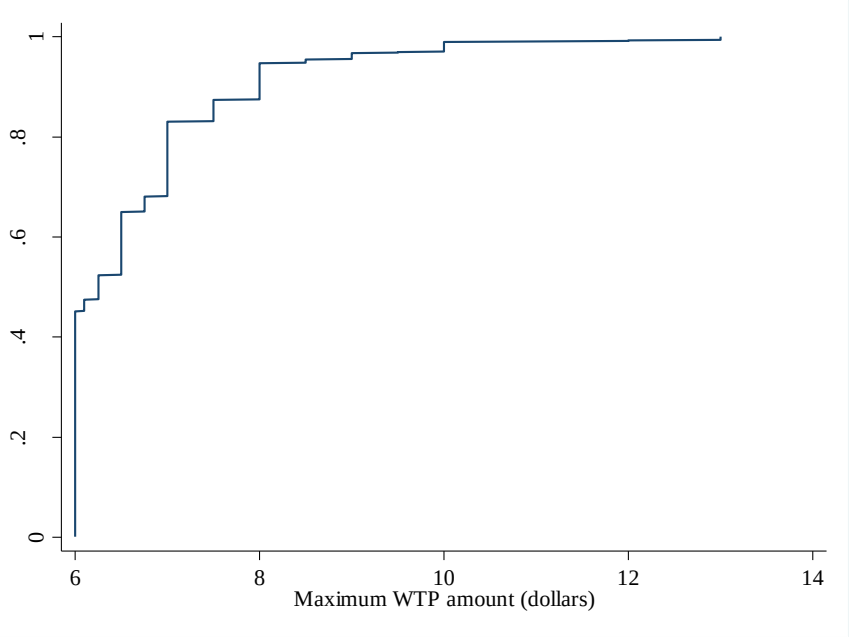

Figure 13. Cumulative graph of the WTP for certified gluten-free bread

As a follow-up to the WTP question, respondents were asked how certain they were of their responses. The majority at 59% were very certain, while only 4% were not at all confident. Those that designated an unwillingness to pay a premium were asked for their rationale, to which 50% responded that they would rather go without bread or bake their own than pay such high prices. The seconded highest percentage choice at 22% was the belief that gluten-free bread is already too expensive. 14% of respondents felt that it is unfair to be charged a premium for certification, 5% felt that certification is unnecessary for their diet, 4% felt that the benefits of certification do not outweigh the costs, and the remaining 5% indicated that they have other reasons for refusing to pay a premium.

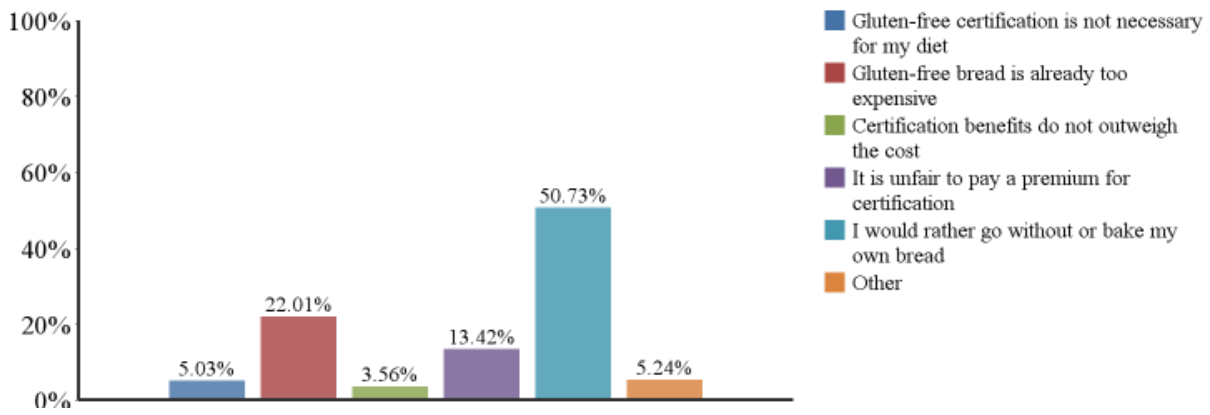

Figure 14. Reasons behind unwillingness to pay a premium

Other statistics of interest are the frequencies with which various product attributes and manufacturing factors are considered at the time of gluten-free bread purchases. These are detailed in Table 7. When choosing which factors they considered in their purchasing decisions, respondents were also asked to rank these factors in order of significance. Table 8 provides the mean rankings for each factor.

Table 7

Factors considered in gluten-free bread purchases

Purchase Considerations	Respondents	Percentage
Flavor	866	82.01
Texture	736	69.70
Density	320	30.30
Dryness	398	37.69
Price	589	55.78
Size of loaf	286	27.08
Visual (ex. rising, browning, etc.)	124	11.74
Type (white, multigrain)	367	34.75
Nutritional content (calories, low sodium, high fiber, etc.)	322	30.49
Brand name (Udi's, Rudi's Ener-G, etc.)	326	30.87
"Certified Gluten-Free" label	574	54.36
Dedicated gluten-free facility	388	36.74
Dedicated gluten-free production line	233	22.06

Table 8

Mean ranks for each factor considered in gluten-free bread purchases

Variable	Mean
FlavorRank	2.29
TextureRank	2.93
DensityRank	4.45
DrynessRank	4.27
PriceRank	3.82
SizeRank	5.00
VisualRank	6.24
TypeRank	4.66
NutrientsRank	4.20
BrandRank	4.40
CertificationRank	3.10
FacilityRank	3.56
ProductionRank	4.10

Results

Maximum Willingness to Pay

Even though the Tobit model was chosen to avoid the downward bias that OLS results would incur because of the large proportion of $6.00 WTP responses, before running the Tobit estimations, exploratory analyses via OLS were used to obtain easily interpretable coefficients. These analyses provided an idea of which variables significantly impact WTP for gluten-free certification and whether this impact is positive or negative.

The principal OLS regression in these analyses took the respondents' maximum WTP amount as the independent variable and all demographic, purchasing pattern, and decision-making variables as independent variables. The results of this regression are shown in Table 9 below.

Table 9

OLS regression results for coefficients on determinants of maximum willingness to pay

Variable	MaxWillingness
male	-0.120
	(0.13)
ethnicity_white	-0.283
	(0.25)
ethnicity_african_american	-0.735
	(0.65)
ethnicity_asian	-0.079
	(0.43)
ethnicity_hispanic	-0.387
	(0.38)
ethnicity_idigenous	0.193
	(1.05)
ethnicity_latino	-1.183
	(1.04)
ethnicity_multiracial	-0.389

	(0.34)
ethnicity_other	.
	.
Age	-0.010***
	(0.00)
location_urban	-0.173*
	(0.10)
location_suburban	-0.218***
	(0.08)
location_rural	.
	.
education_some_high	.
	.
education_high_school	0.171
	(0.41)
education_technical	-0.072
	(0.42)
education_some_college	-0.037
	(0.39)
education_college	0.040
	(0.39)
education_postgrad	0.025
	(0.39)
employment_student	0.260
	(0.19)
employment_full	0.116
	(0.14)
employment_part	0.090
	(0.15)
employment_homemaker	0.214
	(0.15)
employment_unemployed	0.355
	(0.23)
employment_retired	.
	.
Income	0.000**
	(0.00)
Frequency	0.005**
	(0.00)
purchase_location_regular	.
	.
purchase_location_specialty	0.292***
	(0.07)
purchase_location_bakery	0.881***
	(0.17)
purchase_location_online	0.248

	(0.25)
purchase_location_other	-0.003
	(0.19)
purchase_location_bake	0.133
	(0.12)
Children	-0.027
	(0.03)
recipient_self	.
	.
recipient_other	-0.066
	(0.10)
recipient_both	-0.118
	(0.08)
condition_WA	-0.162
	(0.21)
condition_WI	-0.240
	(0.19)
condition_CD	-0.074
	(0.19)
condition_diet	.
	.
condition_other	-0.286
	(0.24)
condition_none	-0.453
	(1.04)
Length	-0.002
	(0.00)
knowledge_both	0.144
	(0.15)
knowledge_label	0.070
	(0.16)
knowledge_guarantees	-0.017
	(0.25)
knowledge_neither	.
	.
Priming	-0.035
	(0.06)
Flavor	-0.018
	(0.08)
Texture	0.007
	(0.07)
Density	0.017
	(0.08)
Dryness	0.060
	(0.07)
Price	-0.358***

	(0.07)
Size	0.039
	(0.08)
Visual	-0.045
	(0.10)
Type	0.038
	(0.07)
Nutrients	-0.069
	(0.07)
Brand	0.064
	(0.07)
Certification	0.158**
	(0.07)
Facility	0.157**
	(0.07)
ProductionLine	0.014
	(0.09)
certainty_very	0.086
	(0.17)
certainty_fairly	0.155
	(0.17)
certainty_not	.
	.
_cons	7.057***
	(0.58)

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Of all the independent variables included in this regression, those that proved to be statistically significant are Age, location_urban, location_suburban, Income, Frequency, purchase_location_specialty, purchase_location_bakery, Price, Certification, and Facility.

Next, Tobit regressions were run on the maximum WTP and the log of the maximum WTP in an effort to reveal which model most closely reflects the data. In these regressions, lower limits were taken to be $6.00 and the log of $6.00, respectively, while upper limits were taken to be $13.00 and the log of $13.00, respectively. The results of these estimations can be

seen in Table 10 and the marginal effects of each variable on WTP and the log of WTP can be seen in Tables 11 and 12, respectively.

Table 10

Regression results for Tobit regressions on maximum WTP and the log of maximum WTP

Variable	MaxWillingness	ln(MaxWillingness)
male	-0.274	-0.036
	(0.22)	(0.03)
ethnicity_white	-0.281	-0.031
	(0.42)	(0.05)
ethnicity_african_american	-1.366	-0.176
	(1.33)	(0.17)
ethnicity_asian	0.138	0.024
	(0.70)	(0.09)
ethnicity_hispanic	-0.427	-0.046
	(0.63)	(0.08)
ethnicity_idigenous	0.751	0.117
	(1.60)	(0.21)
ethnicity_latino	-9.683	-1.258
	(0.00)	(0.00)
ethnicity_multiracial	-0.540	-0.063
	(0.57)	(0.07)
ethnicity_other	.	.
	.	.
Age	-0.017***	-0.002***
	(0.01)	(0.00)
location_urban	-0.296*	-0.038*
	(0.17)	(0.02)
location_suburban	-0.440***	-0.057***
	(0.14)	(0.02)
location_rural	.	.
	.	.
education_some_high	.	.
	.	.
education_high_school	0.093	0.008
	(0.72)	(0.09)
education_technical	-0.192	-0.032
	(0.72)	(0.09)
education_some_college	-0.079	-0.010
	(0.68)	(0.09)

education_college	0.031	0.002
	(0.68)	(0.09)
education_postgrad	0.031	0.004
	(0.68)	(0.09)
employment_student	0.498	0.065
	(0.33)	(0.04)
employment_full	0.194	0.027
	(0.24)	(0.03)
employment_part	0.235	0.034
	(0.26)	(0.03)
employment_homemaker	0.355	0.047
	(0.26)	(0.03)
employment_unemployed	0.505	0.063
	(0.40)	(0.05)
employment_retired	.	.
	.	.
Income	0.000***	0.000***
	(0.00)	(0.00)
Frequency	0.009***	0.001***
	(0.00)	(0.00)
purchase_location_regular	.	.
	.	.
purchase_location_specialty	0.455***	0.056***
	(0.12)	(0.02)
purchase_location_bakery	1.258***	0.159***
	(0.26)	(0.03)
purchase_location_online	0.416	0.055
	(0.42)	(0.05)
purchase_location_other	-0.071	-0.008
	(0.33)	(0.04)
purchase_location_bake	0.068	0.006
	(0.21)	(0.03)
Children	-0.086	-0.013*
	(0.05)	(0.01)
recipient_self	.	.
	.	.
recipient_other	-0.043	-0.004
	(0.16)	(0.02)
recipient_both	-0.143	-0.016
	(0.13)	(0.02)
condition_WA	-0.165	-0.014
	(0.36)	(0.05)
condition_WI	-0.285	-0.031
	(0.33)	(0.04)
condition_CD	-0.052	-0.002
	(0.33)	(0.04)

condition_diet	.	.
	.	.
condition_other	-0.414	-0.047
	(0.41)	(0.05)
condition_none	0.398	0.070
	(1.61)	(0.21)
Length	-0.003	-0.000
	(0.00)	(0.00)
knowledge_both	0.369	0.054
	(0.26)	(0.03)
knowledge_label	0.229	0.034
	(0.28)	(0.04)
knowledge_guarantees	0.143	0.025
	(0.44)	(0.06)
knowledge_neither	.	.
	.	.
Priming	-0.068	-0.009
	(0.10)	(0.01)
Flavor	0.021	0.005
	(0.14)	(0.02)
Texture	0.016	0.002
	(0.12)	(0.02)
Density	0.055	0.006
	(0.13)	(0.02)
Dryness	0.133	0.016
	(0.12)	(0.02)
Price	-0.658***	-0.089***
	(0.12)	(0.02)
Size	0.019	0.003
	(0.13)	(0.02)
Visual	-0.032	-0.007
	(0.17)	(0.02)
Type	0.065	0.009
	(0.12)	(0.01)
Nutrients	-0.091	-0.011
	(0.12)	(0.02)
Brand	0.152	0.018
	(0.12)	(0.02)
Certification	0.294***	0.039***
	(0.11)	(0.01)
Facility	0.219*	0.027*
	(0.12)	(0.02)
ProductionLine	0.040	0.005
	(0.14)	(0.02)
certainty_very	0.346	0.048
	(0.31)	(0.04)

certainty_fairly	0.745**	0.105***
	(0.31)	(0.04)
certainty_not	.	.
	.	.
_cons	5.907***	1.769***
	(1.01)	(0.13)
sigma	1.508***	0.195***
	(0.05)	(0.01)
LR chi^2	193.76	200.50
Prob > chi^2	0.0000	0.0000
Log-likelihood	-1361.83	-200.97

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 11

Marginal effects of dependent variables on maximum WTP

Variable	dy/dx	Std. Err.	z	P>z	[95% Conf.	Interval]
male	-.0054634	.0044273	-1.23	0.217	-.0141408	.0032139
ethnicity_white	-.0055903	.0084187	-0.66	0.507	-.0220905	.01091
ethnicity_african_american	-.0271952	.0265155	-1.03	0.305	-.0791646	.0247741
ethnicity_asian	.0027462	.0140045	0.20	0.845	-.024702	.0301944
ethnicity_hispanic	-.0085032	.0126543	-0.67	0.502	-.0333051	.0162987
ethnicity_idigenous	.0149611	.0319149	0.47	0.639	-.0475909	.0775131
ethnicity_latino	-.1928482	.0100612	-19.17	0.000	-.2125679	-.1731285
ethnicity_multiracial	-.0107623	.0113309	-0.95	0.342	-.0329703	.0114458
ethnicity_other	0	(omitted)				
Age	-.0003302	.0001187	-2.78	0.005	-.0005629	-.0000975
location_urban	-.0058868	.0033225	-1.77	0.076	-.0123988	.0006253
location_suburban	-.0087698	.0027661	-3.17	0.002	-.0141913	-.0033483
location_rural	0	(omitted)				
education_some_high	0	(omitted)				
education_high_school	.0018504	.0142939	0.13	0.897	-.0261651	.0298659
education_technical	-.0038344	.0144174	-0.27	0.790	-.032092	.0244231
education_some_college	-.0015712	.0135721	-0.12	0.908	-.0281719	.0250296
education_college	.0006217	.0135021	0.05	0.963	-.0258419	.0270852
education_postgrad	.0006082	.0135735	0.04	0.964	-.0259955	.0272118
employment_student	.0099112	.0065596	1.51	0.131	-.0029453	.0227677
employment_full	.0038612	.0048003	0.80	0.421	-.0055472	.0132697
employment_part	.0046894	.0051745	0.91	0.365	-.0054524	.0148313

employment_homemaker	.0070788	.0052211	1.36	0.175	-.0031544	.017312
employment_unemployed	.0100511	.0079084	1.27	0.204	-.005449	.0255512
employment_retired	0	(omitted)				
Income	9.22e-08	2.54e-08	3.63	0.000	4.25e-08	1.42e-07
Frequency	.0001774	.0000604	2.94	0.003	.0000591	.0002957
purchase_location_regular	0	(omitted)				
purchase_location_specialty	.0090595	.002466	3.67	0.000	.0042263	.0138927
purchase_location_bakery	.0245823	.0051299	4.79	0.000	.014528	.0346367
purchase_location_online	.0082857	.0083767	0.99	0.323	-.0081323	.0247036
purchase_location_other	-.0014205	.0065984	-0.22	0.830	-.0143532	.0115121
purchase_location_bake	.0013693	.0042052	0.33	0.745	-.0068728	.0096114
Children	-.0017061	.0010906	-1.56	0.118	-.0038436	.0004314
recipient_self						
recipient_other	-.0008498	.0032732	-0.26	0.795	-.0072651	.0055655
recipient_both	-.0028447	.0026233	-1.08	0.278	-.0079863	.0022968
condition_WA	-.0032777	.0070832	-0.46	0.644	-.0171606	.0106052
condition_WI	-.0056761	.0065983	-0.86	0.390	-.0186084	.0072563
condition_CD	-.0010214	.006537	-0.16	0.876	-.0138337	.0117908
condition_diet						
condition_other	-.0082703	.0081983	-1.01	0.313	-.0243387	.007798
condition_none	.0078207	.0313407	0.25	0.803	-.0536059	.0692473
Length	-.0000602	.0000784	-0.77	0.442	-.0002138	.0000934
knowledge_both	.0073961	.0053095	1.39	0.164	-.0030103	.0178025
knowledge_label	.0046084	.0057195	0.81	0.420	-.0066016	.0158183
knowledge_guarantees	.002882	.0087972	0.33	0.743	-.0143602	.0201241
knowledge_neither						
Priming	-.0013593	.0020894	-0.65	0.515	-.0054544	.0027358
Flavor	.0004251	.0028425	0.15	0.881	-.0051462	.0059963
Texture	.0003221	.0024681	0.13	0.896	-.0045152	.0051594
Density	.0010998	.0025081	0.44	0.661	-.0038161	.0060156
Dryness	.0026463	.0024194	1.09	0.274	-.0020957	.0073883
Price	-.0130976	.0023763	-5.51	0.000	-.017755	-.0084402
Size	.0003761	.0026415	0.14	0.887	-.0048012	.0055533
Visual	-.0006332	.0034555	-0.18	0.855	-.0074058	.0061393
Type	.0012998	.0022975	0.57	0.572	-.0032032	.0058027
Nutrients	-.0018063	.0024285	-0.74	0.457	-.0065661	.0029534
Brand	.0030205	.0023791	1.27	0.204	-.0016425	.0076835
Certification	.0058576	.0022244	2.63	0.008	.0014978	.0102173
Facility	.0043566	.002476	1.76	0.078	-.0004962	.0092094
ProductionLine	.0007974	.00285	0.28	0.780	-.0047885	.0063832
certainty_very	.0068924	.0061812	1.12	0.265	-.0052225	.0190074
certainty_fairly	.0148416	.0062635	2.37	0.018	.0025654	.0271178
certainty_not	0	(omitted)				

Note: dy/dx for factor levels is the discrete change from the base level.

Table 12

Marginal effects of dependent variables on the log of maximum WTP

Variable	dy/dx	Std. Err.	z	P>z	[95% Conf.	Interval]
male	-.014316	.0113902	-1.26	0.209	-.0366403	.0080083
ethnicity_white	-.0122433	.0216877	-0.56	0.572	-.0547504	.0302638
ethnicity_african_american	-.0699624	.068717	-1.02	0.309	-.2046452	.0647205
ethnicity_asian	.0096226	.0360934	0.27	0.790	-.0611192	.0803643
ethnicity_hispanic	-.0182838	.0325738	-0.56	0.575	-.0821273	.0455597
ethnicity_idigenous	.0465474	.082392	0.56	0.572	-.114938	.2080328
ethnicity_latino	-.4990379	.0115497	-43.21	0.000	-.5216749	-.4764008
ethnicity_multiracial	-.0251853	.0291643	-0.86	0.388	-.0823463	.0319757
ethnicity_other	0	(omitted)				
Age	-.00086	.0003045	-2.82	0.005	-.0014568	-.0002632
location_urban	-.0151507	.0085437	-1.77	0.076	-.0318961	.0015947
location_suburban	-.0225548	.0070964	-3.18	0.001	-.0364636	-.008646
location_rural	0	(omitted)				
education_some_high						
education_high_school	.0033456	.0369951	0.09	0.928	-.0691635	.0758546
education_technical	-.0120504	.0367248	-0.33	0.743	-.0840297	.0599289
education_some_college	-.0037743	.0349676	-0.11	0.914	-.0723095	.0647609
education_college	.0009935	.0348201	0.03	0.977	-.0672527	.0692396
education_postgrad	.0016218	.0350098	0.05	0.963	-.0669962	.0702397
employment_student	.0257705	.0168681	1.53	0.127	-.0072904	.0588315
employment_full	.0107929	.0123415	0.87	0.382	-.013396	.0349819
employment_part	.013324	.0133077	1.00	0.317	-.0127587	.0394067
employment_homemaker	.0185734	.0134237	1.38	0.166	-.0077366	.0448835
employment_unemployed	.0250328	.0203371	1.23	0.218	-.0148273	.0648929
employment_retired	0	(omitted)				
Income	2.45e-07	6.50e-08	3.76	0.000	1.17e-07	3.72e-07
Frequency	.000463	.0001548	2.99	0.003	.0001596	.0007665
purchase_location_regular	0	(omitted)				
purchase_location_specialty	.0225616	.0065295	3.46	0.001	.0097639	.0353592
purchase_location_bakery	.0732337	.0186334	3.93	0.000	.0367129	.1097546
purchase_location_online	.0221618	.0235517	0.94	0.347	-.0239986	.0683222
purchase_location_other	-.003053	.0152558	-0.20	0.841	-.0329537	.0268478
purchase_location_bake	.0024204	.010161	0.24	0.812	-.0174948	.0223356
Children	-.0050773	.002809	-1.81	0.071	-.0105828	.0004282
recipient_self	0	(omitted)				
recipient_other	-.0017337	.0084972	-0.20	0.838	-.0183879	.0149205
recipient_both	-.0061157	.0066681	-0.92	0.359	-.019185	.0069536
condition_WA	-.0057503	.0188073	-0.31	0.760	-.042612	.0311114
condition_WI	-.0121418	.0175276	-0.69	0.488	-.0464952	.0222116
condition_CD	-.0006901	.0175219	-0.04	0.969	-.0350325	.0336522

condition_diet	0	(omitted)				
condition_other	-.0179658	.0207417	-0.87	0.386	-.0586188	.0226873
condition_none	.0316245	.1023042	0.31	0.757	-.1688882	.2321371
Length	-.0001355	.0002017	-0.67	0.502	-.0005308	.0002599
knowledge_both	.0202537	.01195	1.69	0.090	-.0031679	.0436753
knowledge_label	.0125004	.013031	0.96	0.337	-.0130399	.0380406
knowledge_guarantees	.0088274	.0205642	0.43	0.668	-.0314777	.0491326
knowledge_neither	0	(omitted)				
Priming	-.0035973	.0053777	-0.67	0.504	-.0141373	.0069428
Flavor	.0019805	.0073217	0.27	0.787	-.0123698	.0163308
Texture	.000705	.0063514	0.11	0.912	-.0117435	.0131536
Density	.0023856	.0064602	0.37	0.712	-.0102761	.0150473
Dryness	.0063724	.0062277	1.02	0.306	-.0058337	.0185784
Price	-.0353313	.0060383	-5.85	0.000	-.0471662	-.0234964
Size	.0013779	.0067966	0.20	0.839	-.0119432	.014699
Visual	-.0029501	.0089029	-0.33	0.740	-.0203993	.0144992
Type	.0037216	.0059131	0.63	0.529	-.0078679	.015311
Nutrients	-.0041673	.0062462	-0.67	0.505	-.0164097	.0080751
Brand	.0071069	.0061235	1.16	0.246	-.0048948	.0191087
Certification	.0156164	.00571	2.73	0.006	.004425	.0268078
Facility	.0105435	.0063616	1.66	0.097	-.0019251	.0230121
ProductionLine	.0019131	.0073413	0.26	0.794	-.0124755	.0163018
certainty_very	.0189116	.0159178	1.19	0.235	-.0122868	.05011
certainty_fairly	.0417158	.0161328	2.59	0.010	.0100962	.0733354
certainty_not	0	(omitted)				

Note: dy/dx for factor levels is the discrete change from the base level.

The overall significance of a Tobit regression model can be determined by the magnitude of the regression's chi-squared and "Prob > chi-squared" statistics. The ideal chi-squared statistic is as large as possible, while the "Prob > chi-squared" statistic should be as small as possible. The chi-squared and "Prob > chi-squared" statistics for the WTP model are 193.76 and 0.0000, respectively, while those of the log of WTP model are 200.50 and 0.0000, respectively. Both models exhibit large chi-squared values and 0.0000 "Prob > chi-squared" values, implying that both are statistically significant, even at the 0.01% level. In other words, both equations reject the null hypothesis that all independent variable coefficients are equal to zero. However, since the log model has a higher chi-squared statistic, this model is deemed the better fit to the data.

In order to arrive at a final, condensed regression model, the "kitchen sink" log of WTP model is gleaned via a multi-step process. First, the full model is regressed and any variables that are not significant even at the 10% level are removed. From there, one variable is added back into the model at a time, removing insignificant variables and retaining significant variables. When a categorical variable is statistically significant, its associated categorical variables are kept in the model in order to establish a base case from which to interpret coefficients. Once the "best" model is obtained from the data and variables at hand, the overall significance of the model is checked. Table 13 provides the final regression results and Table 14 states the marginal effects of the included variables.

Table 13

Regression results for the final Tobit model of the log of WTP

Variable	ln(MaxWillingness)
Age	-0.003***
	(0.00)
location_urban	-0.041*
	(0.02)
location_suburban	-0.057***
	(0.02)
location_rural	.
	.
Income	0.000***
	(0.00)
Frequency	0.001***
	(0.00)
purchase_location_regular	.
	.
purchase_location_specialty	0.053***
	(0.02)
purchase_location_bakery	0.154***
	(0.03)
purchase_location_online	0.063
	(0.05)
purchase_location_other	-0.007

	(0.04)
purchase_location_bake	0.000
	(0.03)
Children	-0.014**
	(0.01)
Price	-0.090***
	(0.01)
Certification	0.043***
	(0.01)
Facility	0.035**
	(0.01)
certainty_very	0.050
	(0.04)
certainty_fairly	0.107***
	(0.04)
certainty_not	.
	.
_cons	1.834***
	(0.05)
sigma	0.198***
	(0.01)
LR chi^2	176.66
Prob > chi^2	0.0000
Log-likelihood	-212.89

Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Table 14

Marginal effects of the dependent variables in the final log of WTP model

Variable	dy/dx	Std. Err.	z	P>z	[95% Conf.	Interval]
Age	-.0011984	.0002313	-5.18	0.000	-.0016518	-.0007451
location_urban	-.0160318	.008317	-1.93	0.054	-.0323329	.0002692
location_suburban	-.0224049	.0070242	-3.19	0.001	-.0361721	-.0086377
location_rural	0	(omitted)				
Income	2.58e-07	6.19e-08	4.17	0.000	1.37e-07	3.79e-07
Frequency	.0004564	.0001462	3.12	0.002	.0001697	.000743
purchase_location_regular						
purchase_location_specialty	.0211849	.0063917	3.31	0.001	.0086575	.0337124
purchase_location_bakery	.0706979	.0179503	3.94	0.000	.0355159	.1058799
purchase_location_online	.0255223	.0236929	1.08	0.281	-.0209149	.0719595
purchase_location_other	-.0026747	.0150451	-0.18	0.859	-.0321626	.0268131
purchase_location_bake	.0000145	.009776	0.00	0.999	-.019146	.019175

Children	-.0053606	.0024633	-2.18	0.030	-.0101885	-.0005327
Price	-.0356027	.0055634	-6.40	0.000	-.0465067	-.0246986
Certification	.017125	.0055595	3.08	0.002	.0062286	.0280214
Facility	.0137457	.0056656	2.43	0.015	.0026413	.0248502
certainty_very						
certainty_fairly	.0173249	.0127278	1.36	0.173	-.0076211	.0422709
certainty_not	.0404995	.0131977	3.07	0.002	.0146325	.0663665

Note: dy/dx for factor levels is the discrete change from the base level.

The chi-squared statistic in this concise model is 176.66 and the "Prob > chi-squared" statistic is 0.0000. As expected, this model is statistically significant, even at the 0.01% level. Furthermore, since this model is a log-level model, it is implied that a change in one of the dependent variables leads to a constant percentage change in WTP. Thus, when interpreting the marginal effects listed in Table 14, multiplying a given effect by 100 reveals the percentage change that the associated dependent variable causes in one's WTP.

The first variable that proved to be statistically significant was the continuous age variable. With a coefficient of -0.003 and a p-value of 0.000, age proved to be significant even at the 0.01% level. The negative nature of the marginal effect implies that an increase of 1 year in age induces a 0.12% decrease in WTP for gluten-free certification.

When compared to the base case of living in a rural area, both living in suburban and living in urban areas were significant influences in one's WTP for certification. With coefficients of 0.001 and 0.054, these variables were statistically significant at the 0.1% and 10% levels, respectively. The negative marginal effects tell us that living in either of these location types results in a drop from the WTP of those living in rural areas. Specifically, living in a suburban area causes a 2.24% decrease, and living in an urban area causes a 1.6% decrease.

With a p-value of 0.000, household income proved to be another highly significant dependent variable, remaining significant even at that 0.01% level. Because income was coded in terms of dollars, Table 14 reports a coefficient of 0.000, but as seen in Table B.4 in Appendix

B, income has a positive coefficient of $6.53x10^{-7}$. Since income has a positive marginal effect, a $10,000 increase in household income induces a 0.26% increase in WTP for gluten-free certification.

Another significant variable in the model is the continuous variable representing the frequency of gluten-free bread purchases. This frequency variable had a coefficient of 0.001 and a p-value of 0.002, signifying statistical significance at the 1% level. The positive marginal effect of frequency implies that a one unit increase in frequency, or the purchase of one more loaf of gluten-free bread a year, increases WTP for certification by 0.05%.

The next couple of significant variables in the log-level WTP model come from the group of categorical variables describing a consumer's typical shopping venue. Compared to the base case of shopping at regular supermarkets, shopping at specialty stores and shopping at gluten-free bakeries were both significant, and with p-values of 0.001 and 0.000, respectively, they were statistically significant even at the 0.01% level. The positive marginal effect of the variable for shopping at specialty stores reveals that shopping at these locations increases WTP 2.12% over the WTP for certification at regular supermarkets, while the marginal effect of choosing gluten-free bakeries denotes an increase in WTP of 7.07% over that when regular supermarkets are frequented.

When controlling for the consumers that bake most of their gluten-free bread at home, the mean WTP amount was about $6.98, a premium of $0.98. T-tests reject the null hypothesis that there is no difference between the mean WTP of this population and the mean WTP for the whole sample in favor of the alternative that the mean WTP of those who bake at home is less than that of the whole population.

Table 15

Two-sample t test of total and bake at home mean WTP amounts with equal variances

ln(MaxWillingness)	Obs	Mean	Std. Err.	Std. Dev.	[95% Conf. Interval]	
Unrestricted	1056	1.962517	.0011623	.0377692	1.960236	1.964797
Bake at home	92	1.943043	.0030587	.0293384	1.936967	1.949119
Combined	1148	1.960956	.0011076	.0375282	1.958783	1.963129
diff		.0194733	.0040405		.0115457	.0274008

diff = mean(Unrestricted) - mean(Bake at home) t = 4.8195

Ho: diff = 0 degrees of freedom = 1146

Ha: diff < 0 Ha: diff != 0 Ha: diff > 0

Pr(T < t) = 1.0000 Pr(T > t) = 0.0000 Pr(T > t) = 0.0000

Table 16

Two-sample t test of total and bake at home mean WTP amounts with unequal variances

ln(MaxWillingness)	Obs	Mean	Std. Err.	Std. Dev.	[95% Conf. Interval]	
Unrestricted	1056	1.962517	.0011623	.0377692	1.960236	1.964797
Bake at home	92	1.943043	.0030587	.0293384	1.936967	1.949119
Combined	1148	1.960956	.0011076	.0375282	1.958783	1.963129
diff		.0194733	.0032721		.0129941	.0259524

diff = mean(Unrestricted) - mean(Bake at home) t = 5.9513

Ho: diff = 0 Satterthwaite's degrees of freedom = 118.962

Ha: diff < 0 Ha: diff != 0 Ha: diff > 0

Pr(T < t) = 1.0000 Pr(T > t) = 0.0000 Pr(T > t) = 0.0000

The number of children in one's household was also a significant determinant of WTP. With a coefficient of -0.014 and a p-value of 0.030, this variable was statistically significant at the 5% level. Furthermore, the negative marginal effect implies that an increase of one child in a

household reduces WTP for certification by 0.54%.

The next several significant variables come from the group of potential factors that consumers consider when deciding whether to purchase a given loaf of gluten-free bread. The three that proved to be significant in affecting WTP for certified loaves were price of the loaf, certification status, and the use of a dedicated gluten-free facility during manufacture. With p-values of 0.000, 0.002, and 0.015, these factors were statistically significant at the 0.01%, 1%, and 5%, respectively. The negative marginal effect of price indicates that considering price in one's purchase decision-making reduces their WTP for certification by 3.56%. On the other hand, the positive marginal effects of valuing certification status and of valuing the use of a dedicated facility reveal that these considerations increase WTP by 1.71% and 1.37%, respectively.

Finally, when compared to the base case of having no confidence in one's stated maximum WTP for a certified loaf of gluten-free bread, being fairly certain was statistically significant at the 1% level with a p-value of 0.007. The positive marginal effect implies that being fairly confident in one's response increased their WTP by 1.73% when compared to being uncertain.

As can be seen from their absence from the final regression model, none of the following were statistically significant, even at the 10% level: gender, ethnicity, education, employment, recipient of bread purchases, condition requiring a gluten-free diet, length time since beginning to purchase gluten-free bread, knowledge about gluten-free certification, priming with a fraud story, and the consideration of flavor, texture, density, dryness, size, visual characteristics, nutritional contents, brand name or use of a dedicated gluten-free production line in making a purchasing decision.

The insignificance of the dummy variable indicating that a consumer considered the use of a dedicated production line in the manufacturing of gluten-free bread, while that for considering the use of a dedicated facility was significant prompted further examination:

Table 17

Tobit results of regression of the consideration of solely a dedicated production line (i.e. a dedicated facility is not considered) on the log of the maximum WTP

Variable	ln(MaxWillingness)
ProductionLine_NoFacility	-0.029
	(0.03)
_cons	1.816***
	(0.01)
sigma	0.214***
	(0.01)
LR chi^2	0.88
Prob > chi^2	0.3476
Log-likelihood	-280.84

Table 18

Marginal effects from Tobit regression of the consideration of solely a dedicated production line on the log of the maximum WTP

Variable	dy/dx	Std. Err.	z	P>z	[95% Conf.	Interval]
ProductionLine_NoFacility	-.0111857	.0119387	-0.94	0.349	-.0345852	.0122137

Note: dy/dx for factor levels is the discrete change from the base level.

Table 19

Tobit results of regressions of the consideration of dedicated facilities, the consideration of dedicated facilities and/or productions lines, and the consideration of both dedicated facilities and dedicated production lines on the log of the maximum WTP

Variable	ln(MaxWillingness)	ln(MaxWillingness)	ln(MaxWillingness)
Age	-0.003***	-0.003***	-0.003***
	(0.00)	(0.00)	(0.00)
location_urban	-0.041*	-0.041*	-0.041*
	(0.02)	(0.02)	(0.02)
location_suburban	-0.057***	-0.057***	-0.054***
	(0.02)	(0.02)	(0.02)
location_rural	.	.	.
	.	.	.
Income	0.000***	0.000***	0.000***
	(0.00)	(0.00)	(0.00)
Frequency	0.001***	0.001***	0.001***
	(0.00)	(0.00)	(0.00)
purchase_location_regular	.	.	.
	.	.	.
purchase_location_specialty	0.053***	0.053***	0.053***
	(0.02)	(0.02)	(0.02)
purchase_location_bakery	0.154***	0.155***	0.161***
	(0.03)	(0.03)	(0.03)
purchase_location_online	0.063	0.066	0.068
	(0.05)	(0.05)	(0.05)
purchase_location_other	-0.007	-0.007	-0.003
	(0.04)	(0.04)	(0.04)
purchase_location_bake	0.000	-0.000	0.002
	(0.03)	(0.03)	(0.03)
Children	-0.014**	-0.014**	-0.014**
	(0.01)	(0.01)	(0.01)
Price	-0.090***	-0.090***	-0.093***
	(0.01)	(0.01)	(0.01)
Certification	0.043***	0.045***	0.043***
	(0.01)	(0.01)	(0.01)
certainty_very	0.050	0.049	0.052
	(0.04)	(0.04)	(0.04)
certainty_fairly	0.107***	0.106***	0.107***
	(0.04)	(0.04)	(0.04)
certainty_not	.	.	.
	.	.	.

Facility	0.035**		
	(0.01)		
FacilityOrProductionLine		0.031**	
		(0.01)	
Facility&ProductionLine			0.036*
			(0.02)
_cons	1.834***	1.835***	1.837***
	(0.05)	(0.05)	(0.05)
sigma	0.198***	0.198***	0.199***
	(0.01)	(0.01)	(0.01)
LR chi^2	176.66	175.61	174.35
Prob > chi^2	0.0000	0.0000	0.0000
Log-likelihood	-212.89	-213.42	-214.04

Table 20

Marginal effects from Tobit regression of the consideration of a dedicated facility or a dedicated production line on the log of the maximum WTP

Variable	dy/dx	Std. Err.	z	P>z	[95% Conf.	Interval]
Age	-.001217	.0002312	-5.26	0.000	-.0016701	-.0007639
location_urban	-.0160111	.0083216	-1.92	0.054	-.0323212	.000299
location_suburban	-.0225292	.0070271	-3.21	0.001	-.0363019	-.0087564
location_rural	0	(omitted)				
Income	2.64e-07	6.19e-08	4.26	0.000	1.42e-07	3.85e-07
Frequency	.0004523	.0001465	3.09	0.002	.0001652	.0007394
purchase_location_regular						
purchase_location_specialty	.0212796	.0063962	3.33	0.001	.0087433	.0338159
purchase_location_bakery	.0709543	.0179884	3.94	0.000	.0356978	.1062108
purchase_location_online	.0267704	.0238552	1.12	0.262	-.0199849	.0735257
purchase_location_other	-.0026659	.0150299	-0.18	0.859	-.0321241	.0267922
purchase_location_bake	-.0001823	.0097714	-0.02	0.985	-.0193339	.0189693
Children	-.005376	.0024647	-2.18	0.029	-.0102067	-.0005454
Price	-.0356965	.0055658	-6.41	0.000	-.0466053	-.0247876
Certification	.0176777	.0055382	3.19	0.001	.006823	.0285323
FacilityOrProductionLine	.0121713	.0055368	2.20	0.028	.0013193	.0230232

certainty_very	.0170319	.012763	1.33	0.182	-.0079832	.042047
certainty_fairly	.0400899	.013228	3.03	0.002	.0141635	.0660162
certainty_not	0	(omitted)				

Note: dy/dx for factor levels is the discrete change from the base level.

Table 21

Marginal effects from Tobit regression of the consideration of a dedicated facility and a dedicated production line on the log of the maximum WTP

Variable	dy/dx	Std. Err.	z	P>z	[95% Conf.	Interval]
Age	-.0011965	.0002319	-5.16	0.000	-.0016509	-.000742
location_urban	-.0159932	.0083311	-1.92	0.055	-.0323218	.0003355
location_suburban	-.0213457	.0070452	-3.03	0.002	-.0351541	-.0075373
location_rural	0	(omitted)				
Income	2.61e-07	6.19e-08	4.22	0.000	1.40e-07	3.83e-07
Frequency	.0004672	.0001462	3.19	0.001	.0001806	.0007537
purchase_location_regular	0	(omitted)				
purchase_location_specialty	.0212282	.0063907	3.32	0.001	.0087027	.0337537
purchase_location_bakery	.0739797	.018074	4.09	0.000	.0385554	.109404
purchase_location_online	.0275982	.0239545	1.15	0.249	-.0193517	.074548
purchase_location_other	-.0011918	.0151535	-0.08	0.937	-.030892	.0285084
purchase_location_bake	.0006289	.0098003	0.06	0.949	-.0185794	.0198371
Children	-.0053832	.002466	-2.18	0.029	-.0102164	-.00055
Price	-.0366735	.005576	-6.58	0.000	-.0476022	-.0257449
Certification	.017001	.0056453	3.01	0.003	.0059364	.0280657
Facility&ProductionLine	.0140755	.0074356	1.89	0.058	-.0004979	.028649
certainty_very	.0179415	.0127095	1.41	0.158	-.0069687	.0428517
certainty_fairly	.0403829	.0131703	3.07	0.002	.0145695	.0661962
certainty_not	0	(omitted)				

Note: dy/dx for factor levels is the discrete change from the base level.

In order to separate the effect of a dedicated production line from that of a dedicated facility, a variable was created to denote the consideration of a dedicated production line when a dedicated facility was not considered. With a p-value of 0.349, considering a dedicated production line was not significant when a dedicated facility was not considered. Conversely, with p-values of 0.028 and 0.058, the variable for considering dedicated facilities and/or dedicated production lines and the variable for considering both dedicated facilities and dedicated production lines were significant at the 5% and 10% levels, respectively. Thus, considering either dedicated facilities or dedicated production lines induced a 1.22% increase in WTP, and considering both dedicated facilities and dedicated production lines lead to a 1.41% increase in WTP.

Although administering a gluten-free fraud priming story to half of the survey participants did not have a significant effect on their stated maximum WTP amounts, it is germane to investigate if the priming story had an effect on any subsets of the population. One way to subdivide the population is by age. Thus, participants were divided into three categories: (1) young, which encompassed those indicating they were either under 24, between 25 and 34, or between 35 and 44, (2) middle, which included those indicating ages between 45 and 54 or between 55 and 64, and (3) elderly, which were those participants over the age of 65. As can be seen in Table 22, priming became negatively statistically significant at the 5% level when considering the middle age group and the combination of the middle and elderly age groups, but remained insignificant for the young and elderly age groups, individually. In both cases, priming had a positive marginal effect, indicating that receiving the treatment story caused a 1.88% and 4.96% decrease in WTP, respectively.

Table 22

Tobit regression results of priming on WTP of different age subgroups of population

Variable	Young	Middle	Elderly	Combined (Middle/Elderly)
Priming	0.009	-0.050**	-0.044	-0.050**
	(0.02)	(0.02)	(0.04)	(0.02)
_cons	1.819***	1.828***	1.815***	1.826***
	(0.01)	(0.02)	(0.03)	(0.02)
sigma	0.226***	0.203***	0.129***	0.196***
	(0.01)	(0.01)	(0.02)	(0.01)

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Priming also proved to be statistically significant when the population was divided into three groups based on the length for which participants had been purchasing gluten-free bread: (1) new, which included those purchasing for 6 months or less, (2) moderate, which included those purchasing for 6 months to 2 years, and (3) extended, which included those purchasing for over 2 years. In this way, priming was negatively statistically significant at the 5% level for the extended group, but remained insignificant for the new and moderate length groups. The negative marginal effect revealed that shopping for gluten-free bread for over 2 years resulted in a 1.72% reduction in WTP.

Table 23

Tobit regression results of priming on WTP of different length of purchase subgroups of population

Variable	New	Moderate	Extended
Priming	0.025	0.022	-0.043**

	(0.05)	(0.03)	(0.02)
_cons	1.783***	1.794***	1.845***
	(0.04)	(0.02)	(0.01)
sigma	0.252***	0.227***	0.201***
	(0.02)	(0.01)	(0.01)

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Next, the population was divided according to frequency of purchase, creating the following three divisions: (1) rare, which included purchasing gluten-free bread 3 times a year or less, (2) somewhat, which included purchasing 1 to 3 times per month, and (2) often, which included purchasing 3 times a month or more. Priming only became statistically significant in the often group, and was inversely related to WTP at the 10% level. The negative marginal effect in this regression revealed a decrease of 3.2% in WTP for certification when consumers purchased gluten-free bread at least 3 times a month.

Table 24

Tobit regression of priming on WTP of different frequency of purchase groups

Variable	Rare	Somewhat	Often
model			
Priming	-0.002	-0.017	-0.093*
	(0.02)	(0.03)	(0.05)
_cons	1.835***	1.800***	1.820***
	(0.01)	(0.02)	(0.03)
sigma	0.210***	0.229***	0.206***
	(0.01)	(0.01)	(0.03)

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Another subdivision of the population that was of interest was employment status. Thus, the sample was divided into two groups: (1) employed, which included those with full- or part-time jobs, and (2) unemployed, which included students, homemakers, retired individuals, and

those that were otherwise unemployed. Regressing Priming on WTP while controlling for these two groupings resulted in Priming being negatively statistically significant at the 5% level in the unemployed group. The negative marginal effect indicated that being unemployed reduces one's WTP by 1.9%. Relatedly, a regression was also run on the subset of the population that does not hold a full-time job. In this case, priming was also significant at the 5% level and had a -0.04 coefficient. The negative marginal effect revealed that not being employed full-time resulted in 1.51% less of a WTP.

Table 25

Tobit regression of priming on WTP in employment groups

Variable	Employed	Unemployed	Not full-time
Priming	0.010	-0.051**	-0.040**
	(0.02)	(0.02)	(0.02)
_cons	1.810***	1.837***	1.831***
	(0.01)	(0.02)	(0.01)
sigma	0.204***	0.235***	0.223***
	(0.01)	(0.01)	(0.01)

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

After running the Tobit regression, the mean of the predicted values was calculated as can be seen in Table 26.

Table 26

Mean log WTP amount based on Tobit model predicted values

	Mean	Std. Err.	[95% Conf. Interval]	
lnWTP	1.962517	.0011623	1.960236	1.964797

Taking the natural log of the reported 1.962517 mean reveals that the average WTP amount for a loaf of certified gluten-free bread is about $7.12, a $1.12 premium over the average price of gluten-free bread.

Willingness to Pay a Premium

Not only are the determinants of the WTP to pay for certified gluten-free bread of interest, but of similar importance are the factors determining whether or not a consumer will choose to pay a premium. Therefore, a dummy variable was created from the logarithm of the WTP variable in order to indicate the willingness to pay a premium, i.e. this variable equaled 1 when the consumer stated their WTP as any value over $6, and 0 when the consumer stated their WTP as $6. A logit regression was then run with the full array of dependent variables from the data as shown in Table 27. Once these results were obtained, the multi-step trimming process employed for the WTP regressions was again utilized to arrive at the "best" model, which appears in Table 28. The marginal effects of the variables included in the final model can be found in Table 29.

Table 27

Logit regression of all dependent variables on the WTP a premium

Variable	Premium
male	-0.417
	(0.29)
ethnicity_white	0.342
	(0.54)
ethnicity_african_american	0.184
	(1.59)
ethnicity_asian	0.976
	(1.00)
ethnicity_hispanic	0.229
	(0.83)

ethnicity_idigenous	.
	.
ethnicity_latino	.
	.
ethnicity_multiracial	-0.038
	(0.75)
ethnicity_other	.
	.
Age	-0.016**
	(0.01)
location_urban	-0.255
	(0.22)
location_suburban	-0.574***
	(0.18)
location_rural	.
	.
education_some_high	.
	.
education_high_school	-0.225
	(0.89)
education_technical	-0.200
	(0.89)
education_some_college	0.089
	(0.84)
education_college	0.082
	(0.84)
education_postgrad	0.121
	(0.84)
employment_student	0.621
	(0.44)
employment_full	0.103
	(0.31)
employment_part	0.356
	(0.33)
employment_homemaker	0.304
	(0.34)
employment_unemployed	0.320
	(0.50)
employment_retired	.
	.
Income	0.000***
	(0.00)
Frequency	0.011***
	(0.00)
purchase_location_regular	.
	.

purchase_location_specialty	0.336**
	(0.17)
purchase_location_bakery	1.022**
	(0.41)
purchase_location_online	0.420
	(0.57)
purchase_location_other	-0.135
	(0.41)
purchase_location_bake	-0.304
	(0.27)
Children	-0.190***
	(0.07)
recipient_self	.
	.
recipient_other	0.045
	(0.22)
recipient_both	0.058
	(0.18)
condition_WA	0.085
	(0.46)
condition_WI	-0.022
	(0.43)
condition_CD	0.152
	(0.43)
condition_diet	.
	.
condition_other	-0.201
	(0.52)
condition_none	.
	.
Length	-0.001
	(0.01)
knowledge_both	0.524
	(0.33)
knowledge_label	0.242
	(0.36)
knowledge_guarantees	0.342
	(0.54)
knowledge_neither	.
	.
Priming	-0.087
	(0.14)
Flavor	0.108
	(0.19)
Texture	0.044
	(0.16)

Density	0.169
	(0.17)
Dryness	0.170
	(0.16)
Price	-0.816***
	(0.16)
Size	-0.078
	(0.17)
Visual	-0.038
	(0.23)
Type	0.085
	(0.15)
Nutrients	-0.006
	(0.16)
Brand	0.209
	(0.16)
Certification	0.366**
	(0.15)
Facility	0.094
	(0.17)
ProductionLine	0.059
	(0.19)
certainty_very	0.436
	(0.38)
certainty_fairly	1.483***
	(0.39)
certainty_not	.
	.
_cons	-1.507
	(1.27)
LR chi^2	202.99
Prob > chi^2	0.0000
Log-likelihood	-623.54

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 28

Regression results for the final Tobit model of the WTP a premium

Variable	Premium
Age	-0.022***
	(0.01)
location_urban	-0.261
	(0.21)

location_suburban	-0.538***
	(0.18)
location_rural	.
	.
Income	0.000***
	(0.00)
Frequency	0.012***
	(0.00)
purchase_location_specialty	0.311*
	(0.16)
purchase_location_bakery_NoFacility	0.819
	(0.58)
purchase_location_online	0.492
	(0.55)
purchase_location_other	-0.096
	(0.39)
purchase_location_bake	-0.329
	(0.25)
Children	-0.176***
	(0.06)
Price	-0.791***
	(0.14)
Certification	0.381***
	(0.14)
certainty_very	0.426
	(0.36)
certainty_fairly	1.452***
	(0.37)
certainty_not	.
	.
Density	0.256*
	(0.15)
Facility_NoBakeryPurchases	0.200
	(0.15)
Facility&BakeryPurchases	1.379***
	(0.53)
_cons	-0.036
	(0.51)
LR chi^2	184.06
Prob > chi^2	0.0000
Log-likelihood	-635.00

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 29

Marginal effects of the variables in the final willingness to pay a premium model

Variable	dy/dx	Std. Err.	z	P>z	[95% Conf.	Interval]
Age	-.0046196	.0012028	-3.84	0.000	-.0069771	-.0022621
location_urban	-.0540684	.0437845	-1.23	0.217	-.1398844	.0317477
location_suburban	-.1114683	.0364795	-3.06	0.002	-.1829668	-.0399699
location_rural	0	(omitted)				
Income	1.63e-06	3.25e-07	5.01	0.000	9.91e-07	2.26e-06
Frequency	.0023934	.00076	3.15	0.002	.0009037	.003883
purchase_location_specialty	.0644649	.0328532	1.96	0.050	.0000739	.1288559
purchase…bakery_NoFacility	.1697839	.1197954	1.42	0.156	-.0650108	.4045786
purchase_location_online	.1019999	.1141081	0.89	0.371	-.1216478	.3256477
purchase_location_other	-.0199935	.081553	-0.25	0.806	-.1798345	.1398474
purchase_location_bake	-.0681056	.0523864	-1.30	0.194	-.1707811	.0345698
Children	-.0364663	.0127461	-2.86	0.004	-.0614482	-.0114845
Price	-.1638702	.0279486	-5.86	0.000	-.2186485	-.1090919
Certification	.0789005	.0288683	2.73	0.006	.0223197	.1354812
certainty_very	.0883365	.0745969	1.18	0.236	-.0578708	.2345438
certainty_fairly	.301057	.0746272	4.03	0.000	.1547903	.4473237
certainty_not	0	(omitted)				
Density	.0529625	.0309494	1.71	0.087	-.0076972	.1136223
Facility_NoBakeryPurchases	.0415074	.0305715	1.36	0.175	-.0184116	.1014265
Facility&BakeryPurchases	.2858418	.1079872	2.65	0.008	.0741907	.4974928

Note: dy/dx for factor levels is the discrete change from the base level.

The chi-squared statistic on this final model is 184.06 and the "Prob > chi-squared" statistic is 0.0000, indicating that, overall, the model is significant at the 0.001% level and the null hypothesis that the coefficients on all included variables are equal to zero can be rejected.

Furthermore, the marginal effect of a given variable can be interpreted as said variable's impact on the probability of paying a premium for certified gluten-free bread when holding all other variables constant.

The first significant variable this model is the continuous age variable. With its p-value of 0.000, age is statistically significant even at the 0.01% level, and its negative marginal effect implied that a 1 year increase in age prompted a 0.46 percentage point reduction in the probability of paying a premium.

Compared to the base case of living in a rural area, the variable for living in a suburban area is statistically significant at the 0.1% level with a p-value of 0.003. The negative marginal effect indicated that when compared to living in a rural area, living in a suburban area decreased the probability of paying a premium by 11.15 percentage points.

Income was also statistically significant at the 1% with its p-value of 0.000. The negative marginal effect signified that a $10,000 increase in income induced a 0.02 percentage point increase in the probability of paying a premium for certified gluten-free bread.

Next, frequency of purchase also proved significant in the model. With a p-value of 0.002, frequency was statistically significant at the 1% level and its marginal effect signified that purchasing one more loaf of bread a year caused a 0.24 percentage point increase in the probability of paying a premium.

When compared to the base case of shopping mostly at regular supermarkets, the variable for shopping at specialty stores was significant. With a p-value of 0.051, shopping at specialty stores was statistically significant at the 10% level. The marginal effect for typically shopping at

a specialty food store denoted that shopping at these venues induced a 6.45 percentage point increase in the probability of paying a premium.

With a p-value of 0.005, the number of children in one's household proved to be statistically significant at the 1% level. The negative marginal effect implied that the addition of 1 more child generated a 3.65 percentage point decrease in the probability of paying a premium for certified bread.

Three attributes considered when making purchasing decisions were also significant: price, certification status, and density of a loaf of gluten-free bread. With p-values of 0.000, 0.007, and 0.089, respectively, the first two variables were statistically significant at the 1% level, while density was significant at the 10% level. The marginal effect of price was negative, implying that considering a loaf's price before purchasing it induced a 16.39 percentage point decrease in the probability of paying a premium for certification. The positive marginal effect of certification indicated that valuing a loaf's certification status caused a 7.89 percentage point increase in the probability of paying a premium. The positive marginal effect of density signified a 5.3 percentage point increase in the probability of paying a premium when a consumer considered the density of a loaf of bread when deciding whether to purchase it.

Although the dummy variable representing the consideration of the use of dedicated gluten-free facilities when making a purchasing decision was significant when regressed alone on the choice to pay a premium, when adding the variable for purchasing most bread at gluten-free bakeries was added to the model, dedicated facilities became insignificant.

Table 30

Logit regression of consideration of the use of a dedicated facility on the WTP a premium

Variable	Premium
Facility	0.286**
	(0.13)
_cons	0.090
	(0.08)
LR chi^2	4.92
Prob > chi^2	0.0266
Log-likelihood	-724.57

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 31

Logit model of the WTP a premium including the consideration of the use of a dedicated facility and purchase location variables

Variable	Premium
Age	-0.022***
	(0.01)
location_urban	-0.261
	(0.21)
location_suburban	-0.536***
	(0.18)
location_rural	.
	.
Income	0.000***
	(0.00)
Frequency	0.012***
	(0.00)
purchase_location_regular	.
	.
purchase_location_specialty	0.310*
	(0.16)
purchase_location_bakery	1.021***
	(0.39)
purchase_location_online	0.492
	(0.55)
purchase_location_other	-0.098

	(0.39)
purchase_location_bake	-0.329
	(0.25)
Children	-0.176***
	(0.06)
Price	-0.791***
	(0.14)
Certification	0.382***
	(0.14)
certainty_very	0.428
	(0.36)
certainty_fairly	1.451***
	(0.37)
certainty_not	.
	.
Density	0.256*
	(0.15)
Facility	0.212
	(0.15)
_cons	-0.044
	(0.51)
LR chi^2	183.84
Prob > chi^2	0.0000
Log-likelihood	-635.11

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Thus, three dummy variables were created to designate (1) purchasing at bakeries while not considering dedicated facilities, (2) considering dedicated facilities while note purchasing at bakeries, and (3) both purchasing at bakeries and considering dedicated facilities. With a p-value of 0.007, the latter variable proved significant at the 1% level. The positive marginal effect indicated that both purchasing at gluten-free bakeries and considering dedicated facilities increased the probability of paying a premium by 2.77 percentage points when compared to the base case of neither purchasing at bakeries nor considering dedicated facilities.

After running the logit regression, the mean of the predicted values was calculated. This mean indicates that the average probability of choosing to pay a premium for gluten-free certification is about 55%.

Table 32

Mean for the logit model of the WTP a premium

	Mean	Std. Err.	[95% Conf. Interval]	
Premium	.5482955	.0061873	.5361547	.5604362

Discussion

In the introduction section, eight main hypotheses were presented to be tested through the conduction of a contingent valuation survey and subsequent analysis. In this section, the previously stated results will be elaborated upon and synthesized with the hypotheses of interest.

Maximum Willingness to Pay

The title of this research project poses the following question: "Is gluten-free worth the price?" Based on the data amassed through the contingent valuation survey, it is clear that gluten-free certification is worth the price, as the Tobit analysis revealed that consumers were willing to pay a premium of $1.12, or about 18.67% of the average $6.00 price, for certified, as opposed to non-certified, gluten-free bread. Since the payment card in this study contained a final option of "more than $12.00" for maximum WTP amounts, it was decided, for purposes of estimation, to code this option as $13.00. Doing so introduced some measurement error, since individuals could be willing to pay a higher price than $13.00. However, only 7 respondents, less than 1%, chose this option, so the effects of any measurement error would likely be minor.

Hypothesis 1

The first hypothesis was that newly gluten-free consumers are willing to pay higher premiums for gluten-free certification, or equivalently, that WTP decreases with length of time one has been a consumer. However, although the negative coefficient on the variable denoting length of time for which a participant had been purchasing gluten-free bread would coincide with this hypothesis, it proved to be insignificant with a p-value of 0.743.

Hypothesis 2

The second hypothesis made was that infrequent gluten-free bread consumers are willing to pay higher premiums, or that WTP decreases with frequency of purchase. Since the variable for frequency of purchase had a statistically significant positive coefficient, respondents' WTP increased as frequency of purchase increased, which is in contraction with this hypothesis. While it was expected that infrequent consumers would pay more, treating gluten-free bread as a "treat," or "specialty" item, a possible explanation for the positive relationship between frequency of purchase and WTP is that as frequency increases, gluten-free bread becomes more of a staple food item in the household. Therefore, it is pertinent that the bread is safe for its recipient, and the consumer is willing to pay a higher price to ensure that something that is consistently eaten is meeting health standards.

Hypothesis 3

The third hypothesis to be tested was that consumers with WA, WI, or CD are willing to pay higher premiums than those purchasing gluten-free bread as part of a healthy diet. However, none of the variables denoting reasons for purchasing gluten-free bread proved to be statistically significant, and even if they had, all their coefficients were all negative, implying a hypothetical inverse relationship with WTP. Since the variable for a healthy diet was omitted from the WTP regression, these negative coefficients, if significant, would have been in contradiction with this hypothesis since they would denote a decrease in WTP when compared to that of the healthy diet group.

It is surprising that these medical-related variables were not statistically significant when compared to the variable representing buying gluten-free bread in order to follow a specific diet.

A possible reason for this lack of significance over the diet variable is that people following a gluten-free diet are typically doing so because they believe that gluten is detrimental to their health. Therefore, although a gluten-free diet is not medically necessary for these individuals, they may want to practice strict avoidance, in which case certification may be of high value.

Hypothesis 4

The fourth hypothesis was that individuals purchasing gluten-free bread for members of their household are willing to pay higher premiums than those purchasing for themselves. In the WTP regression, the dummy variable associated with a respondent purchasing gluten-free bread for themselves was omitted. Thus, the coefficients on the dummy variables associated with purchasing gluten-free bread for others or for both one's self and others can be interpreted in relation to the dummy variable for self-purchases. Neither variable's coefficient was statistically significant, however, since both coefficients are negative, if they were significant, they would imply that these behaviors induced a lower WTP than buying gluten-free bread solely for one's self. This contradicts the fourth hypothesis since it was believed that purchasing for someone else, such as a child or other loved one, would increase how much one was willing to spend since they would be providing for some else's wellbeing.

Hypothesis 5

The fifth hypothesis was that consumers who are knowledgeable about and/or consider certification status when purchasing gluten-free bread are willing to pay higher premiums or in other words, WTP increases with knowledge about the certification program. Again, the coefficients on dummy variables associated with various levels of familiarity with certification were insignificant. The coefficients on the variables for knowledge, when compared to the base

case of no knowledge, were positive. In the case of statistical significance, this would have implied that knowing what the certification label looked like, what it ensured, or both would increase one's maximum WTP price for certification. This makes sense since familiarity with certification among gluten-free shoppers is likely associated with a valuation of certification, and therefore, the presence of this certification would add worth to the product. If significant, this would have affirmed the fifth hypothesis. However, it is possible that the reason for the insignificance of these knowledge variables is that only about 5% of participants had no knowledge of certification, and thus familiarity with it is not a distinctive characteristic of gluten-free consumers.

The positive, significant coefficient on the dummy variable for considering certification in one's purchasing decision implied that valuing certification leads to an increase in WTP, affirming part of the fifth hypothesis. The lack of significance of the variables denoting knowledge about certification but the significance of this valuation variable implies that not all gluten-free shoppers who are cognizant of certification actually value it when choosing a loaf of bread to buy. This could be due to explanations such as a lack of confidence in certification or unsatisfying certification standards.

Hypothesis 6

The sixth hypothesis was that consumers purchasing gluten-free bread from specialty gluten-free establishments are likely to pay a higher premium than those shopping at regular supermarkets. Omitting the dummy variable for shopping at regular supermarkets allows the coefficients of the other dummy variables to be interpreted in relation to this behavior. Of all the possible shopping venues from which respondents could choose, the coefficients on the dummy

variables associated with shopping most often at specialty food stores and gluten-free bakeries were positive and statistically significant. A positive coefficient on the dummy variable for bakeries coincides with the sixth hypothesis since it denotes an increase in WTP when respondents chose to shop at these establishments when compared to shopping at regular grocery stores. There are a few reasons why this could be so (Table 33 below): (1) since a majority of bakery shoppers consider the use of dedicated facilities and/or production lines when making purchase, consumers at gluten-free bakeries could feel more assured that the products they are purchasing are safe, (2) since a majority of bakery shoppers consider a loaf's flavor and a majority consider its texture, consumers could deem these products as higher quality than other commercially-made gluten-free breads, or (3) since a majority of bakery shoppers do not consider price when making a purchasing decision, prices at these bakeries could already be higher than at other locations.

Table 33

Frequency of shoppers who typically purchase at gluten-free bakeries compared with those who consider the use of a dedicated gluten-free facility and/or production line, texture, or price in making a purchasing decision

	Don't consider	Consider	Total
Facility and/or Production Line	15	28	43
Texture	9	34	43
Price	28	15	43

Hypothesis 7

The seventh hypothesis was that consumers that regularly bake gluten-free bread at home are willing to pay little to no premium. The fact that the mean WTP of the group of consumers that

typically bake at home was statistically less than that of the whole population indicates that these consumers are willing to pay smaller premiums than gluten-free consumers as a whole. However, the mean WTP among bakers still constitutes a 16.33% premium, contradicting the hypothesis that these consumers would pay a trivial premium, if any premium at all. This implies that those who choose to bake most of their gluten-free bread at home do not do so because they are unwilling to pay a premium for certification or because they do not value certification. Rather, since a substantial majority of bake-at-home respondents considered flavor and texture when deciding whether to purchase a gluten-free loaf of bread (Table 34 below), it may be the case that these individuals choose to bake at home because they prefer homemade bread for its other attributes, such as enhanced taste or feel.

Table 34

Frequency of shoppers who typically bake their own gluten-free bread at home compared with those who consider the loaf of bread's flavor or texture in making a purchasing decision

	Don't consider	Consider	Total
Flavor	17	75	92
Texture	21	71	92

Hypothesis 8

The eighth hypothesis was that consumers primed with a gluten-free fraud story are likely to pay a higher premium than those not exposed to the story. On the contrary, the insignificant coefficient on the priming variable indicated that the treatment story had no statistically significant effect on a consumer's WTP. One possible reason for this is that participants could have been disinclined to spend the time to read the news story and thus, it would not affect their WTP decision. Another, likely more plausible, reason for the insignificance of the priming story

is that it did not offer any new information to participants. Survey respondents may have already been aware of fraudulent gluten-free labeling, manufacturing processes, etc., and if this is the case, hearing of yet another instance of gluten-free fraud would not persuade them to increase their WTP for certification. If they were already cognizant of fraudulent behaviors, participants would have previously factored these types of instances into their WTP amounts.

In relation to this hypothesis, an interesting result was that priming with a fraud story proved significant in the following sub-populations: (1) individuals between the ages of 45 and 54, (2) those over the age of 45, (3) respondents who had been purchasing gluten-free bread for over 2 years, (4), those that purchase gluten-free bread 3 or more times a month, (5) participants that did not hold either a full- or part-time job, and (6) those that were not employed full-time. In all of these groups, priming caused a decrease in WTP, which still contradicts expectations and could be a result of these groups having stricter budgeting constraints.

Other Significant Variables

Another variable that was very significant in the WTP determination was a respondent's age bracket. The negative coefficient on the age variable implies that the older the respondent, the less they were willing to pay for gluten-free certification.

The dummy variables for living in urban and suburban areas were statistically significant when that for living in rural areas was omitted. Both variables had negative coefficients, indicating that living in these areas had a negative impact on WTP when compared to the WTP of those individuals living in rural areas. This could be explained by the tendency of suburban and urban areas to offer more shopping venues and larger varieties of options than rural areas. Thus, people living in urban or suburban environments have increased access to alternatives.

Income also proved to be a significant factor affecting WTP. With a positive coefficient, an increase in income also increased a participant's WTP amount. This makes intuitive sense because as one's income increases, they can afford to allocate more money to gluten-free purchases.

Another variable experiencing statistical significance was that for the number of children in the household. With a negative coefficient, WTP decreases as the number of children increases, which makes sense with regards to budget constraints. However, what is interesting is that the variable for children is significant, but that for the recipient of the gluten-free purchases is insignificant. This supports the notion that the significance of the variable on number of children is not based on the children being the recipients of the gluten-free purchases. Rather, the significance of this variable could be due to the fact that more children equates to larger households to feed and an incentive to save money wherever possible.

The effects of the three purchasing decision factors that proved to be significant, namely price, certification status, and use of a gluten-free facility, also make intuitive sense. The negative coefficient on the price dummy variable indicates that when a consumer considers the price of a loaf before purchasing it, their WTP extra for certification is negatively impacted. If a consumer weighs a product's price before purchase, it is likely that they have a certain budget constraint on their purchases and thus, they may not be capable of paying extra money for something like certification, regardless of their value or desire for such an attribute. On the other hand, the positive coefficients on the certification and facility dummy variables imply positive relationships between the consideration of these attributes and WTP. The positive impact of the consideration of a loaf's certification status on WTP makes obvious sense since a consumer's WTP amount is a measure of how much beyond sale price they would pay for certification.

People who already value certification will be more willing to pay higher prices for it. As for dedicated facilities, consumers who value dedicated gluten-free facilities do so because they believe that these manufacturing locations offer an added degree of assurance that the product they consume will be gluten-free. Thus, it makes sense that these consumers would also highly value certification programs, which is in line with the positive coefficient on the facility variable. Furthermore, these consumers may also be willing to pay a higher premium in order to verify that the gluten-free facilities that they value are meeting the expectations of their claims.

Insignificant Variables

One noteworthy variable that proved insignificant in the determination of WTP for gluten-free certification was the dummy variable indicating that the use of a dedicated production line was utilized in the manufacturing of gluten-free bread. It is surprising that the added protection that the use of a dedicated production line in an otherwise gluten-using facility would not be related to a greater WTP. Since the consideration of just a dedicated production line was not statistically significant when regressed on the log of WTP, it can be concluded that a dedicated production line alone is not enough to entice consumers to pay more for certification. It can be inferred that this attribute is not sufficient in assuring consumers of the safety of their bread or validity of its gluten-free claims. Furthermore, the inclusion of a dummy variable denoting that either a dedicated facility or dedicated production line is considered when making a purchasing decision in the regression on log WTP as opposed to just a dummy for facility, causes the regression to have a smaller chi-squared statistic, although still maintaining a p-value of 0.0000. Moreover, the marginal effect of this new dummy is approximately 0.004 smaller than that on the facility dummy in the original regression, denoting a decrease in the magnitude of the positive relationship with WTP. Thus, the inclusion of the consideration of a dedicated

production line has a negative effect on the relationship with WTP and decreases the significance of the overall model. These results support the notion that without a dedicated gluten-free facility, solely a dedicated production line is not a great enough safety or quality assurance measure to induce increased WTP for certification. This could be because about 97% of the respondents that considered a dedicated facility were those that had an intolerance or allergy to wheat or gluten, i.e. WA, WI, NCGS, or CD, and thus the highest gluten-free standards are of importance for these individuals. Furthermore, the variable for considering both a dedicated gluten-free facility and a dedicated production line is significant, adding evidence to the conclusion that a consideration of a dedicated production line only influences WTP in the presence of the consideration of a dedicated facility.

Table 35

Frequency of shoppers who consider the use of a dedicated gluten-free facility based on the reason why they purchase gluten-free bread

	Condition						
	WA	WI	CD	Diet	Other	None	Total
Consider facility	46	68	263	2	8	1	388

Willingness to Pay a Premium

Based on the logit predicted average, about 55%, or over half, of gluten-free consumers would be willing to pay a premium for a certified loaf of bread. Since a payment card question was used to determine WTP a premium, there is a possibility that this percentage has a downward bias. WTP a premium was regarded as any stated maximum WTP that was higher than the $6.00 average price for a loaf of gluten-free bread. However, if a consumer was willing

to pay a premium between $6.00 and the next choice, $6.10, they likely would have stated their WTP as $6.00, which would have been regarded an unwillingness to pay a premium.

When reviewing the final models for both the maximum WTP amounts and the WTP a premium on certified gluten-free bread, the included significant variables are nearly identical. The only differences are that the dummy variable for living in an urban area and that for considering a dedicated gluten-free facility in one's purchasing decision are significant in the maximum WTP model, but not in the WTP a premium model, and the WTP a premium model contains dummy variable for considering the density of a loaf of gluten-free bread when making purchasing decisions and three dummy variables for whether a consumer purchases mostly at gluten-free bakeries, considers dedicated gluten-free facilities when making purchasing decisions, or both, the last of which was significant.

The fact that both models include almost the same list of significant variables makes intuitive sense. If a variable has an effect on whether or not one chooses to pay a premium for gluten-free certification, it is logical that said variable would also affect the magnitude of the premium. The effects on the decision to pay a premium of the significant variables that appear in both models can be interpreted much like their effects on the magnitude of WTP amounts. The negative marginal effect of age implied that as consumer's age, they are less likely to choose to pay a premium for certification. The negative marginal effect of living in a suburban area when compared to living in a rural area suggested that those living in suburbs were less likely to pay a premium, which could be explained by more variety and ease of access to alternatives. The positive marginal effects of income and frequency of purchase revealed that as either of these increase, consumers were more likely to pay a premium. This could be because more money allows shoppers to allocate more funds to gluten-free purchases, and higher frequencies of

purchase may imply greater necessity. The positive marginal effects of shopping in specialty stores over regular supermarkets implied greater probability of paying a premium, which could be because these shoppers have a greater need for stricter gluten-free standards, because quality standards in these locations are higher, or because prices in these establishments are already higher. The negative marginal effect of the number of children implied that the more children in a household, the less likely a consumer is to pay a premium. This may be explained by the fact that a larger household has more expenses and cannot afford to spend more for gluten-free bread. The negative marginal effect of the consideration of price when making a purchasing decision coincides with the notion that considering price indicates a budget constraint and thus less of a probability of affording to pay a premium. The positive marginal effect of considering certification status when buy gluten-free bread makes intuitive sense since valuing certification would make a consumer more willing to pay additional amounts for said certification.

The one variable that was statistically significant in the choice of whether to pay a premium, but not in the magnitude of the WTP, was the dummy variable for considering the density of a loaf of gluten-free bread when making a purchasing decision. The positive marginal effect on this variable indicated that considering density increased the probability of paying a premium for a certified loaf of gluten-free bread. Gluten-free breads are often very dense and heavy, making it difficult to find one similar in consistency to a loaf of "regular" bread. The positive correlation between considering bread density and paying a premium for certification may exist because of this difficulty in finding light and fluffy gluten-free bread. Since finding such a loaf of gluten-free bread is challenging, people may be willing to ensure the gluten-free safety of this loaf by paying a premium for certification.

An interesting difference in the models of WTP amounts and WTP a premium is that the dummy variable for considering the use of dedicated gluten-free facilities appears in the first, but not the latter. Instead, in the choice to pay a premium model, considering the use of dedicated facilities is broken into two variables based on whether the consumer shops mostly at gluten-free bakeries and a dummy variable is included for when a consumer engages in both. This final dummy variable was the only one that came out as significant in the model. Thus, considering the use of a gluten-free facility in the production of a loaf of gluten-free bread was statistically significant in determining the magnitude of a consumer's WTP, but it was only statistically significant in determining the probability that a consumer will choose to pay a premium when the consumer also shops mostly at gluten-free bakeries.

Conclusion

This study sought to answer the question: "Is gluten-free worth the price?" Specifically, the aims of this research were two-fold: (1) to determine whether gluten-free consumers are willing to pay a premium for gluten-free certification and (2) to ascertain how much of a premium these consumers are willing to pay. A gluten-free diet entails a complete avoidance of wheat, rye, and barley proteins, and is commonly followed by individuals suffering from WA, WI, NCGS, and CD. In addition to these medically-necessitated reasons for adhering to a gluten-free diet, some individuals follow it for presumed health benefits or in an attempt to ameliorate symptoms from other conditions.

Regardless of their reason for following a gluten-free diet, consumers rely on food labeling to inform them of the presence of gluten in products they are purchasing. The problem in the United States is that out of the three grains implicated in a gluten-free diet, FALCPA only requires wheat, because it is one of the top eight food allergens, to appear, in its common name, after the word "contains" on the label. Since there are various names and derivatives of food ingredients, rye and barley could be present, unbeknownst to the consumer. Thus, the usage of gluten-free labels on products has attempted to provide assurance to consumers that a given item is safe for consumption. Under FDA regulations, to be labeled "gluten-free," a product must contain less than 20ppm of gluten, yet testing is not mandated; on the other hand, manufacturers are simply held responsible for their adherence to this standard. It is these sources of uncertainty that not only threaten the health of those obeying a gluten-free diet, but served as the motivation for this research project. Four major gluten-free certification programs have emerged in the United States, and it was of interest to determine consumers' WTP for the verification of high manufacturing standards that these programs guarantee.

Since no other research has focused on the objectives of this study, research investigating WTP for other attributes were consulted. To approach the gluten-free certification question, a contingent valuation survey based on the payment card method was employed. Nearly 1,300 responses were gleaned from consumers at the FARE Walk for Food Allergy Boston, via online support groups, and by word of mouth in only one month's time, and of these, 1,056 provided usable data. A logit model was used to estimate the binary decision to pay a premium, and because around half of the respondents reported a premium of $0, a Tobit model was used to avoid the downward bias the OLS model would possess in estimating the magnitude of consumers' WTP. Furthermore, using a two-limit Tobit model allowed the censoring of WTP choices in the payment card to be taken into account.

Analyses revealed that gluten-free certification is indeed worth the price, with consumers willing to pay a premium averaging at about $1.12 above the mean $6.00 price tag on a loaf of gluten-free bread. As expected, consumers who shopped mostly at specialty stores or gluten-free bakeries and those who considered certification status when making purchasing decisions were willing to pay higher premiums. Higher income consumers and individuals considering the use of dedicated gluten-free facilities were willing to pay higher premiums as well. Contrary to initial hypotheses, WTP increased with frequency of bread purchase. Residing in urban or suburban areas, number of children in the household and the consideration of the price of a loaf when making a purchasing decision were negatively related to WTP. Although priming participants with a story about fraudulent gluten-free labeling did not affect WTP in the general population, it did have significant effects within certain subgroups: (1) individuals between the ages of 45 and 54, (2) those over the age of 45, (3) respondents who had been purchasing gluten-free bread for over 2 years, (4), those that purchase gluten-free bread 3 or more times a month,

(5) participants that did not hold either a full- or part-time job, and (6) those that were not employed full-time. In all of these groups, priming caused a decrease in WTP, which contradicts the expectation that such a story would induce a higher WTP.

In addition to identifying the factors that impact WTP for certification and their respective relationship with the magnitude of this amount, logit analyses also estimated the influences on the choice to pay a premium and predicted the average probability of making this choice to be about 55%. It was discovered that those factors included in the choice model were almost exactly the same as those in the magnitude model. The divergence of the choice model from that of the magnitude one lied in the absence of the variable for living in an urban area, the addition of a dummy variable for the consideration of a loaf's density when making a purchasing decision, and the substitution of a variable representing both the consideration of the use of dedicated facilities and shopping mostly at gluten-free bakeries in the choice model for a dummy designating solely the consideration of the use of a dedicated facility that appeared in the magnitude model. In other words, consideration of the use of dedicated gluten-free facility during purchase decision-making was a significant, positively-related determinant of the magnitude of the premium a consumer was willing to pay, but was only a significant, positively-related determinant of whether a consumer would pay a premium if the consumer also typically shopped at gluten-free bakeries. With regards to the variables appearing in both models, the nature of their relationship with the dependent variables, whether positive or negative, remained consistent, yet the degree to which each influenced the amount of premium appeared greater than that to which they influenced the choice to pay a premium.

Moreover, while there were a large number of individuals who reported a maximum WTP of $6.00, or a $0 premium, doing so did not necessarily negate the conclusion that

consumers are willing to pay a premium. These consumers were also asked why they chose not to pay a premium. Around 22% believed that gluten-free bread was already too expensive, 4% remarked that certification benefits do not outweigh the cost, implying that it is the inflated price of an average loaf of gluten-free bread or the desire for more stringent certification standards that deter consumers from paying a premium for certification. Approximately 51% indicated an inclination to go without bread or bake their own at home rather than paying extra for certification. Since these individuals would forgo bread or make homemade versions instead of purchasing the uncertified loaves, these responses also imply that the consumers value and would prefer certification, but the starting prices already meet or exceed their budget constraints. Thus, the decision not to pay a premium for certification does not automatically equate to a lack of value bestowed upon certification. For at least 77% of these zero-premium gluten-free consumers, the data hint that the real reason behind their unwillingness to pay a premium is that gluten-free bread is already priced exceedingly higher than its regular, gluten-based counterpart.

Based on the findings of this project, there is a clear need and desire for widespread gluten-free certification. Thus, it would prove beneficial for the gluten-free community if the FDA revised the gluten-free label regulations to require certification for a product to claim gluten-free status. This stricter requisite would further safeguard foods for gluten-free consumers and increase the liability of manufactures, likely ensuring better manufacturing practices. Furthermore, pervasive certification among gluten-free foods could also benefit the gluten-free market by increasing sales. Consumers who had previously forgone gluten-free products because of the uncertainty of their gluten-free status may begin purchasing these products if they are certified.

Since the largest sector of survey participants were those with Celiac Disease, it would also be advantageous for the gluten-free community if the FDA amended FALCPA to include rye and barley and worked with the FSIS and the Tobacco Tax and Trade Bureau (TTB), the two agencies whose governed products are exempt from FALCPA, to extend FALCPA regulations and the above mentioned certification requirement to FSIS and TTB commodities. The FSIS controls meat, poultry, and some egg products, that could come from animals fed gluten-based diets, or could contain fillers, stocks, or other additives containing gluten. The TTB regulates most alcoholic beverages, including distilled spirits, which could come from wheat, and malted beverages that are often made from barley. Since these products could be cause for concern for sensitive gluten-free consumers, it would behoove the U.S. government to mandate gluten-free labeling compliance for all gluten-containing products. Moving forward, the government could also require labeling for non-food products containing gluten, such as soaps and shampoos that could also cause detrimental reactions.

Finally, this study has served as novel research into the economic side of an increasingly apparent health concern and diet trend. While this study initiated the investigation of consumer WTP for gluten-free certification, due to time and project constraints, the scope of the project was confined to gluten-free bread. Bread was chosen since it is a staple food item and assumed to be one of the most commonly purchased gluten-free food products. However, WTP for certification could vary with products. Therefore, future studies should focus on expanding the scope to include more gluten-free foods and even non-food products that can consist of gluten-containing ingredients. This will provide a more accurate picture of the consumer WTP for gluten-free certification in the gluten-free market as a whole.

On another note, given that many of the zero-premium gluten-free consumers indicated that average prices for gluten-free bread where already too high before certification was considered, further work is needed to investigate the costs of gluten-free ingredients and safety precautions in the manufacturing processes. This would be a worthwhile endeavor in order to determine the true costs of manufacturing gluten-free products and evaluate whether they are currently overpriced. Doing so could prompt a movement to lower prices of gluten-free products, making them more affordable for those who need them and subsequently possibly affecting consumers' WTP for certification.

Appendix A: Tables Listed in the Text

Table A.1

Definitions of main variables

Variable	Definition
Length	Amount of time participant has purchased gluten-free bread
Frequency	Frequency of gluten-free bread purchases
Reason	Reason for purchasing gluten-free bread
Recipient	Recipient of gluten-free bread purchases in the household
PurchaseLocation	Location where participant most often shops for gluten-free bread
Flavor	Dummy variable =1 when flavor is considered in gluten-free bread purchases
FlavorRank	Participant's ranking of flavor among other purchasing considerations
Texture	Dummy variable =1 when texture is considered in gluten-free bread purchases
TextureRank	Participant's ranking of texture among other purchasing considerations
Density	Dummy variable=1 when density is considered in gluten-free bread purchases
DensityRank	Participant's ranking of density among other purchasing considerations
Dryness	Dummy variable =1 when dryness is considered in gluten-free bread purchases
DrynessRank	Participant's ranking of dryness among other purchasing considerations
Price	Dummy variable =1 when price is considered in gluten-free bread purchases
PriceRank	Participant's ranking of price among other purchasing considerations
Size	Dummy variable =1 when size of the loaf is considered in gluten-free bread purchases
SizeRank	Participant's ranking of size of loaf among other purchasing considerations
Visual	Dummy variable =1 when visual characteristics are considered in gluten-free bread purchases
VisualRank	Participant's ranking of visual characteristics among other purchasing considerations
Type	Dummy variable =1 when the type of bread is considered in gluten-free bread purchases
TypeRank	Participant's ranking of type of bread among other purchasing considerations
Nutrients	Dummy variable =1 when nutritional contents are considered in gluten-free bread purchases
NutrientsRank	Participant's ranking of nutritional contents among other purchasing considerations
Brand	Dummy variable =1 when the brand name is considered in gluten-free bread purchases
BrandRank	Participant's ranking of brand name among other purchasing considerations
Certification	Dummy variable =1 when certification status is considered in gluten-free bread purchases

CertificationRank	Participant's ranking of certification status among other purchasing considerations
Facility	Dummy variable =1 when the use of a dedicated gluten-free facility is considered in gluten-free bread purchases
FacilityRank	Participant's ranking of use of a dedicated gluten-free facility among other purchasing considerations
ProductionLine	Dummy variable =1 when the use of a dedicated gluten-free production line is considered in gluten-free bread purchases
ProductionLineRank	Participant's ranking of use of a dedicated gluten-free production line among other purchasing considerations
Knowledge	How knowledgeable participants are of gluten-free certification
Priming	Dummy variable =1 when a gluten-free fraud story was presented to the participant prior to willingness to pay questions
PayAverage	Whether or not participants are willing to pay the average $6 price of a loaf of gluten-free bread
PayPremium	Whether or not participants are willing to pay a premium for gluten-free certification
MaxWillingness	The maximum price participants are willing to pay for a certified gluten-free loaf of bread
Certainty	How certain participants are of their maximum willingness to pay choice
ReasonNo	Reason why participants are not willing to pay a premium for gluten-free bread
Gender	Gender of participant
Ethnicity	Race/ethnicity of participant
Age	Age range of participant
Location	Whether participant lives in a rural, suburban, or urban area
Education	Level of participant's education
Children	Number of children under the age of 18 living in the household
Employment	Participant's current employment status
Income	Approximate household yearly income before taxes
Premium	Dummy variable =1 when consumer is willing to pay a premium for certification

Table A.2

Definitions of sub-variables

Variable	Definition
length_1mo	Dummy variable =1 when participant has been a gluten-free bread consumer for under 1 month
length_6mo	Dummy variable =1 when participant has been a gluten-free bread consumer for 1 - 6 months
length_1yr	Dummy variable =1 when participant has been a gluten-free bread consumer for

	6 months to 1 year
length_2yr	Dummy variable =1 when participant has been a gluten-free bread consumer for 1 - 2 years
length_3yr	Dummy variable =1 when participant has been a gluten-free bread consumer for 3 or more years
frequency_1wk	Dummy variable =1 when participant purchases gluten-free bread once a week or more
frequency_3mo	Dummy variable =1 when participant purchases gluten-free bread 2 - 3 times a month
frequency_1mo	Dummy variable =1 when participant purchases gluten-free bread once a month
frequency_2_3mo	Dummy variable =1 when participant purchases gluten-free bread every 2 - 3 months
frequency_2_3yr	Dummy variable =1 when participant purchases gluten-free bread 2 - 3 times a year
frequency_1yr	Dummy variable =1 when participant purchases gluten-free bread once a year or less
condition_WA	Dummy variable =1 when participant or someone in household has Wheat Allergy
condition_WI	Dummy variable =1 when participant or someone in household has Wheat/Gluten Intolerance
condition_CD	Dummy variable =1 when participant or someone in household has Celiac Disease
condition_diet	Dummy variable =1 when participant or someone in household eats gluten-free as part of a healthy diet
condition_other	Dummy variable =1 when participant or someone in household eats gluten-free for other reasons
condition_none	Dummy variable =1 when participant is not interested in product
recipient_self	Dummy variable =1 when participant purchases gluten-free bread for themselves
recipient_other	Dummy variable =1 when participant purchases gluten-free bread for someone in their household
recipient_both	Dummy variable =1 when participant purchases gluten-free bread for themselves and someone in their household
purchase_location_regular	Dummy variable =1 when participant purchases gluten-free bread at "regular" supermarkets
purchase_location_specialty	Dummy variable =1 when participant purchases gluten-free bread at specialty food stores
purchase_location_bakery	Dummy variable =1 when participant purchases gluten-free bread at gluten/allergen-free bakeries
purchase_location_online	Dummy variable =1 when participant purchases gluten-free bread through online retailers
purchase_location_other	Dummy variable =1 when participant purchases gluten-free bread other ways
purchase_loca	Dummy variable =1 when participant bakes gluten-free bread at home

tion_bake	
knowledge_both	Dummy variable =1 when participant is familiar with the gluten-free certification label and what it guarantees
knowledge_label	Dummy variable =1 when participant is familiar with the gluten-free certification label but not what it guarantees
knowledge_guarantees	Dummy variable =1 when participant is familiar with what the gluten-free certification label guarantees but not the label, itself
knowledge_neither	Dummy variable =1 when participant is familiar with neither the gluten-free certification label nor what it guarantees
pay_average_yes	Dummy variable =1 when participant is willing to pay the $6.00 average price of gluten-free bread
pay_average_no	Dummy variable =1 when participant is not willing to pay the $6.00 average price of gluten-free bread
certainty_very	Dummy variable =1 when participant is very certain of the maximum willingness to pay choice
certainty_fairly	Dummy variable =1 when participant is fairly certain of the maximum willingness to pay choice
certainty_not	Dummy variable =1 when participant is not at all certain of the maximum willingness to pay choice
reason_no_necessary	Dummy variable =1 when participant is not willing to pay a premium for gluten-free certification because certification is not necessary for their diet
reason_no_expensive	Dummy variable =1 when participant is not willing to pay a premium for gluten-free certification because gluten-free bread is already too expensive
reason_no_outweigh	Dummy variable =1 when participant is not willing to pay a premium for gluten-free certification because the benefits do no outweigh the cost
reason_no_unfair	Dummy variable =1 when participant is not willing to pay a premium for gluten-free certification because it is unfair to pay a premium for certification
reason_no_without	Dummy variable =1 when participant is not willing to pay a premium for gluten-free certification because they would rather go without or bake their own bread
reason_no_other	Dummy variable =1 when participant is not willing to pay a premium for gluten-free bread for other reasons

Appendix B: Supplementary Tables

Table B.1

OLS regression results for coefficients on determinants of maximum WTP

Variable	Coef.	Std. Err.	t	P>t	[95% Conf.	Interval]
male	-.1198505	.1295318	-0.93	0.355	-.3740361	.1343352
ethnicity_white	-.282532	.2543624	-1.11	0.267	-.7816778	.2166138
ethnicity_african_american	-.7347956	.6474369	-1.13	0.257	-2.005288	.5356967
ethnicity_asian	-.0789222	.4322967	-0.18	0.855	-.927236	.7693917
ethnicity_hispanic	-.3871323	.3792693	-1.02	0.308	-1.131388	.3571236
ethnicity_idigenous	.1928383	1.046743	0.18	0.854	-1.861229	2.246906
ethnicity_latino	-1.183176	1.041275	-1.14	0.256	-3.226513	.8601616
ethnicity_multiracial	-.3892034	.3417974	-1.14	0.255	-1.059927	.2815199
ethnicity_other	0	(omitted)				
Age	-.0104951	.003528	-2.97	0.003	-.0174183	-.0035718
location_urban	-.1729939	.0994744	-1.74	0.082	-.3681966	.0222088
location_suburban	-.2176188	.0822309	-2.65	0.008	-.378984	-.0562537
location_rural	0	(omitted)				
education_some_high	0	(omitted)				
education_high_school	.1708214	.4144881	0.41	0.680	-.6425458	.9841887
education_technical	-.0723048	.4160032	-0.17	0.862	-.8886451	.7440356
education_some_college	-.0373901	.3919072	-0.10	0.924	-.8064458	.7316657
education_college	.0395544	.390238	0.10	0.919	-.7262257	.8053345
education_postgrad	.0251525	.3922371	0.06	0.949	-.7445506	.7948556
employment_student	.2598484	.1944297	1.34	0.182	-.1216892	.6413859
employment_full	.1158998	.1390542	0.83	0.405	-.1569721	.3887717
employment_part	.0896821	.1505807	0.60	0.552	-.2058086	.3851727
employment_homemaker	.2137051	.1530864	1.40	0.163	-.0867026	.5141128
employment_unemployed	.3552415	.2295998	1.55	0.122	-.0953117	.8057946
employment_retired	0	(omitted)				
Income	1.92e-06	7.65e-07	2.51	0.012	4.17e-07	3.42e-06
Frequency	.0045991	.0017845	2.58	0.010	.0010974	.0081008
purchase_location_regular	0	(omitted)				
purchase_location_specialty	.2915847	.0739813	3.94	0.000	.1464081	.4367614
purchase_location_bakery	.8813131	.165425	5.33	0.000	.5566928	1.205933
purchase_location_online	.2484177	.2545289	0.98	0.329	-.2510548	.7478902
purchase_location_other	-.0027731	.1855755	-0.01	0.988	-.3669357	.3613894
purchase_location_bake	.1334267	.1200015	1.11	0.266	-.1020572	.3689106
Children	-.0268911	.0324889	-0.83	0.408	-.0906453	.0368632
recipient_self	0	(omitted)				
recipient_other	-.065644	.0984622	-0.67	0.505	-.2588605	.1275724
recipient_both	-.1175515	.0782325	-1.50	0.133	-.2710703	.0359673

condition_WA	-.1620889	.208348	-0.78	0.437	-.5709388	.2467609
condition_WI	-.2400381	.1935197	-1.24	0.215	-.6197898	.1397137
condition_CD	-.0742572	.1924859	-0.39	0.700	-.4519804	.3034659
condition_diet	0	(omitted)				
condition_other	-.2858584	.2372142	-1.21	0.228	-.7513537	.1796369
condition_none	-.4525023	1.043912	-0.43	0.665	-2.501014	1.59601
Length	-.0019266	.0023332	-0.83	0.409	-.0065052	.002652
knowledge_both	.1444317	.1475188	0.98	0.328	-.1450505	.4339139
knowledge_label	.070356	.1607904	0.44	0.662	-.2451697	.3858816
knowledge_guarantees	-.0165093	.2516656	-0.07	0.948	-.5103632	.4773445
knowledge_neither	0	(omitted)				
Priming	-.0354379	.062278	-0.57	0.569	-.1576485	.0867727
Flavor	-.017708	.0848228	-0.21	0.835	-.1841592	.1487433
Texture	.0068114	.073011	0.09	0.926	-.1364611	.1500839
Density	.0170807	.0756339	0.23	0.821	-.1313389	.1655003
Dryness	.0604431	.0731843	0.83	0.409	-.0831695	.2040558
Price	-.3582568	.0699506	-5.12	0.000	-.4955238	-.2209898
Size	.0392284	.0777042	0.50	0.614	-.1132539	.1917106
Visual	-.0447139	.1032135	-0.43	0.665	-.2472539	.1578262
Type	.0383749	.0684889	0.56	0.575	-.0960237	.1727734
Nutrients	-.0685524	.0721398	-0.95	0.342	-.2101154	.0730106
Brand	.0644007	.0714258	0.90	0.367	-.0757612	.2045626
Certification	.1579686	.0660279	2.39	0.017	.0283994	.2875378
Facility	.1572501	.0743074	2.12	0.035	.0114335	.3030667
ProductionLine	.0142717	.0861098	0.17	0.868	-.1547053	.1832486
certainty_very	.0860993	.1662771	0.52	0.605	-.2401931	.4123918
certainty_fairly	.1552785	.1701404	0.91	0.362	-.1785951	.489152
certainty_not	0	(omitted)				
_cons	7.056686	.583848	12.09	0.000	5.910977	8.202395

				Number of obs	=	1056
Source	SS	df	MS	F(56, 999)	=	3.03
Model	168.125119	56	3.00223426	Prob > F	=	0.0000
Residual	988.239863	999	.989229092	R-squared	=	0.1454
				Adj R-squared	=	0.0975
Total	1156.36498	1055	1.09608055	Root MSE	=	.9946

Table B.2

Regression results for Tobit regression on the maximum WTP

Variable	Coef.	Std. Err.	t	P>t	[95% Conf.	Interval]
male	-.2743308	.2222034	-1.23	0.217	-.7103687	.161707

ethnicity_white	-.280698	.4223854	-0.66	0.506	-1.10956	.5481643
ethnicity_african_american	-1.365529	1.3298	-1.03	0.305	-3.975045	1.243987
ethnicity_asian	.1378927	.70325	0.20	0.845	-1.242121	1.517906
ethnicity_hispanic	-.4269634	.6349592	-0.67	0.501	-1.672967	.8190404
ethnicity_idigenous	.7512274	1.602589	0.47	0.639	-2.393592	3.896047
ethnicity_latino	-9.683303	.	.	.	.	.
ethnicity_multiracial	-.5403955	.568403	-0.95	0.342	-1.655794	.5750026
ethnicity_other	0	(omitted)				
Age	-.0165803	.0059271	-2.80	0.005	-.0282113	-.0049492
location_urban	-.2955872	.166487	-1.78	0.076	-.6222908	.0311163
location_suburban	-.440348	.1382623	-3.18	0.001	-.7116652	-.1690307
location_rural	0	(omitted)				
education_some_high	0	(omitted)				
education_high_school	.0930993	.7180856	0.13	0.897	-1.316026	1.502225
education_technical	-.1917882	.723151	-0.27	0.791	-1.610854	1.227278
education_some_college	-.0787665	.6814519	-0.12	0.908	-1.416005	1.258472
education_college	.0312378	.6780182	0.05	0.963	-1.299262	1.361738
education_postgrad	.0305584	.6816154	0.04	0.964	-1.307	1.368117
employment_student	.4976614	.3289577	1.51	0.131	-.1478644	1.143187
employment_full	.1938806	.2409057	0.80	0.421	-.2788575	.6666187
employment_part	.2354656	.2597613	0.91	0.365	-.2742734	.7452047
employment_homemaker	.3554419	.2617994	1.36	0.175	-.1582966	.8691804
employment_unemployed	.5046866	.3965119	1.27	0.203	-.2734034	1.282776
employment_retired	0	(omitted)				
Income	4.63e-06	1.27e-06	3.65	0.000	2.14e-06	7.12e-06
Frequency	.0089092	.0030173	2.95	0.003	.0029882	.0148303
purchase_location_regular	0	(omitted)				
purchase_...specialty	.4554622	.1229953	3.70	0.000	.2141041	.6968204
purchase_location_bakery	1.258459	.2645499	4.76	0.000	.739323	1.777595
purchase_location_online	.416211	.4240099	0.98	0.327	-.4158391	1.248261
purchase_location_other	-.070648	.3277542	-0.22	0.829	-.7138121	.5725161
purchase_location_bake	.0682909	.2098387	0.33	0.745	-.3434832	.4800651
Children	-.0856666	.0547615	-1.56	0.118	-.1931271	.0217939
recipient_self	0	(omitted)				
recipient_other	-.0427241	.1644628	-0.26	0.795	-.3654554	.2800072
recipient_both	-.1427257	.1313384	-1.09	0.277	-.4004558	.1150045
condition_WA	-.1649373	.3570601	-0.46	0.644	-.8656096	.5357349
condition_WI	-.2849133	.3325063	-0.86	0.392	-.9374026	.3675759
condition_CD	-.0515237	.3300385	-0.16	0.876	-.6991705	.5961231
condition_diet	0	(omitted)				
condition_other	-.4140402	.4107179	-1.01	0.314	-1.220007	.3919267
condition_none	.3984244	1.610481	0.25	0.805	-2.761882	3.558731
Length	-.0030228	.0039337	-0.77	0.442	-.0107421	.0046965
knowledge_both	.3692939	.2632452	1.40	0.161	-.1472817	.8858696
knowledge_label	.2294508	.2839692	0.81	0.419	-.3277923	.786694
knowledge_guarantees	.1432471	.4376973	0.33	0.744	-.7156624	1.002157

knowledge_neither	0	(omitted)				
Priming	-.068253	.1048854	-0.65	0.515	-.2740734	.1375675
Flavor	.0213439	.1427381	0.15	0.881	-.2587563	.3014441
Texture	.0161743	.1239258	0.13	0.896	-.2270099	.2593584
Density	.0552209	.1259452	0.44	0.661	-.191926	.3023678
Dryness	.1328755	.1214223	1.09	0.274	-.1053959	.3711468
Price	-.6576568	.1173698	-5.60	0.000	-.8879759	-.4273377
Size	.0188826	.132623	0.14	0.887	-.2413683	.2791336
Visual	-.0317967	.1734899	-0.18	0.855	-.3722422	.3086488
Type	.0652636	.1153337	0.57	0.572	-.1610599	.291587
Nutrients	-.0906989	.1218636	-0.74	0.457	-.3298363	.1484384
Brand	.1516663	.1193865	1.27	0.204	-.0826102	.3859429
Certification	.2941208	.1112939	2.64	0.008	.0757247	.5125169
Facility	.2187551	.1239474	1.76	0.078	-.0244715	.4619817
ProductionLine	.0400379	.1431029	0.28	0.780	-.2407782	.3208539
certainty_very	.3460827	.3104217	1.11	0.265	-.2630692	.9552346
certainty_fairly	.7452259	.3148641	2.37	0.018	.1273565	1.363095
certainty_not	0	(omitted)				
_cons	5.90722	1.005972	5.87	0.000	3.933165	7.881275
sigma	1.507868	.0484201			1.412851	1.602884

LR chi^2	193.67
Prob > chi^2	0.0000
Log-likelihood	-1361.83

Table B.3

Regression results for Tobit regression on the log of maximum WTP

Variable	Coef.	Std. Err.	t	P>t	[95% Conf.	Interval]
male	-.0360757	.0287043	-1.26	0.209	-.0924032	.0202518
ethnicity_white	-.0308527	.0546258	-0.56	0.572	-.138047	.0763416
ethnicity_african_american	-.1763021	.173092	-1.02	0.309	-.515967	.1633628
ethnicity_asian	.0242484	.0909666	0.27	0.790	-.1542587	.2027555
ethnicity_hispanic	-.0460744	.0820574	-0.56	0.575	-.2070987	.11495
ethnicity_idigenous	.1172975	.2076484	0.56	0.572	-.2901786	.5247736
ethnicity_latino	-1.257554	.	.	.	.	.
ethnicity_multiracial	-.0634658	.0734563	-0.86	0.388	-.2076117	.0806801
ethnicity_other	0	(omitted)				
Age	-.0021672	.000766	-2.83	0.005	-.0036704	-.000664
location_urban	-.038179	.0215207	-1.77	0.076	-.0804099	.0040518
location_suburban	-.0568371	.0178714	-3.18	0.002	-.0919068	-.0217674
location_rural	0	(omitted)				
education_some_high	0	(omitted)				

education_high_school	.0083098	.0926726	0.09	0.929	-.1735451	.1901648
education_technical	-.0316511	.0933357	-0.34	0.735	-.2148071	.1515049
education_some_college	-.0096121	.0879134	-0.11	0.913	-.1821278	.1629036
education_college	.0024877	.0874735	0.03	0.977	-.1691649	.1741402
education_postgrad	.0040522	.087936	0.05	0.963	-.1685079	.1766123
employment_student	.0649407	.0425052	1.53	0.127	-.0184688	.1483501
employment_full	.0271977	.0310942	0.87	0.382	-.0338197	.088215
employment_part	.0335759	.0335325	1.00	0.317	-.0322262	.099378
employment_homemaker	.0468042	.0338117	1.38	0.167	-.0195456	.1131541
employment_unemployed	.0630816	.0512305	1.23	0.218	-.0374499	.1636131
employment_retired	0	(omitted)				
Income	6.17e-07	1.64e-07	3.76	0.000	2.95e-07	9.38e-07
Frequency	.0011669	.0003898	2.99	0.003	.0004019	.0019319
purchase_location_regular	0	(omitted)				
purchase_location_specialty	.0562861	.0158999	3.54	0.000	.025085	.0874871
purchase_location_bakery	.1585611	.034266	4.63	0.000	.0913197	.2258025
purchase_location_online	.0553621	.054765	1.01	0.312	-.0521053	.1628294
purchase_location_other	-.0083629	.0422669	-0.20	0.843	-.0913048	.074579
purchase_location_bake	.0064887	.0271003	0.24	0.811	-.0466912	.0596685
Children	-.0127946	.0070803	-1.81	0.071	-.0266885	.0010994
recipient_self	0	(omitted)				
recipient_other	-.0043269	.0212688	-0.20	0.839	-.0460635	.0374097
recipient_both	-.0155024	.0169712	-0.91	0.361	-.0488057	.0178008
condition_WA	-.0142961	.0462092	-0.31	0.757	-.1049741	.0763818
condition_WI	-.0308908	.0430491	-0.72	0.473	-.1153677	.0535861
condition_CD	-.0016861	.042733	-0.04	0.969	-.0855426	.0821704
condition_diet	0	(omitted)				
condition_other	-.0467281	.0530936	-0.88	0.379	-.1509157	.0574594
condition_none	.0700979	.2086796	0.34	0.737	-.3394017	.4795976
Length	-.0003413	.0005082	-0.67	0.502	-.0013387	.000656
knowledge_both	.0540305	.0340773	1.59	0.113	-.0128407	.1209016
knowledge_label	.0343168	.0367516	0.93	0.351	-.0378021	.1064357
knowledge_guarantees	.0245801	.0565573	0.43	0.664	-.0864044	.1355645
knowledge_neither	0	(omitted)				
Priming	-.009065	.0135511	-0.67	0.504	-.0356567	.0175268
Flavor	.0049908	.0184509	0.27	0.787	-.031216	.0411976
Texture	.0017767	.0160053	0.11	0.912	-.0296312	.0331845
Density	.0060115	.0162804	0.37	0.712	-.0259361	.0379591
Dryness	.0160581	.0156932	1.02	0.306	-.0147372	.0468534
Price	-.0890334	.0151692	-5.87	0.000	-.1188005	-.0592664
Size	.0034723	.0171265	0.20	0.839	-.0301357	.0370802
Visual	-.007434	.0224332	-0.33	0.740	-.0514555	.0365874
Type	.0093782	.0149007	0.63	0.529	-.019862	.0386183
Nutrients	-.0105013	.0157394	-0.67	0.505	-.0413873	.0203846
Brand	.0179092	.0154308	1.16	0.246	-.0123712	.0481896
Certification	.0393527	.0143793	2.74	0.006	.0111357	.0675697

Facility	.0265692	.0160185	1.66	0.097	-.0048646	.0580029
ProductionLine	.004821	.0185	0.26	0.794	-.0314823	.0411243
certainty_very	.0476564	.0401173	1.19	0.235	-.0310673	.1263802
certainty_fairly	.105122	.0406939	2.58	0.010	.0252669	.1849771
certainty_not	0	(omitted)				
_cons	1.769419	.1299672	13.61	0.000	1.514379	2.024458
sigma	.1954292	.0063275			.1830126	.2078459

LR chi^2	200.5
Prob > chi^2	0.0000
Log-likelihood	-200.97

Table B.4

Regression results for the final Tobit model of the log of the WTP

Variable	Coef.	Std. Err.	t	P>t	[95% Conf.	Interval]
Age	-.003035	.0005834	-5.20	0.000	-.0041798	-.0018901
location_urban	-.0406002	.0210479	-1.93	0.054	-.0819014	.0007011
location_suburban	-.0567399	.0177757	-3.19	0.001	-.0916202	-.0218595
location_rural	0	(omitted)				
Income	6.53e-07	1.57e-07	4.17	0.000	3.45e-07	9.61e-07
Frequency	.0011557	.0003702	3.12	0.002	.0004292	.0018822
purchase_location_regular	0	(omitted)				
purchase_location_specialty	.0531532	.0156625	3.39	0.001	.0224195	.083887
purchase_location_bakery	.154323	.0333849	4.62	0.000	.0888135	.2198324
purchase_location_online	.0631355	.0540525	1.17	0.243	-.042929	.1691999
purchase_location_other	-.0073179	.0415547	-0.18	0.860	-.0888586	.0742227
purchase_location_bake	.0000393	.026464	0.00	0.999	-.0518896	.0519682
Children	-.0135756	.0062397	-2.18	0.030	-.0258194	-.0013318
Price	-.0901629	.0140273	-6.43	0.000	-.1176879	-.0626378
Certification	.0433686	.0140673	3.08	0.002	.0157651	.0709721
Facility	.0348107	.0143336	2.43	0.015	.0066845	.0629368
certainty_very	0	(omitted)				
certainty_fairly	.0498869	.0391182	1.28	0.202	-.0268727	.1266465
certainty_not	.1072034	.0397463	2.70	0.007	.0292113	.1851954
_cons	1.833605	.0525395	34.90	0.000	1.730509	1.936701
sigma	.19821	.0064205		.1856114	.2108086	

LR chi^2	176.66
Prob > chi^2	0.0000
Log-likelihood	-212.89

Table B.5

Marginal effects of priming on the log of the maximum WTP for the young age group

	dy/dx	Std. Err.	z	P>z	[95% Conf.	Interval]
Priming	.0033064	.0073723	0.45	0.654	-.011143	.0177558

Table B.6

Marginal effects of priming on the log of the maximum WTP for the middle age group

	dy/dx	Std. Err.	z	P>z	[95% Conf.	Interval]
Priming	-.0187727	.0089816	-2.09	0.037	-.0363764	-.001169

Table B.7

Marginal effects of priming on the log of the maximum WTP for the elderly age group

	dy/dx	Std. Err.	z	P>z	[95% Conf.	Interval]
Priming	-.0162485	.0160126	-1.01	0.310	-.0476326	.0151357

Table B.8

Marginal effects of priming on the log of the maximum WTP for the combined middle and elderly age group

	dy/dx	Std. Err.	z	P>z	[95% Conf.	Interval]
Priming	-.0185475	.0081606	-2.27	0.023	-.0345419	-.002553

Table B.9

Marginal effects of priming on the log of the maximum WTP for the new length group

	dy/dx	Std. Err.	z	P>z	[95% Conf.	Interval]
Priming	.0089526	.0165608	0.54	0.589	-.0235059	.0414111

Table B.10

Marginal effects of priming on the log of the maximum WTP for the moderate length group

	dy/dx	Std. Err.	z	P>z	[95% Conf.	Interval]
Priming	.0080623	.0098011	0.82	0.411	-.0111474	.0272721

Table B.11

Marginal effects of priming on the log of the maximum WTP for the extended length group

	dy/dx	Std. Err.	z	P>z	[95% Conf.	Interval]
Priming	-.0172055	.0073301	-2.35	0.019	-.0315721	-.0028388

Table B.12

Marginal effects of priming on the log of the maximum WTP for the rare frequency group

	dy/dx	Std. Err.	z	P>z	[95% Conf.	Interval]
Priming	-.0009125	.0076351	-0.12	0.905	-.0158771	.014052

Table B.13

Marginal effects of priming on the log of the maximum WTP for the somewhat frequency group

	dy/dx	Std. Err.	z	P>z	[95% Conf.	Interval]
Priming	-.006254	.0093314	-0.67	0.503	-.0245432	.0120352

Table B.14

Marginal effects of priming on the log of the maximum WTP for the often frequency group

	dy/dx	Std. Err.	z	P>z	[95% Conf.	Interval]
Priming	-.031969	.0164423	-1.94	0.052	-.0641954	.0002574

Table B.15

Marginal effects of priming on the log of the maximum WTP for the employed group

	dy/dx	z	P>z	[95% Conf. Interval]	
Priming	.0040412	0.59	0.554	-.0093549	.0174373

Table B.16

Marginal effects of priming on the log of the maximum WTP for the unemployed group

	dy/dx	Std. Err.	z	P>z	[95% Conf. Interval]	
Priming	-.019016	.0093287	-2.04	0.042	-.0373	-.000732

Table B.17

Marginal effects of priming on the log of the maximum WTP for the non-full-time group

	dy/dx	Std. Err.	z	P>z	[95% Conf. Interval]	
Priming	-.0151076	.0075243	-2.01	0.045	-.0298549	-.0003602

Table B.18

Logit regression of all dependent variables on the WTP a premium

Variable	Coef.	Std. Err.	z	P>z	[95% Conf.	Interval]
male	-.4168944	.286837	-1.45	0.146	-.9790846	.1452958
ethnicity_white	.3419568	.5447613	0.63	0.530	-.7257557	1.409669
ethnicity_african_american	.1843766	1.588456	0.12	0.908	-2.92894	3.297693
ethnicity_asian	.9755948	1.000292	0.98	0.329	-.984941	2.936131
ethnicity_hispanic	.2291461	.8307158	0.28	0.783	-1.399027	1.857319
ethnicity_idigenous	0	(omitted)				
ethnicity_latino	0	(omitted)				
ethnicity_multiracial	-.0383072	.7495619	-0.05	0.959	-1.507422	1.430807
ethnicity_other	0	(omitted)				
Age	-.0158082	.0078394	-2.02	0.044	-.0311731	-.0004433
location_urban	-.2554859	.2227989	-1.15	0.252	-.6921636	.1811919
location_suburban	-.5738471	.1838588	-3.12	0.002	-.9342037	-.2134905

location_rural	0	(omitted)				
education_some_high	0	(omitted)				
education_high_school	-.2252881	.8915425	-0.25	0.801	-1.972679	1.522103
education_technical	-.2001146	.8946391	-0.22	0.823	-1.953575	1.553346
education_some_college	.0893498	.8403765	0.11	0.915	-1.557758	1.736458
education_college	.0823081	.836388	0.10	0.922	-1.556982	1.721598
education_postgrad	.1214438	.8405616	0.14	0.885	-1.526027	1.768914
employment_student	.621476	.4357081	1.43	0.154	-.2324961	1.475448
employment_full	.1025498	.3059374	0.34	0.737	-.4970764	.7021761
employment_part	.355629	.3311891	1.07	0.283	-.2934897	1.004748
employment_homemaker	.3042086	.3377467	0.90	0.368	-.3577628	.96618
employment_unemployed	.3202667	.500921	0.64	0.523	-.6615205	1.302054
employment_retired	0	(omitted)				
Income	7.78e-06	1.75e-06	4.44	0.000	4.34e-06	.0000112
Frequency	.0105868	.0039941	2.65	0.008	.0027585	.0184152
purchase_location_regular	0	(omitted)				
purchase_...specialty	.3359849	.1651986	2.03	0.042	.0122016	.6597681
purchase_location_bakery	1.022248	.412659	2.48	0.013	.2134511	1.831045
purchase_location_online	.4203056	.5735884	0.73	0.464	-.7039071	1.544518
purchase_location_other	-.1350922	.4088649	-0.33	0.741	-.9364528	.6662684
purchase_location_bake	-.3040221	.2665313	-1.14	0.254	-.8264138	.2183696
Children	-.1900383	.0721597	-2.63	0.008	-.3314687	-.0486079
recipient_self	0	(omitted)				
recipient_other	.0452497	.2185183	0.21	0.836	-.3830384	.4735377
recipient_both	.0577245	.1751478	0.33	0.742	-.2855589	.401008
condition_WA	.0854462	.4612689	0.19	0.853	-.8186243	.9895167
condition_WI	-.0215073	.4273798	-0.05	0.960	-.8591563	.8161418
condition_CD	.151917	.425124	0.36	0.721	-.6813107	.9851447
condition_diet	0	(omitted)				
condition_other	-.2014066	.5227049	-0.39	0.700	-1.225889	.8230761
condition_none	0	(empty)				
Length	-.0012867	.0051982	-0.25	0.805	-.011475	.0089017
knowledge_both	.5241317	.3279797	1.60	0.110	-.1186966	1.16696
knowledge_label	.2420265	.3575254	0.68	0.498	-.4587104	.9427633
knowledge_guarantees	.3417162	.5430129	0.63	0.529	-.7225695	1.406002
knowledge_neither	0	(omitted)				
Priming	-.0869339	.1389458	-0.63	0.532	-.3592626	.1853948
Flavor	.1082297	.1919008	0.56	0.573	-.2678889	.4843483
Texture	.0435264	.1614857	0.27	0.788	-.2729798	.3600325
Density	.1689073	.1703539	0.99	0.321	-.1649802	.5027948
Dryness	.1701245	.1633816	1.04	0.298	-.1500975	.4903465
Price	-.8156895	.1568329	-5.20	0.000	-1.123076	-.5083027
Size	-.0778141	.1711289	-0.45	0.649	-.4132206	.2575924
Visual	-.0379567	.2278506	-0.17	0.868	-.4845356	.4086222
Type	.0845016	.1532502	0.55	0.581	-.2158633	.3848665
Nutrients	-.0063084	.1610979	-0.04	0.969	-.3220546	.3094378

Brand	.2094161	.1590943	1.32	0.188	-.1024031	.5212352
Certification	.3658709	.1478408	2.47	0.013	.0761084	.6556335
Facility	.094447	.1666548	0.57	0.571	-.2321904	.4210843
ProductionLine	.0593008	.1932542	0.31	0.759	-.3194704	.4380721
certainty_very	.4358129	.3803069	1.15	0.252	-.3095749	1.181201
certainty_fairly	1.483207	.3884418	3.82	0.000	.7218746	2.244538
certainty_not	0	(omitted)				
_cons	-1.506934	1.270176	-1.19	0.235	-3.996433	.9825648
LR chi^2	202.99					
Prob > chi^2	0.0000					
Log-likelihood	-623.54					

Table B.19

Regression results for the final logit model of the WTP a premium

Variable	Coef.	Std. Err.	z	P>z	[95% Conf.	Interval]
Age	-.0222869	.0059431	-3.75	0.000	-.0339351	-.0106386
location_urban	-.2608473	.2117905	-1.23	0.218	-.6759491	.1542545
location_suburban	-.5377678	.1787568	-3.01	0.003	-.8881246	-.1874109
location_rural	0	(omitted)				
Income	7.85e-06	1.63e-06	4.81	0.000	4.65e-06	.0000111
Frequency	.0115466	.0037272	3.10	0.002	.0042415	.0188518
purchase_location_specialty	.3110043	.1595246	1.95	0.051	-.0016581	.6236667
purchase…bakery_NoFacility	.8191054	.5797893	1.41	0.158	-.3172609	1.955472
purchase_location_online	.4920884	.5512272	0.89	0.372	-.588297	1.572474
purchase_location_other	-.0964567	.393491	-0.25	0.806	-.867685	.6747715
purchase_location_bake	-.3285688	.2534549	-1.30	0.195	-.8253312	.1681936
Children	-.1759281	.0623296	-2.82	0.005	-.2980918	-.0537644
Price	-.7905753	.1425247	-5.55	0.000	-1.069919	-.511232
Certification	.3806474	.1409899	2.70	0.007	.1043123	.6569825
certainty_very	.4261706	.3607723	1.18	0.237	-.2809301	1.133271
certainty_fairly	1.452419	.3700122	3.93	0.000	.7272087	2.17763
certainty_not	0	(omitted)				
Density	.2555124	.1500361	1.70	0.089	-.0385529	.5495778
Facility_NoBakeryPurchases	.2002485	.1479639	1.35	0.176	-.0897554	.4902523
Facility&BakeryPurchases	1.379015	.5269234	2.62	0.009	.3462639	2.411766
_cons	-.0362675	.5074734	-0.07	0.943	-1.030897	.958362
LR chi^2	184.06					
Prob > chi^2	0.0000					
Log-likelihood	-635.00					

Table B.20

Logit regression of the consideration of a dedicated facility on the WTP a premium

Variable	Coef.	Std. Err.	z	P>z	[95% Conf.	Interval]
Facility	.2856035	.1291397	2.21	0.027	.0324943	.5387126
_cons	.0898808	.0774605	1.16	0.246	-.0619389	.2417006
LR chi^2	4.92					
Prob > chi^2	0.0266					
Log-likelihood	-724.57					

Table B.21

Logit regression of the WTP a premium model including both the consideration of a dedicated facility and purchase locations

Variable	Coef.	Std. Err.	z	P>z	[95% Conf.	Interval]
Age	-.02229	.0059428	-3.75	0.000	-.0339378	-.0106423
location_urban	-.2609256	.2118682	-1.23	0.218	-.6761798	.1543285
location_suburban	-.5357456	.1787301	-3.00	0.003	-.8860501	-.1854411
location_rural	0	(omitted)				
Income	7.87e-06	1.63e-06	4.82	0.000	4.67e-06	.0000111
Frequency	.0115496	.0037273	3.10	0.002	.0042442	.0188551
purchase_location_regular	0	(omitted)				
purchase_location_specialty	.310384	.1595292	1.95	0.052	-.0022876	.6230556
purchase_location_bakery	1.020843	.3948843	2.59	0.010	.2468843	1.794802
purchase_location_online	.4920891	.5512426	0.89	0.372	-.5883267	1.572505
purchase_location_other	-.0977854	.3935429	-0.25	0.804	-.8691152	.6735445
purchase_location_bake	-.3291407	.2534688	-1.30	0.194	-.8259305	.1676491
Children	-.1759442	.0623358	-2.82	0.005	-.2981202	-.0537682
Price	-.7909843	.1424993	-5.55	0.000	-1.070278	-.5116909
Certification	.3823274	.1409203	2.71	0.007	.1061286	.6585261
certainty_very	.428097	.3608078	1.19	0.235	-.2790733	1.135267
certainty_fairly	1.451204	.3700523	3.92	0.000	.7259151	2.176493
certainty_not	0	(omitted)				
Density	.2556127	.1500396	1.70	0.088	-.0384595	.549685
Facility	.2119522	.1457988	1.45	0.146	-.0738082	.4977127
_cons	-.0437468	.5073545	-0.09	0.931	-1.038143	.9506497
LR chi^2	183.84					
Prob > chi^2	0.0000					
Log-likelihood	-635.11					

Appendix C: Survey

Willingness to Pay for Gluten-Free Certification

Researchers: Amanda Merrill and Sean B. Cash, Ph.D.

Study Title: Is gluten-free worth the price? A study on consumer willingness to pay a premium on certified versus non-certified gluten-free food.

Purpose and Duration: The purpose of this study is to investigate the consumer willingness to pay a premium for certified versus non-certified gluten-free foods. We expect that it will take 5 – 10 minutes of your time.

Procedures: You will be presented with a series of questions regarding your gluten-free shopping preferences. We ask you to try your best to answer each as completely and accurately as possible.

Risks and Benefits: There are no anticipated risks associated with this study and no direct benefits. However, as a result of your participation, you will assist the researchers in better understanding gluten-free shopping considerations and desires and formulating an analysis that has the potential to improve the gluten-free market and the prevalence of gluten-free certification.

Confidentiality: The results of this study will be presented in a Senior Honors Thesis and may be published in a scholarly journal, presented, or otherwise used as a learning device. Nevertheless, complete confidentiality of responses will be maintained and no identifiers will be used to connect you to your responses.

Request for more information: You may ask questions at any time during the survey. Should you have further queries in the future, you may also contact either of the two researchers, Amanda Merrill (Amanda.Merrill@tufts.edu) or Sean B. Cash (Sean.Cash@tufts.edu).

Consent: By clicking the arrow button in the bottom right hand corner of this page, you confirm that you understand the purpose and procedures of this study and are willing to participate.

When answering questions, define "gluten-free" bread as bread either made from non-gluten-containing ingredients or consisting of less than 20 parts per million of gluten, unless otherwise stated.

Are you a current consumer of gluten-free bread or considering buying gluten-free?

- ❍ Yes
- ❍ No

If “Yes” is selected, then skip to “How long have you purchased gluten-free b...” If “No” is selected, then skip to end of survey.

How long have you purchased gluten-free bread?
- ❍ Under 1 month
- ❍ 1-6 months
- ❍ 6 months to 1 year
- ❍ 1-2 years
- ❍ 3 years or more

How often do you purchase gluten-free bread?
- ❍ Once a week or more often
- ❍ 2-3 times a month
- ❍ Once a month
- ❍ Every 2-3 months
- ❍ 2-3 times a year
- ❍ Once a year or less

Which of the following best describes your need for this gluten-free bread?
- ❍ I or someone in my household has Wheat Allergy.
- ❍ I or someone in my household has Wheat Intolerance.
- ❍ I or someone in my household has Celiac Disease.
- ❍ I or someone in my household eat(s) gluten-free as part of a healthy diet.
- ❍ I or someone in my household eat(s) gluten-free for other reasons.
- ❍ I am not at all interested in this product.

Which of the following best describes your gluten-free bread purchases?

- ❍ I buy gluten-free bread for myself.
- ❍ I buy gluten-free bread for someone in my household.
- ❍ Both

Where do you most often shop for/purchase gluten-free bread?

- ❍ "Regular" Supermarket (ex. Market Basket, Stop & Shop, etc.)
- ❍ Specialty Food Stores (ex. Whole Foods)
- ❍ Gluten/Allergen-Free Bakeries
- ❍ Online Retailers
- ❍ Other
- ❍ I bake at home

What factors do you consider when purchasing gluten-free bread? Please drag and drop your choices into the box in order of importance. You may indicate as many factors as you consider important.

Product considerations:
_____ Flavor
_____ Texture
_____ Density
_____ Dryness
_____ Price
_____ Size of loaf
_____ Visual (ex. rising, browning, etc.)
_____ Type (white, multigrain)
_____ Nutritional content (calories, low sodium, high fiber, etc.)
_____ Brand name (Udi's, Rudi's, Ener-G, etc.)
_____ "Certified Gluten-Free" label
_____ Dedicated gluten-free facility
_____ Dedicated gluten-free production line

Are you familiar with the label "Certified Gluten-Free" and what it guarantees?

- ❍ I am familiar with both the label AND what it guarantees.
- ❍ I am familiar with the label but not what it guarantees.
- ❍ I am familiar with what the label guarantees but not with the label itself.
- ❍ I am familiar with NEITHER the label nor what it guarantees.

Below is a description of the most common North American gluten-free certification:

Gluten Intolerance Group (GIG)

- Upper limit of less than 10ppm
- Oats and ingredients derived from wheat, barley, and rye but have been processed to remove gluten CAN be included
- Final product must be tested for gluten by GIG
- At-risk raw ingredients are tested as needed
- Does NOT require dedicated gluten-free facility or production line
- Certification lasts one year
- Manufacturers are required to test product throughout the year
- Manufacturers are NOT required to regularly submit to a third party lab for testing

Source: http://www.glutenfreedietitian.com/newsletter/wp-content/uploads/2011/07/BLOGGlutenFreeCertificationsTABLEJuly143.pdf

Please take a minute to read through the following gluten-free labeling-related news article:

Durham man who sold fake gluten-free bread gets 11 years in prison

By Jay Price

April 12, 2011

2011-04-12T19:04:56Z

RALEIGH — The Durham man [Paul Seelig, 48] was sentenced today to 11 years in prison for falsely representing bake goods he sold at street fairs and on the Internet as gluten-free, sickening more than two dozen customers.

Several of his customers with the disease testified during the trial that Seelig's products had made them ill. One woman said that she had delivered her baby prematurely, something that can be triggered in celiac patients by exposure to gluten.

Seelig's company, Great Specialty Products, sold baked items that he claimed were homemade. Instead, witnesses including a former employee testified, he bought bread from a commercial baker in New Jersey and bagels from retailers such as Costco. He then repackaged them in his home kitchen and sold them at the State Fair, street fairs and by home delivery.

He advertised that the bread was made in a 150,000-square-foot commercial kitchen and that the company raised its own grains on a 400-acre farm.

He sold some of those products as gluten-free, though they weren't. Customers and investigators tested the products and found high levels of gluten. Seelig claimed that he tested his bread for gluten weekly, though he couldn't produce test records for the trial. He also maintained that he got his gluten-free products from an Amish baker in Ohio, who had no phone, no street or e-mail address, and said that he paid in cash, so there were no payment records.

Gluten-free products sell at premium prices, but there is no federal standard for them, so Seelig's conviction was an unusual courtroom victory for celiac sufferers, who have to rely on the honesty of food companies and restaurants that claim to produce products without gluten.

Source: http://www.newsobserver.com/2011/04/12/1125084/durham-man-who-sold-fake-gluten.html (shortened)

For the next few questions, please keep in mind your household budget. In previous surveys, we have found individuals to overstate the amount they would actually be willing to pay once they are at the point of sale. For this reason, please imagine that you are shopping and actually deciding whether or not to pay for the described product or quality.

The average price of a loaf of gluten-free bread in the U.S. is $6.00. Are you willing to pay this price?

- ❍ Yes
- ❍ No

Would you be willing to pay a premium (i.e. a price above the average selling price) for your bread to be certified gluten-free?

- ❍ Yes
- ❍ No

Keeping in mind the average selling price of $6.00 for a loaf of gluten-free bread, what is the maximum amount you would be willing to pay for a loaf of CERTIFIED gluten-free bread containing the label we showed you previously?

- ❍ $6.00
- ❍ $6.10
- ❍ $6.25
- ❍ $6.50
- ❍ $6.75
- ❍ $7.00
- ❍ $7.50
- ❍ $8.00
- ❍ $8.50
- ❍ $9.00
- ❍ $9.50
- ❍ $10.00
- ❍ $10.50
- ❍ $11.00
- ❍ $11.50
- ❍ $12.00
- ❍ More than $12.00

How certain are you of your response?

- ❍ Very
- ❍ Fairly
- ❍ Not at all

Display if for "What is the maximum amount you are willing to pay for gluten-free certification, in addition to t..." $0.00 is selected.

You have indicated that you would not be willing to pay a premium for gluten-free certification. Please choose the reason that most closely matches your belief.

- ❍ Gluten-free certification is not necessary for my diet
- ❍ Gluten-free bread is already too expensive
- ❍ Certification benefits do not outweigh the cost
- ❍ It is unfair to pay a premium for certification
- ❍ I would rather go without or bake my own bread
- ❍ Other

Please indicate your gender.

- ❍ Male
- ❍ Female

Please indicate your ethnicity.

- ❍ White/Caucasian
- ❍ African American
- ❍ Asian/Pacific Islander
- ❍ Hispanic
- ❍ Indigenous or Aboriginal
- ❍ Latino
- ❍ Multiracial
- ❍ Other

What is your age?

- ❍ 18 - 24
- ❍ 25 - 34
- ❍ 35 - 44
- ❍ 45 - 54
- ❍ 55 - 64
- ❍ 65 and over

Which of the following best describes the area you live in?

- ❍ Urban
- ❍ Suburban
- ❍ Rural

What is your highest level of education?

- ❍ Some high school
- ❍ High school graduate or equivalent
- ❍ Vocational/technical school
- ❍ Some college
- ❍ College graduate
- ❍ Postgraduate/professional

Please indicate the number of children in your household under the age of 18.

- ❍ None
- ❍ One
- ❍ Two
- ❍ Three
- ❍ Four or more

What is your current work status?

- ❍ Student
- ❍ Work full time
- ❍ Work part time
- ❍ Homemaker
- ❍ Unemployed
- ❍ Retired

Please indicate your approximate yearly household income before taxes. (Include total income of all adults living in your household.)

- ❍ Under $25,000
- ❍ $25,001 - $49,999
- ❍ $50,000 - $74,999
- ❍ $75,000 - $99,999
- ❍ $100,000 -$149,999
- ❍ $150,000 and over
- ❍ Prefer not to answer

References

Alhassan, M., Loomis, J., Frasier, M., Davies, S., & Andales, A. (2013). Estimating farmers' willingness to pay for improved irrigation: An economic study of the bontanga irrigation scheme in northern Ghana. *Journal of Agricultural Science, 5*(4), 31-42.

Arrow, K., Solow, R., Portney, P. R., Leamer, E. E., Radner, R., & Schuman, H. (1993). Report of the NOAA panel on contingent valuation. *Federal Register, 58*(10), 4601-4614.

Asthma and Allergy Foundation of America (AAFA) Editorial Board. (2005). Wheat allergy. Retrieved September 15, 2013, Retrieved from http://www.aafa.org/display.cfm?id=9&sub=20&cont=519

Batte, M. T., Hooker, N. H., Haab, T. C., & Beaverson, J. (2007). Putting their money where their mouths are: Consumer willingness to pay for multi-ingredient, processed organic food products. *Food Policy, 32*(2), 145-159. doi:http://dx.doi.org/10.1016/j.foodpol.2006.05.003

Boulder Brands, I. (2012). Smart balance signs definitive agreement to acquire Udi's healthy foods, LLC. Retrieved May 5, 2014, Retrieved from http://globenewswire.com/news-release/2012/06/01/478300/257899/en/Smart-Balance-Signs-Definitive-Agreement-to-Acquire-Udi-s-Healthy-Foods-LLC.html

Boye, J. I., & Godefroy, S. B. (Eds.). (2010). *Allergen management in the food industry* (1st ed.). Hoboken, New Jersey: John Wiley & Sons, Inc.

Boyle, K. J. (2003). Contingent valuation in practice. In P. A. Champ, K. J. Boyle & T. C. Brown (Eds.), *A primer on nonmarket valuation* (pp. 111-169) Kluwer Academic Publishers.

Brannick, M. T. Logistic regression. Retrieved May 4, 2014, Retrieved from http://luna.cas.usf.edu/~mbrannic/files/regression/Logistic.html

Buie, T. (2013). The relationship of autism and gluten. *Clinical Therapeutics, 35*(5), 578-583. doi:http://dx.doi.org/10.1016/j.clinthera.2013.04.011

Burnett, P., Kuethe, T. H., & Price, C. (2011). Consumer preference for locally grown produce: An analysis of willingness-to-pay and geographic scale. *Journal of Agriculture, Food Systems, and Community Development*, , 269-278.

Cameron, T. A., & Huppert, D. D. (1989). OLS versus ML estimation of non-market resource values with payment card interval data. *Journal of Environmental Economics and Management, 17*(3), 230-246. doi:http://dx.doi.org/10.1016/0095-0696(89)90018-1

Canadian Celiac Association. (2011). Certification. Retrieved November 11, 2013, Retrieved from http://www.celiac.ca/index.php/about-the-cca/certification/

Canadian Celiac Association. (2013). Gluten-free certification program. Retrieved November 11, 2013, Retrieved from http://www.glutenfreecertification.ca/certification/

Canadian food inspection agency (CFIA) compliance and enforcement of gluten-free claims, (2012).

Carpio, C. E., & Isengildina-Massa, O. (2009). Consumer willingness to pay for locally grown products: The case of South Carolina. *Agribusiness, 25*(3), 412-426. doi:10.1002/agr.20210

Carson, R. T., Flores, N. E., & Meade, N. F. (2001). Contingent valuation: Controversies and evidence. *Environmental and Resource Economics, 19*, 173-210.

Carson, R. T., & Hanemann, W. M. (2005). Contingent valuation. In K. Maler, & J. R. Vincent (Eds.), *Handbook of environmental economics: Valuing environmental changes* (2nd ed., pp. 821-936). Amsterdam: Elsevier B.V.

Celiac Sprue Association. (2013). *The Celiac Sprue Association Recognition Seal Program background information and application instructions*

Collin, P., Thorell, L., Kaukinen, K., & Mäki, M. (2004). The safe threshold for gluten contamination in gluten-free products. can trace amounts be accepted in the treatment of coeliac disease? *Alimentary Pharmacology & Therapeutics, 19*(12), 1277-1283. doi:10.1111/j.1365-2036.2004.01961.x

Cornelisse-Vermaat, J. R., Voordouw, J., Vassiliki, Y., Theodoridis, G., & Frewer, L. J. (2007). Food-allergic consumers' labelling preferences: A cross-cultural comparison. *European Journal of Public Health, 18*(2), 115-120. doi:10.1093/eurpub/ckm032

Cummings, R. G., & Taylor, L. O. (1999). Unbiased value estimates for environmental goods: A cheap talk design for the contingent valuation method. *American Economic Review, 89*(3), 649-665.

DiGiacomo, D. V., Tennyson, C. A., Green, P. H., & Demmer, R. T. (2013). Prevalence of gluten-free diet adherence among individuals without celiac disease in the USA: Results from the continuous national health and nutrition examination survey 2009–2010. *Scand J Gastroenterol*, *48*(8), 921-925. doi:10.3109/00365521.2013.809598

Elkan, A., Sjoberg, B., Kolsrud, B., Ringertz, B., Hafstrom, I., & Frostegard, J. (2008). Gluten-free vegan diet induces decreased LDL and oxidized LDL levels and raised atheroprotective natural antibodies against phosphorylcholine in patients with rheumatoid arthritis: A randomized study. *Arthritis Research & Therapy JID - 101154438*, *10*(2) doi:10.1186/ar2388

Fasano A, Berti I, Gerarduzzi T,et al. (2003). Prevalence of celiac disease in at-risk and not-at-risk groups in the united states: A large multicenter study. *Archives of Internal Medicine*, *163*(3), 286-292. doi:10.1001/archinte.163.3.286

Fernandez-Cornejo, J., Daberkow, S. G., & McBride, W. D. (2001). Decomposing the size effect on the adoption of innovations: Agrobiotechnology and precision farming. *American Agricultural Economics Association 2001 Annual Meeting,* Chicago, IL.

Food allergen labeling and consumer protection act of 2004, Public Law 108-282, Title IIU.S.C. 201 (2004).

Food and Agriculture Organization of the United States, Economic and Social Development Department. (2000). Applications of the contingent valuation method in developing countries. Retrieved December 20, 2013, Retrieved from http://www.fao.org/docrep/003/x8955e/x8955e03.htm

Food labeling; gluten-free labeling of foods, RuleU.S.C. (2013).

Food Manufacturing. (2013). Consumer trends: Gluten-free market experiencing double-digit growth. Retrieved February 2, 2014, Retrieved from http://www.foodmanufacturing.com/news/2013/07/consumer-trends-gluten-free-market-experiencing-double-digit-growth

Gaesser, G. A., & Angadi, S. S. (2012). Gluten-free diet: Imprudent dietary advice for the general population? [Abstract]. *Journal of the Academy of Nutrition and Dietetics*, *112*(9) 1330-1333.

Gluten Intolerance Group. (2014). FAQ: Gluten-free certification organization (GFCO). Retrieved May 5, 2014, Retrieved from https://www.gluten.net/programs/industry-programs/gluten-free-certification-organization/faq-gluten-free-certification-organization-gfco/

Gluten-Free Agency. (2012). Gluten-free market trends. Retrieved February 2, 2014, Retrieved from http://thegluten-freeagency.com/gluten-free-market-trends/

Gluten-Free Certification Program. (2013). *Gluten-free certification program technical release #1*

Gluten-Free Certification Program. (2014). Program pricing. Retrieved May 5, 2014, Retrieved from http://www.glutenfreecertification.ca/certification/program-pricing/

Hafstrom, I., Ringertz, B., Spangberg, A., von Zweigbergk, L., Brannemark, S., Nylander, I., . . . Klareskog, L. (2001). A vegan diet free of gluten improves the signs and symptoms of

rheumatoid arthritis: The effects on arthritis correlate with a reduction in antibodies to food antigens. *Rheumatology, 40*(10), 1175-1179. doi:10.1093/rheumatology/40.10.1175

Harpman, D. A., Welsh, M. P., & Bishop, R. C. (1993). Nonuse economic value: Emerging policy analysis tool. *Rivers*, *4*(4), 280-291.

Harrison, G. W., & Rutström, E. E. (2008). Experimental evidence on the existence of hypothetical bias in value elicitation methods. In C. R. Plott, & V. L. Smith (Eds.), *Handbook of experimental economics results* (1st ed., pp. 752-767) Elsevier.

Hatanaka, M., Bain, C., & Busch, L. (2005). Third-party certification in the global agrifood system. *Food Policy, 30*(3), 354-369. doi:http://dx.doi.org/10.1016/j.foodpol.2005.05.006

Hausman, J. A. (Ed.). (1993). *Contingent valuation: A critical assessment*. Amsterdam: Elsevier Science B.V.

Hicks, J. R. (1946). *Value and capital: An inquiry into some fundamental principles of economic theory* (Second ed.). Oxford: Oxford University Press.

Hlywiak, K. H. (2008). Hidden sources of gluten. *Practical Gastroenterology, 32*(9), 27-34; 39.

Houba, R., Doekes, G., & Heederik, D. (1998). Occupational respiratory allergy in bakery workers: A review of the literature. *American Journal of Industrial Medicine, 34*(6), 529-546. doi:10.1002/(SICI)1097-0274(199812)34:6<529::AID-AJIM1>3.0.CO;2-I

Hu, W., Woods, T., Bastin, S., Cox, L., & You, W. (2011). Assessing consumer willingness to pay for value-added blueberry products using a payment card survey. *Journal of Agricultural and Applied Economics, 43*(2), 243-258.

Huang, C. L., Kan, K., & Fu, T. (1999). Consumer willingness-to-pay for food safety in Taiwan: A binary-ordinal probit model of analysis. *Journal of Consumer Affairs, 33*(1), 76-91. doi:10.1111/j.1745-6606.1999.tb00761.x

James, S. P. (2005). National institutes of health consensus development conference statement on celiac disease, June 28–30, 2004. *Gastroenterology, 128*(4, Supplement 1), S1-S9. doi:http://dx.doi.org/10.1053/j.gastro.2005.02.007

Jayson L. Lusk, & Hudson, D. (2004). Willingness-to-pay estimates and their relevance to agribusiness decision making. *Review of Agricultural Economics, 26*(2), 152-169.

Johansson, S. G. O., Bieber, T., Dahl, R., Friedmann, P. S., Lanier, B. Q., Lockey, R. F., . . . Williams, H. C. (2004). Revised nomenclature for allergy for global use: Report of the nomenclature review committee of the world allergy organization, October 2003. *Journal of Allergy and Clinical Immunology*, *113*(5), 832-836. doi:http://dx.doi.org/10.1016/j.jaci.2003.12.591

Johansson, S. G. O., Bieber, T., Dahl, R., Friedmann, P. S., Lanier, B. Q., Lockey, R. F., . . . Williams, H. C. (2004). Revised nomenclature for allergy for global use: Report of the nomenclature review committee of the world allergy organization, October 2003. *Journal of Allergy and Clinical Immunology*, *113*(5), 832-836. doi:http://dx.doi.org/10.1016/j.jaci.2003.12.591

Jordan, J. L., & Elnagheeb, A. H. (1993). Willingness to pay for improvements in drinking water quality. *Water Resources Research, 29*(2), 237-245. doi:10.1029/92WR02420

Keet, C. A., Matsui, E. C., Dhillon, G., Lenehan, P., Paterakis, M., & Wood, R. A. (2009). The natural history of wheat allergy. *Annals of Allergy, Asthma & Immunology, 102*(5), 410-415. doi:http://dx.doi.org/10.1016/S1081-1206(10)60513-3

Kim, H. J., & Cho, Y. (2002). Estimating willingness to pay for reduced copper contamination in southwestern Minnesota. *Journal of Agricultural & Resource Economics, 27*(2)

Lancaster, K. J. (1966). A new approach to consumer theory. *Journal of Political Economy, 74*(2), 132-157.

Layton, L. (2011,). 3 years after deadline, FDA still hasn't defined 'gluten-free'. *The Washington Post*

Lee, A. R., Ng, D. L., Zivin, J., & Green, P. H. R. (2007). Economic burden of a gluten-free diet. *Journal of Human Nutrition and Dietetics, 20*(5), 423-430. doi:10.1111/j.1365-277X.2007.00763.x

Louden, N. Potential hidden sources of gluten. Retrieved December 27, 2014, Retrieved from http://www.glutenfreegluten.com/wp-content/downloads/Hidden_Gluten_Sources.pdf

Lusk, J. L., & Hudson, D. (2004). Willingness-to-pay estimates and their relevance to agribusiness decision making. *Review of Agricultural Economics, 26*(2), 152-169.

Lusk, J. L., Roosen, J., & Shogren, J. F. (Eds.). (2011). *The oxford handbook of the economics of food consumption and policy*. Oxford: Oxford University Press.

Marcin, T. C. (1992). A characteristics model approach to demand analysis for wood composites. *Forest Sector, Trade and Environmental Impact Models: Theory and Applications: Proceedings of an International Symposium,* Seattle, WA. 119-124.

MarketsandMarkets. (2013). Gluten-free products market global trends & forecasts to 2018. Retrieved February 2, 2014, Retrieved from http://www.marketsandmarkets.com/ResearchInsight/gluten-free-products-natural-and-conventional-market.asp

Mazis, M. B., Ahtola, O. T., & Klippel, R. E. (1975). A comparison of four multi-attribute models in the prediction of consumer attitudes. *Journal of Consumer Research, 2*(1), 38-52.

Miller, C., Guha, B., & Krishnaswamy, G. (2008). Exercise-induced anaphylaxis: A serious but preventable disorder.

Mills, E. N. C., Valovirta, E., Madsen, C., Taylor, S. L., Vieths, S., Anklam, E., . . . Frewer, L. (2004). Information provision for allergic consumers - where are we going with food allergen labelling? *Allergy, 59*(12), 1262-1268. doi:10.1111/j.1398-9995.2004.00720.x

Mintel. (2013). Gluten-free foods - US - September 2013. Retrieved December 8, 2013, Retrieved from http://store.mintel.com/gluten-free-foods-us-september-2013

Moon, W., & Balasubramanian, S. K. (2003). Willingness to pay for non-biotech foods in the U.S. and U.K. *Journal of Consumer Affairs, 37*(2), 317-339. doi:10.1111/j.1745-6606.2003.tb00456.x

Mooney, P. D., Aziz, I., & Sanders, D. S. (2013). Non-celiac gluten sensitivity: Clinical relevance and recommendations for future research. *Neurogastroenterology & Motility, 25*(11), 864-871. doi:10.1111/nmo.12216

Moore, C. C. (2008). *Using empirical benefit estimates in a bioeconomic model of invasive species control*. Ann Arbor, MI: ProQuest LLC.

Morey, E. (2012). What is the contingent valuation method, CVM? Retrieved January 4, 2014, Retrieved from http://www.colorado.edu/economics/morey/4545/nonmarket/cvmbasic.pdf

Morita, E., Kunie, K., & Matsuo, H. (2007). Food-dependent exercise-induced anaphylaxis. *Journal of Dermatological Science, 47*(2), 109-117. doi:http://dx.doi.org/10.1016/j.jdermsci.2007.03.004

Murhpy, J. J., & Stevens, T. H. (2004). *Contingent valuation, hypothetical bias and experimental economics*

O'Rourke, L. (2013). Non celiac gluten sensitivity - what does it mean? Scientists reach agreement on classification. Retrieved September 15, 2013, Retrieved from http://www.gluten.net/articles/2013/01/10/non-celiac-gluten-sensitivity---what-does-it-mean-scientists-reach-agreement-on-classification

Packaged Facts. (2012). Gluten-free foods and beverages in the U.S., 4th edition. Retrieved December 1, 2013, Retrieved from http://www.packagedfacts.com/gluten-free-foods-7144767/

Packaged Facts. (2012). Gluten-free foods and beverages in the U.S., 4th edition. Retrieved December 8, 2013, Retrieved from http://www.packagedfacts.com/gluten-free-foods-7144767/

Pastore, M., Bazzigaluppi, E., Belloni, C., Arcovio, C., Bonifacio, E., & Bosi, E. (2003). Six months of gluten-free diet do not influence autoantibody titers, but improve insulin secretion in subjects at high risk for type 1 diabetes. *The Journal of Clinical Endocrinology & Metabolism, 88*(1), 162-165. doi:10.1210/jc.2002-021177

Paul J Turner, Andrew S Kemp, & Dianne E Campbell. (2011). Advisory food labels: Consumers with allergies need more than "traces" of information. *Bmj, 343* doi:10.1136/bmj.d6180

Poole, J. A., Barriga, K., Leung, D. Y. M., Hoffman, M., Eisenbarth, G. S., Rewers, M., & Norris, J. M. (2006). Timing of initial exposure to cereal grains and the risk of wheat allergy. *Pediatrics, 117*(6), 2175. doi:10.1542/peds.2005-1803

Portney, P. R. (1994). The contingent valuation debate: Why economists should care. *Journal of Economic Perspectives, 8*(4), 3-17.

Quinones-Galvan, A., Lifshitz-Guinzberg, A., & Ruiz-Arguelles, G. J. (1990). Gluten-free diet for AIDS-associated enteropathy. *Annals of Internal Medicine, 113*(10), 806-807. doi:10.7326/0003-4819-113-10-806

Ridker PM, Stampfer MJ,Rifai N. (2001). Novel risk factors for systemic atherosclerosis: A comparison of c-reactive protein, fibrinogen, homocysteine, lipoprotein(a), and standard cholesterol screening as predictors of peripheral arterial disease. *Jama, 285*(19), 2481-2485. doi:10.1001/jama.285.19.2481

Sanders, D. R., Moon, W., & Kuethe, T. H. (2007). Consumer willingness-to-pay for fresh pork attributes. *Journal of Agribusiness, 25*(2), 163-179.

Sapone, A., Bai, J. C., Ciacci, C., Dolinsek, J., Green, P. H., Hadjivassiliou, M., . . . Fasano, A. (2012). Spectrum of gluten-related disorders: Consensus on new nomenclature and classification. Retrieved September 15, 2013, Retrieved from http://www.biomedcentral.com/1741-7015/10/13

Saturni, L., Ferretti, G., & Bacchetti, T. (2010). The gluten-free diet: Safety and nutritional quality. *Nutrients, 2*(1), 16-34.

Shewry, P. R. (2009). Wheat. *Journal of Experimental Botany, 60*(6), 1537-1553. doi:10.1093/jxb/erp058

Sicherer, S. H., & Sampson, H. A. (2010). Food allergy [Abstract]. *The Journal of Allergy and Clinical Immunology, 125*(2) S116-S125. doi:1016/j.jaci.2009.08.028

Simons, E., Weiss, C. C., Furlong, T. J., & Sicherer, S. H. (2005). Impact of ingredient labeling practices on food allergic consumers. *Annals of Allergy, Asthma & Immunology, 95*(5), 426-428. doi:http://dx.doi.org/10.1016/S1081-1206(10)61166-0

Singh, J., & Whelan, K. (2011). Limited availability and higher cost of gluten-free foods. *Journal of Human Nutrition and Dietetics, 24*(5), 479-486. doi:10.1111/j.1365-277X.2011.01160.x

Spence, D. (2013). Bad medicine: Food intolerance. *Bmj, 346* doi:10.1136/bmj.f529

Stevens, L., & Rashid, M. (2008). Gluten-free and regular foods: A cost comparison. *Canadian Journal of Dietetic Practice and Research, 69*(3), 147.

Strawbridge, H. (2013,). Going gluten-free just because? Here's what you need to know. Retrieved from http://www.health.harvard.edu/blog/going-gluten-free-just-because-heres-what-you-need-to-know-201302205916

Tolley, G., Kenkel, D., & Fabian, R. (Eds.). (1994). *Valuing health for policy: An economic approach*. Chicago: The University of Chicago Press.

Turner, P. J., Kemp, A. S., & Campbell, D. E. (2011). Advisory food labels: Consumers with allergies need more than "traces" of information. *Bmj, 343* doi:10.1136/bmj.d6180

U.S. Department of Agriculture, Food and Nutrition Service (FNS). (2006). Get the facts: New food labeling laws. Retrieved October 1, 2013, Retrieved from http://www.fns.usda.gov/fdd/_private/_audit/FoodAllergenFactSheet.pdf

Targeted verification of product formulation and labeling for the eight most common ("big 8") food allergens, 29-13, (2013).

U.S. Department of Health and Human Services, Food and Drug Administration (FDA). (2013). Questions and answers: Gluten-free food labeling final rule. Retrieved November 12, 2013, Retrieved from http://www.fda.gov/Food/GuidanceRegulation/GuidanceDocumentsRegulatoryInformation/Allergens/ucm362880.htm

U.S. Department of Health and Human Services, Food and Drug Administration, Center of Food Safety and Applied Nutrition, Office of Food Safety. (May 2011). *Health hazard assessment for gluten exposure in individuals with celiac disease: Determination of tolerable daily intake levels and levels of concern for gluten.* ().

Udi's. (2013). Our story. Retrieved May 5, 2014, Retrieved from http://udisglutenfree.com/about-us/story/

Udi's. (2014). Products. Retrieved May 5, 2014, Retrieved from http://udisglutenfree.com/product-catalog/

Voordouw, J., Cornelisse-Vermaat, J. R., Yiakoumaki, V., Theodoridis, G., Chryssochoidis, G., & Frewer, L. J. (2009). Food allergic consumers' preferences for labelling practices: A qualitative study in a real shopping environment. *International Journal of Consumer Studies, 33*(1), 94-102. doi:10.1111/j.1470-6431.2008.00735.x

Welsh, M. P., & Poe, G. L. (1998). Elicitation effects in contingent valuation: Comparisons to a multiple bounded discrete choice approach. *Journal of Environmental Economics and Management, 36*(2), 170-185. doi:http://dx.doi.org/10.1006/jeem.1998.1043

Wieser, H., & Koehler, P. (2008). The biochemical basis of celiac disease. *Cereal Chemistry Journal, 85*(1), 1. doi:10.1094/CCHEM-85-1-0001

Worosz, M. R., & Wilson, N. L. W. (2012). A cautionary tale of purity, labeling and product literacy in the gluten-free market. *Journal of Consumer Affairs, 46*(2), 288-318. doi:10.1111/j.1745-6606.2012.01230.x