Journal of Agribusiness

Volume 38 Number 1 Spring 2020

Articles

Journal of Agribusiness 38, 1 (Spring 2020)

Bearers of Bad News: Heterogeneous Effects of Alternative Front-of-Package Labeling Schemes for Nutritional Information

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The effectiveness of front-of-package labeling depends on the extent to which the nutritional information is presented in a way that is noticed and understood by consumers. We show that one reason for ambiguous results in previous research is that the impact of nutritional labeling of specific nutrients on consumer perceptions is heterogeneous; consumers who are more motivated by specific nutritional concerns pay more attention to that nutritional information. Most studies have not taken into account this heterogeneity in consumer preferences based on individual nutritional concerns and, therefore, have often missed the important effects that we find for the motivated subset.

***Key words**:* Food Labels, Food Packaging, Food Policy, Front-of-Package, Nutrition Labels, Nutritional Information

Rising rates of obesity and related problems in public health have spurred considerable interest in public policies and voluntary practices aimed at changing food consumption behavior. Nutritional labeling of food represents one area of ongoing policy research, particularly policy that makes allowance for voluntary labeling (Andrews et al., 2014). A key policy question is how to present important nutritional information in a way that will be noticed and understood by consumers (Andrews et al., 2014). Previous work on alternative package labeling schemes has arrived at mixed results (Hieke and Taylor, 2012; Williams, 2005). In this paper, we show that one reason for ambiguous results is that the impact of nutritional labeling on consumer perceptions is heterogeneous: consumers who are more motivated by specific nutritional concerns quite naturally pay more attention to that particular nutritional information. Consumers who care less are less influenced. Studies that do not take account of this nutrient-specific heterogeneity in consumer preferences or motivations are likely to miss important effects for the motivated subset, even when they control for the mediating effect of a general health or nutritional motivation.

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We implement our study using a survey-based experiment with alternative front of package (FOP) labeling of basic nutritional content, the three treatment regimens representing different levels of salience in the presentation of information. Average treatment effects reveal no systematic pattern of differential responses to more salient FOP labels, which could be interpreted as evidence that labeling modes are unimportant. But estimating a more sophisticated model with heterogeneous treatment effects, we find that more salient label formats have a significantly greater effect on perception for consumers motivated by specific nutrient concerns. Accounting for the interaction between label salience and nutrient-specific concerns is an important innovation of our approach. A key contribution of our paper is to estimate the impact of these nutrient-specific concerns, rather than simply generic motivation, on how consumers respond to front-of-package nutrition labels.

The implications for policy are subtle. On the one hand, the results suggest that close attention to nutritional labeling details is warranted: it does indeed seem to matter how the information is presented. On the other hand, it only matters for some people—namely, those motivated by nutritional concerns in the first place. Reaching consumers who are less motivated may require looking beyond labeling protocols or designing labels that do more than make information more accessible.

Background and Literature Review

Making healthy food choices has become increasingly difficult for Americans over the last several decades. Factors contributing to this trend include: an increasing quantity and variety of low-cost food options, many of which may have limited nutritional value; greater consumption of prepared foods and restaurant foods, which often contain large amounts of salt, sugar or fat that make foods tasty but are not easily noticed by consumers; busy schedules that limit food preparation time; inadequate health and nutrition education; and of most relevance to the current study, confusing packaging/marketing. The end result is that diet-related health problems have become epidemic in the United States, with 39.8% of adult Americans now classified as obese by the CDC, and 71.6% classified as overweight or obese in 2015-16 (Centers for Disease Control and Prevention, n.d.).

Food labels that are complex, confusing, and inconvenient may have exacerbated the problem by making it difficult for many people to find accessible, easy-to-understand nutritional information on the foods they purchase. These issues have caused food manufactures to use Front of Package (FOP) labeling more extensively, as consumers use the federally-mandated nutritional panel less and less (Todd and Variyam, 2008). The federally mandated labels are back-of-package or side-of-package labels and are heavily regulated. FOP labels do not fall under these guidelines, and as a result they are presented in alternative formats and a wide variety of information is displayed in many different ways (U.S. Food and Drug Administration (FDA), 2009).

The label standards currently in place come from the National Labeling and Education Act of 1990, which gave the FDA the power to regulate food labels (FDA, 2013a). From this came the back of package Nutrition Facts panel (NFP) in use today. The required information has changed over the years with the FDA responding to industry and consumer needs; however, the format of the NFP label has remained largely the same. Meanwhile, manufacturers, sometimes in conjunction with various labeling organizations, began adding front-of-package (FOP) labels making various health or nutritional claims about the product. FOP labels include nutritional information, Daily Recommended Values (DV%), specific health claims such as “Low Fat”, and summary labels. A summary label is a logo or emblem displayed on the front of the packaging that indicates the food is healthy according to the criteria set forth by the labeling organization; examples include the “Smart Choices” label of the American Society for Nutrition and NSF International, and the “Heart Check” label of the American Heart Association.

Interpretation of nutrient-specific FOP labels may be facilitated by some kind of categorization based on health-related thresholds, identifying the content as high or low relative to some recommended DV. Such valuations can be made more salient for consumers by color coding, for example, through the use of so-called traffic-light labels that employ color to distinguish between low, medium, and high nutrition values. In our experiment we compare the effects of three alternative labeling treatments, consisting of numerical nutrient content (DV%), a high-low categorization, and a color-coded traffic light label.

Although the FDA has not yet implemented a standard for FOP labeling, industry groups have attempted to do so. In 2013 the Grocery Manufacturers Association and the Food Marketing Institute launched their “Facts Up Front” FOP label, which lists amounts for four primary nutrients: calories, saturated fats, sodium, and sugars. In addition to these standard “negative” nutrients, manufactures would be able to include two positive nutrients; potassium, dietary fiber, protein, vitamin A, vitamin C, vitamin D, calcium, or iron (FactsUpFront.org, 2013).

Intuitively, the potential strengths and weaknesses of the various FOP schemes are fairly apparent. Nutrient-specific nutritional labels, including DV% claims, provide specific content information, but consumers may have a difficult time comprehending and interpreting DV% claims (Block and Peracchio, 2006). While summary labels such as "Smart Choices" are simple, easy to understand, and appear to be preferred by US consumers over a "traffic light" (high-medium-low) style label (Andrews, Burton, and Kees, 2011), the very simplicity of the label and uncertainty about the motives of the manufacturer or labeling association may lead to a loss of credibility. This "schemer schema" may result in consumers discounting or dismissing information provided by summary claims.

A potential problem with any FOP label is that consumers may rate products using only information from the FOP label, potentially ignoring nutritional information not listed, or placed on the back of the package. As a result, consumers may view a food that is nutritionally empty, such as diet soda, as being superior to nutritionally dense foods such as 100% juice, because the information on the FOP label (such as calorie count) is more appealing (Kim et al., 2012).

This study stresses that front of package (FOP) labeling is used as an element of communication with the shopper. In terms of the longstanding debate about measuring the effect of advertising (Colley, 1961), labeling is deemed to affect perception and thereby ultimately sales. Measuring advertising effects directly in terms of sales, as some have tried (Colley, 1962), is difficult (Boyd Jr., Ray, and Strong, 1972) because ultimate sales involve moving the consumer along a hierarchy of effects, from changes in perception to later changes in behavior. Furthermore, the ultimate purchase decision involves the entire marketing mix, including product attributes, the price, the location on the shelf, out-of-stock items, etc. We restrict our investigation to the first link in this chain – namely, measuring the effectiveness of package labeling as communication.

The goal of FOP nutritional labeling is assumed to be to change the healthfulness perception of the food (Antúnez et al., 2013). We measure the communication impact of package labeling on consumer perceptions of the healthfulness of a commonly consumed whole-meal product – frozen dinners. We shy away from ingredient products such as flour or milk because their nutritional implications clearly are recipe-dependent. Instead, we choose the ready-made frozen dinner category because each dinner is typically intended to be an entire meal with little or nothing added to it. A further advantage is that a number of previous studies on nutritional labels have used mock frozen dinners, so our results should be broadly comparable (Andrews, Burton, and Kees, 2011; Kemp et al., 2007; Hersey et al., 2013). For our set of frozen dinners, we manipulate the FOP labeling, which identifies the serving size, calories, fat, sugar, and sodium contained within. These are the key ingredients in most government and industry FOP proposals, including the Facts Up Front label.

The research most closely related to our paper is a series of studies on the effects of individual health and nutritional motivation as well as related characteristics (such as self-control) on consumer responses to nutritional information. A key early study was (Moorman, 1990), who identified the role of consumers' "enduring motivation" in mediating consumer processing of food labels. In Moorman's study, enduring motivation essentially refers to what we will call general nutritional concern, and specifically to the importance an individual attaches to reading food labels generally. The expectation is that nutritional information will be of greater relevance to consumers with greater general nutritional concern; thus, controlling for ability to process information and familiarity with the kind of information provided, more motivated consumers should be more likely to make use of informational labels and, perhaps, such labels should have a greater impact on their perception of the healthfulness of food. However, Moorman also included another motivation measure that was evaluated by means of five seven-point Likert scales (e.g., "I am interested in looking for sodium information on margarine labels"). This scale is much more in keeping with our approach to the measurement of a consumer's motivation, except that we focus the question directly on the consumers' desire for avoidance of the specific nutrient.

Moorman's study was followed by a large number of related studies that allowed for similar heterogeneity in treatment effects according to consumer motivation, the most relevant of which are summarized in Table 1. Not surprisingly, studies do suggest that enduring motivation affects the likelihood that consumers will access nutritional information (Moorman, 1996; Nayga, 1996). Later studies applied this framework to examining the impact of FOP labels as a mode of presenting nutrient information. For example, several studies have focused on the extent to which consumers trust the simplified nutritional claims made on FOP labels (Keller et al., 1997; Garretson and Burton, 2000).

Most relevant to our research are studies examining whether, and if so how, consumer nutritional concern and other consumer characteristics modify the impact or effectiveness of different FOP labeling formats, in terms of the perception of healthfulness or desirability of a product. A priori, there would seem to be offsetting effects. On the one hand, more motivated consumers are in general more likely to use any available nutritional information, and thus they may be more responsive to easily accessible and highly salient and simplified FOP labels, particularly if such labels are more easily interpreted in terms of nutritional goals. On the other hand, motivated consumers may be more likely to seek out and be more capable of interpreting more complex and less salient back-of-package "Nutrition Facts" information, in which case they may be relatively less responsive to FOP labels.

Table 1. FOP Label Research Related to Motivation to Process Label Information (1990-2013).

Author(s)/Title	*Comment*
Moorman (1990, p. 367) The Effects of Stimulus and Consumer Characteristics on the Utilization of Nutrition Information	Introduces the scale: "Enduring Motivation to Process Label Information" measuring general interest in food package labels: 1. "How often do you read nutritional labels"; 2. "How interested are you in reading nutrition and health-related information at the grocery store?"; and 3. "How often do you read nutrition labels at the grocery store?" Another question addresses a nutrition-specific-concern: "I am interested in looking for sodium information on margarine labels."
Nayga (1996) Determinants of Consumers' Use of Nutritional Information on Food Packages	Examines how socio-demographic characteristics of a household's main meal planner are related to the use of nutritional information. Well-educated meal planners are more likely to use nutritional information. Women who place more importance on nutrition are more likely to use nutritional information on packages. The study uses one general nutrition question: "Importance of nutrition when food shopping."
Moorman (1996, p. 42) A Quasi Experiment to Assess the Consumer and Informational Determinants of Nutrition Information Processing Activities: The Case of the Nutrition Labeling and Education Act	Longitudinal, quasi-experiment of actual purchases after implementation of the Nutrition Labeling and Education Act of 1990. Examines consumer and information determinants of nutrition information processing activities. The measure of motivation to read labels was close to the Enduring Motivation to Process: 1. "How interested are you in reading nutrition labels?" and 2. "I really care about reading nutritional labels."
Keller et al. (1997, p. 256) The Effects of Nutrition Package Claims, Nutrition Facts Panels, and Motivation to Process Nutrition Information on Consumer Product Evaluations	Uses Moorman (1990)'s scale: "Enduring Motivation to Process Label Information" and finds that: "Enduring motivation is shown to moderate the effects of product nutrition value on consumer evaluations."
Kozup et al. (2003) Making Healthful Food Choices: The Influence of Health Claims and Nutrition Information on Consumers' Evaluations of Packaged Food Products and Restaurant Menu Items	Measures the effects of a health claim and nutrition information on consumer evaluations of disease risk (but does not measure the individual's nutrient-specific-concern about the ingredients). Also assesses the interaction effects on consumer evaluations and disease-risk perceptions.

Kemp et al. (2007) When Do Nutrient Content and Nutrient Content Claims Matter? Assessing Consumer Tradeoffs Between Carbohydrates and Fat	Uses Moorman's (1990) scale of "Enduring Motivation to Process Label Information." Assesses Enduring Motivation as a moderator of the effects of the nutrient content claim on the consumer's perceptions of likely weight loss and heart disease.
Howlett et al. (2008, p. 95) How Modification of the Nutrition Facts Panel Influences Consumers at Risk for Heart Disease: The Case of Trans Fat	Uses a slightly modified "Enduring Motivation to Process Label Information": 1. "In general, how often do you read the nutrition facts panel that reports nutrient information on food product packages?"; 2. "In general, how interested are you in reading nutrition and health-related information at the grocery store?"; and 3. "I really care about reading nutrition information and nutrition labels." Analyses how the new disclosure of information about an attribute with important consumer health implications might influence disease risk perceptions and purchase intentions of at-risk consumers.
Feunekes et al. (2008, p. 60) Front-of-pack Nutrition Labeling: Testing Effectiveness of Different Nutrition Labeling Formats Front-of-pack in Four European Countries	Uses measures similar to "Enduring Motivation to Process Label Information": 1. "Do you read labels on food products?"; 2. "Have to follow a special diet because of a specific heath need." (the specific need was not specified); 3. "Eat a healthy diet because it helps keep me fit and well."; 4. "Try to eat a healthy diet but find it hard to stick to it."; and 5. "Eat what I like and do not worry about how healthy it is." The result based on these measures was that "providing more information is not necessarily better for everyone."
Andrews, Burton, and Kees. (2011, p. 179) Is Simpler Always Better? Consumer Evaluations of Front-of-package Nutrition Symbols	Uses a nutrition consciousness measure: 1. "I usually am interested in looking for nutritional information on food packages."; 2. "Compared to other people, how much do you feel you know about nutrition?"; and 3. "I would like to see additional nutritional information on food packages." The study predicts and finds that Smart Choices summary icon is better than the more complex Traffic Light icon (with Guideline Daily Amounts). The research also found evidence that nutrition consciousness moderated the Facts Panel information usage but not simpler front-of-package information usage.
Kim et al. (2012) Front-of-Package Nutrition Labels and Consumer Beverage Perceptions	Used participant's diabetes status and whether they were dieting to lose weight to assess the impact of FOP labels on the perceived healthfulness of various beverages. They found that those people with more severe diabetes and those trying to lose weight responded differently than those not in those categories to the FOP labels.

Goodman et al. (2013) The Impact of Adding Front-of-package Sodium Content Labels to Grocery Products: An Experimental Study	Studies four different FOP labels for sodium (no FOP, basic numeric FOP, High/Low FOP, and Traffic Light FOP). "Participants in the three FOP conditions with 'high/low' sodium content descriptors were significantly more likely to choose the lower-sodium product compared with the control group. The detailed traffic light label was ranked most effective at helping participants select low-sodium products." They also found that "participants who reported 'usually' looking for sodium information when grocery shopping were significantly more likely to choose the low-sodium option compared with those who did not."
Hersey et al. (2013, p. 11) Effects of Front-of-package and shelf nutrition labeling systems on consumers	Health-conscious consumers and consumers who have family members on special diets are more likely to purchase foods indicated as 'healthy' by FOP and shelf-labeling systems than price-focused consumers."
Koenigstorfer et al (2014) Healthful Food Decision Making in Response to Traffic Light Color-Coded Nutrition Labeling	Shows that traffic-light FOP labeling leads to more healthful food decision making by consumers with low self-control, but not those with high self-control.

Several studies have attempted to identify such impacts of FOP labels and alternative FOP formats on consumer perceptions, as mediated by general enduring motivation to process nutritional information as developed by Moorman (1990). Drawing generalizations regarding the findings of these papers is complicated by the variety of core research questions examined, from general consumer trust in labeling, to the role of prior nutritional knowledge or familiarity, to the impact of official endorsements. What all the studies share, however, is an emphasis on the role of general, as opposed to specific, nutritional concern as the measure of enduring motivation. Empirically, enduring motivation is often measured in these studies using survey questions derived from Moorman (1990). For example, Howlett, Burton, and Kozup (2008) derive their measure of enduring motivation from Moorman's 1990 scale with the following questions:

1. In general, how often do you read the Nutrition Facts panel that reports nutrient information on food product packages? (not often/very often)

2. In general, how interested are you in reading nutrition and health-related information at the grocery store? (not interested/very interested)

3. I really care about reading nutrition information and nutrition labels. (not at all/very much)

Our study departs from this approach by eliciting subjects' nutrient-specific concerns and explicitly allowing their responses to FOP treatments to depend on these concerns. Specifically, we ask subjects to report their level of concern with the four common nutritional "bads": calories, fats, sodium, and sugars. It seems logical to suppose that a consumer who is concerned about a specific nutrient, such as sodium, will be most responsive to nutritional information relating to sodium, whether in the Nutrition Facts or an FOP label. This leaves open the question of whether a consumer with greater specific motivation will be more or less responsive to a more salient or simplified FOP treatment, compared with a less-concerned individual.

Other studies have examined consumer responses to nutrient-specific information, but to different ends. Kemp et al. (2007), for example, studied the effects of FOP labels for "low-carb" vs. "low-fat" claims for consumers with different levels of motivation. But their motivation measure was in fact the general nutritional concern (enduring motivation) used elsewhere in the literature. To our knowledge, ours is the first study to examine the impact of alternative FOP treatments in a context that allows for heterogeneous responses due to variation in nutrient-specific concerns.

The remainder of the paper is organized as follows. Section 2 describes our survey-based experiment and presents some simple average treatment effects. These suggest very mixed and inconsistent patterns of treatment effects. Section 3 motivates our data analysis with a simple model of adaptive perceptions and describes how the model is implemented empirically using our survey data. The regression results are presented in section 4, and section 5 provides a discussion of our findings and conclusions.

The Experimental Setting and Average Treatment Effects

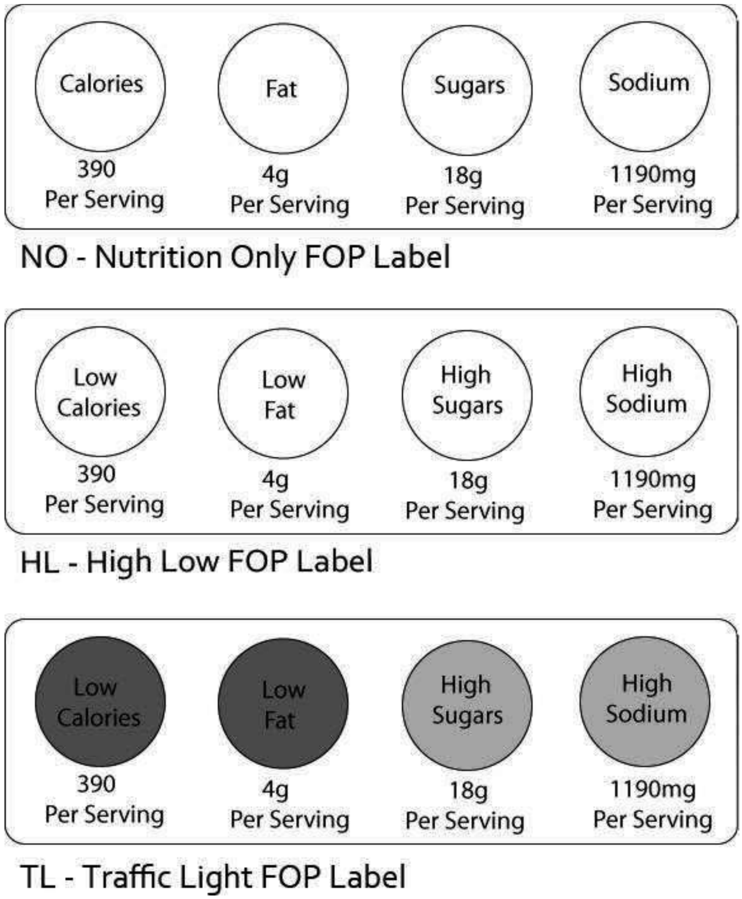
To examine the effects on consumer health perceptions of alternative FOP labeling schemes, we conducted a randomized experiment via an online survey. All survey respondents were asked to rate the healthfulness of four stylized frozen dinners. They were then randomly assigned to three alternative FOP labeling schemes presenting the same basic nutritional information about the dinners and asked to assess the healthfulness again. The treatment effect was measured using a before-after comparison of the health ratings. We describe the survey in more detail here and then turn to some aggregate results. The full survey data set and replication code are publicly available at the Harvard Dataverse (Sundstrom, 2020).

The survey was administered by a large national online survey company. We requested that the sample be representative of the U.S. adult population with respect to state of residence, age, gender, income, and education. In fact, the survey company indicated that the sample was representative of the online U.S. adult population. The survey consisted of three major sections. The first section presented respondents with mockups of four different frozen dinner packages, each consisting of a product description, serving size, and a photograph of the dinner, but no nutritional information. The dinners were based on actual dinners currently sold in the U.S. market, selected to provide options ranging from healthy to unhealthy. Respondents were asked to rate the healthfulness of each dinner on a 9-point Likert scale, with 1 being very unhealthy and 9 being very healthy. Figure 1 shows images of the four dinners. We refer to these initial health ratings as the "control" or "pre-treatment" responses.

Note: The dinner names have been abbreviated in the text with the Meatloaf Dinner, Roasted Chicken and Vegetables, Meat Lasagna with Four Cheese Blend, and Chicken Teriyaki Stir Fry abbreviated as Meatloaf, Chicken, Lasagna, and Stir Fry, respectively.

Figure 1. Images of Dinners Used in the Survey.

The second part of the survey presented each respondent with the same four food products, except that each image included one of three (FOP) labels providing additional nutritional information. Respondents were again asked to rate the healthfulness of each product on the same 9-point scale. The alternative FOP nutritional labels are exhibited in Figure 2.



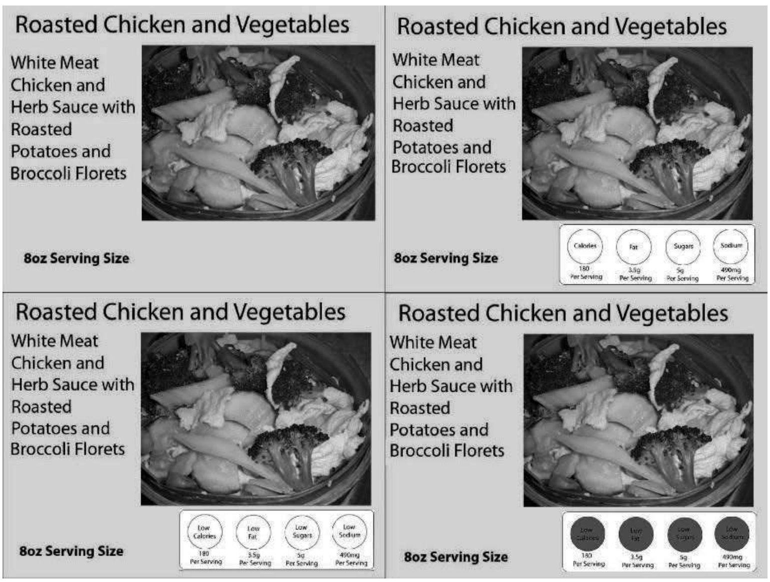
Note: In the survey, the image for the Traffic Light Label was colorized, such that the Low Calories and Low Fat circles were green and the High Sugars and High Sodium circles were red, as described in the text.

Figure 2. FOP Labels: Alternative Treatment Example, Chicken Teriyaki Stir Fry.

- The Nutrition Only (NO) label contained only quantitative nutritional information for calories, fats, sodium, and sugar. The nutrient levels listed were for the entire dinner; in other words, the meal was a single serving.

- The High-Low (HL) treatment contained the same nutritional information as in the NO label but also indicated whether the level of the nutrient was high, medium, or low. The rating level is based on the FDA's recommended nutritional levels for a 2,000 calorie diet (FDA, 2013b; FDA, 2013c). We made the assumption that each meal should represent one-third of daily nutritional intake. If the nutrient level in the meal was below 25% of the daily-recommended intake it was listed as "Low". If it was above 35% the nutrient was listed "High". If it was between the 25% and 35% it was listed as "Medium".

- The Traffic Light (TL) label was identical to the HL label, with the addition that high, medium, and low were color-coded red, yellow, and green, respectively.



Note: The four images represent, clockwise from upper, represent Pre-treatment, Nutrition Only (NO), High, Medium, Low (HL), and Traffic Light (TL). The shaded circles in the Traffic Light treatment were all shaded green to represent Low, or the preferred nutritional choice.

Figure 3. Chicken Dinner: Control and Front-of-Package Label Images Representing the 3 Treatments.

Figure 3 exhibits images of the Chicken Dinner without the nutritional label (the "pre-treatment" exposure) and with each of the three different FOP labels.

Three separate randomized sample groups received the survey, with each group exposed to a different labeling treatment. All three groups first rated the healthfulness of the same four meals viewing the food packages with no nutritional labels (Control or Pre-treatment); the first group then rated the same packages with the Nutrition Only (NO) labels; the second group was exposed to High-Low (HL) labels and the third group was shown Traffic Light (TL) labels. By showing only one FOP labeling scheme to each respondent, we avoided potential cross-contamination of the treatment effects.

The third section of the survey contained questions about perceptions of the FOP labels, nutritional concerns of the respondents, and demographics. We are particularly interested in whether the nutritional motivation of consumers affects their responsiveness to alternative FOP labeling schemes. The relevant questions in the survey are framed as follows: "When you are shopping, how important is it to you to avoid food… high in calories/ fat/ sodium/ sugars?" The responses for each of the four nutrients were, again, on a 9-point Likert scale.

Table 2 provides the basic sample demographics and a comparison with the overall U.S. population age 18 and up (U.S. Census Bureau, 2013). Our sample is a voluntary, online sample, and cannot be considered representative; it may be selective in both observed and unobserved ways. The table suggests that our sample is somewhat older, has higher income, and has greater educational attainment than the U.S. population.

We can measure the treatment effect of the FOP label as the change in perceived healthfulness between the initial (pre-treatment) exposure and the post-FOP exposure. It should be noted that there is no a priori reason to predict that the provision of FOP nutritional information should increase or decrease the health rating of a meal for any given individual. A change in health rating would presumably arise if the new information were a "surprise" relative to whatever expectations the respondent had based on the control or pre-treatment exposure. An individual might be positively or negatively surprised. Furthermore, individuals could be heterogeneous in their evaluation of the information based on their nutritional goals and motivation, which is, of course, the core topic of this paper.

Whatever the direction of the treatment effect for a given individual, however, there appears to be a natural ordering of the relative salience of the different treatments—namely, NO < HL < TL. If this were true, and given the random assignment of treatments, one would predict that if the average treatment effect of the NO treatment were negative (positive) for a particular dinner, the HL effect would also be negative (positive) and greater in magnitude, and the TL effect even more so.

Table 2. Sample Demographics.

Characteristic	Count	Survey	Census	Delta
Gender				
Male	531	51.8%	49.2%	2.6%
Female	495	48.2%	50.8%	-2.6%
Income				
Under $25,000	120	11.7%	25.0%	-13.3%
$25,000-$49,999	222	21.6%	24.5%	-2.9%
$50,000-$74,999	236	23.0%	18.0%	5.0%
$75,000 or More	448	43.7%	32.5%	11.2%
Education				
Some High School	17	1.7%	8.1%	-6.4%
Graduated High School	75	7.3%	28.4%	-21.1%
High School and Some College	279	27.2%	21.2%	6.0%
Graduated College	655	63.8%	34.0%	29.8%
Age				
18-24	92	9.0%	13.0%	-4.0%
25-44	288	28.1%	36.0%	-7.9%
44+	646	63.0%	51.0%	12.0%

Figure 4 shows the mean change in health rating for each dinner. For example, the left-most lightly shaded bar indicates that on average, the respondents exposed to the Nutrition Only (NO) FOP labels lowered their assessment of the healthfulness of the Meatloaf dinner by an average of about 0.9 points on the 9-point scale. In the sample, the standard deviation of the ratings across individuals ranges between 1.5 and 2.0, depending on the dinner and treatment type. Thus, a change of 0.9 points is fairly substantial.

The case of the Lasagna dinner is most consistent with the prediction of a salience hierarchy: respondents receiving the NO treatment were mildly positively surprised and increased their health rating modestly, and the HL and TL treatments were also positive and each in turn stronger in magnitude. The case of Meatloaf is weakly consistent as well, with the negative average treatment effect a little stronger for the HL and TL treatments than the NO. But the Chicken and Stir Fry dinners reveal puzzling patterns that contradict the idea of a hierarchy of treatment effects. For Stir Fry, the treatment effects are all negative but non-monotonically related to salience; in the case of Chicken, the treatments effects are not even in the same direction.

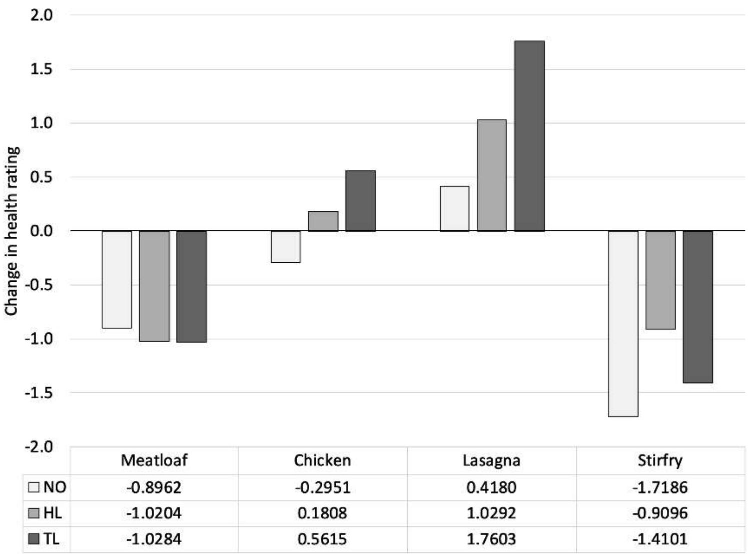
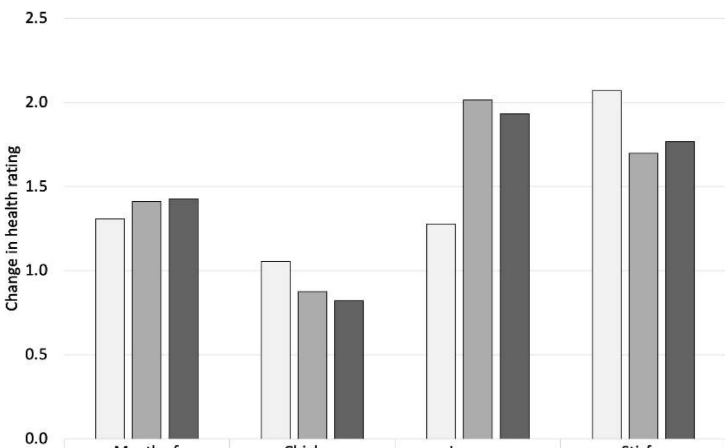


Figure 4. Average Change in Health Rating of Frozen Dinner Meals for Different Front-of-Package Labels.

Table 3. Direction of Change in Health Rating (%).

Dinner	Treatment	Negative	Zero	Positive
Chicken	NO	35.0	39.9	25.1
	HL	15.5	51.6	32.9
	TL	8.5	43.8	47.6
Lasagna	NO	25.4	30.3	44.3
	HL	23.6	16.9	59.5
	TL	5.7	19.6	74.8
Meatloaf	NO	59.6	31.4	9.0
	HL	64.1	28.0	7.9
	TL	62.5	30.3	7.3
Stir Fry	NO	68.6	19.1	12.3
	HL	53.1	22.4	24.5
	TL	71.3	18.6	10.1

The mean changes reported in Figure 4 obscure the fact that some individuals respond positively while others respond negatively. This can be seen in Table 3, which shows the distribution of negative, zero, and positive changes for each dinner and FOP label type. In every case there are both positive and negative changes, and in the case of Chicken and Lasagna in particular, substantial proportions in each direction. These opposing changes are offsetting in the average treatment effect and render it difficult to discern a pattern of relative strength across treatment types. To see whether the treatments exhibit a hierarchy of effects taking account of both positive and negative changes, we examine the mean absolute value of the changes in health ratings, pre- vs. post-treatment. This allows us to see whether TL has a greater impact than the HL or NO labels, in any direction. The results, in Figure 5, still do not suggest any general monotonic pattern in treatment effects.



	Meatloaf	Chicken	Lasagna	Stirfry
NO	1.3060	1.0546	1.2760	2.0683
HL	1.4111	0.8746	2.0146	1.6968
TL	1.4259	0.8202	1.9306	1.7634

Figure 5. Average Change in Absolute Value in Health Rating of Frozen Dinner Meals for Different Front-of-Package Labels.

In sum, a naive comparison of treatment effects does not reveal any systematic pattern suggesting that one or another of the alternative FOP treatments has a stronger impact on perception of healthfulness. However, the average treatment effects may be the wrong evidence to examine. It is possible that the treatments do have systematic effects, but only for certain groups of people. In particular, it may be that the salience of FOP labels only matters for individuals motivated by health concerns, and in particular concerns about the specific nutrients for which the labels provide useful information. There is no reason to expect that a consumer who is not attending to weight gain or blood sugar would care much one way or the other about calories or sugar content. The noise from the responses of such disinterested individuals could mask important effects.

Our survey design allows us to quantify the extent to which each individual cares about each of the nutrients listed on the labels—i.e., their nutrient-specific concern. Consequently, we can analyze the data to discern whether there is heterogeneity in the treatment effects consistent with differential salience for the different labeling schemes. To motivate our empirical methodology, we start with a simple adaptive model of health perception, and then explain how we implement it with our data.

Heterogeneous Responses to Front-of-Package Labeling: Model and Implementation

As we have seen, FOP labels led most subjects to revise their health rating of the hypothetical packaged dinners, and average effects differed across dinners and FOP treatments (label types). Responses were also quite heterogeneous within dinners and treatments: for any given dinner and treatment type, there were large numbers of both increases and decreases in perceived health ratings. In this section we develop a simple empirical model to identify patterns of heterogeneity in treatment effects by responses to questions about the importance of the labeled nutrients to the individual consumer (motivation) and by basic demographic characteristics.

Adaptive Perception Model of the Effect of Nutritional Labeling

We start with the assumption that the consumer (respondent) has a prior belief or perception of the healthfulness of the product and responds to new information from the FOP treatment by adjusting that belief or at least giving added salience to that nutritional information. The impact of the new information should depend on the content of the information as well as the consumer's motivation to process and respond to that information which, in our case, is a function of nutrient-specific concerns. For simplicity, we assume that the consumer's post-treatment health rating is a weighted average (mixture) of her pre-treatment health rating $\hat{h}$ which is based on the initial exposure to the dinner packaging and any nutritional priors, and the health rating h* that she infers from the new information provided in the treatment. The relative weight placed on the new information is a function of the salience of the signal provided by the treatment.

In this set-up, we can express the post-treatment health rating as a weighting of prior healthfulness assessment and the new healthfulness information, where p is the weight given to the (new) label information:

$$(1) \qquad h_{ijt} = (1 - p_{it})\hat{h}_{ij} + p_{it}h^*_{ijt} + u_{ijt}$$

where i indexes the individual, j = {CH, LA, ML, SF} indexes the meal, t = {NO, HL, TL} indexes the FOP treatment, h_{ijt} is the health rating by person i of meal j following treatment t, $\hat{h}_{ij}$ is the pre-treatment health rating by person i of meal j, h^*_{ijt} is the health rating by person i of meal j inferred strictly from the information provided in treatment t, p_{it} is the relative weight (salience) person i attaches to the new information provided by treatment t, and u_{ijt} is a random error term, assumed to be independently and identically distributed with zero mean.

Rearranging, the treatment effect (change in health rating) is simply:

$$(2) \qquad dh_{ijt} \equiv h_{ijt} - \hat{h}_{ij} = p_{it}h^*_{ijt} - p_{it}\hat{h}_{ij} + u_{ijt}$$

This simple formulation exhibits sensible features. First, if the FOP label has no salience, then $p = 0$, and there should be no expected change in health rating: the label is ineffectual. Second, the expected change in rating should be positive (negative) if the information provides a positive (negative) surprise relative to the prior health assessment: Individuals who start with an unusually low (high) pre-treatment health rating are likely to increase (decrease) their rating upon receipt of new nutritional information. In this sense, perceptions exhibit some degree of regression to the mean. Finally, the marginal impact of an increase in the pre-treatment health rating is expected not only to be negative, but also to be more negative for a more salient treatment (greater p).

Empirical Implementation

Equation (2) provides the framework for our regression models. The dependent variable is the change in health rating pre- to post-treatment (*dh*) as the dependent variable. Of the right-hand-side variables, only the pre-treatment health rating is directly observed: it is reported by the respondents. This leaves p and h^* to be determined. Because p is a measure of the salience of the treatment, we simply model it using dummy variables for treatment type, δ_{it}. Taking the NO treatment as the baseline for comparison, we include dummies and interaction terms for the HL and TL treatments.

Conceptually, $h*$ is the health rating inferred solely from the FOP nutrition label information. This is not directly observed, so we assume that it depends on the nutritional information revealed by the treatment label *and* the importance the individual attaches to those aspects of nutrition. Thus, we create an index number to proxy for $h*$. To do so, we combine information about the self-reported health preferences of the individual (nutrient-specific concerns) with the given nutrient content of each dinner. We implement this as follows. Let θ_i^k be individual i's reported importance rating for nutrient k (k = calories, etc.), and let n_j^k be the nutrient content of meal j (where j = chicken, etc.) on nutrient k, which is available to the individual post-treatment. Then a simple index number for the individual's assessment of the (negative) health rating of meal j is $\gamma_{ij} = \sum_k \theta_i^k n_{ij}^k$. Alternative ways of calculating θ_i^k and n_j^k in our data are discussed below. Assuming that most health-conscious consumers view the labeled nutrients as "bads" (to be avoided), γ is an index of "implied unhealthfulness," and should be negatively related to $h*$; so, we assume that $h*_{ijt} = -\gamma_{ij}$.

Because each individual in the sample (randomly) received only one type of FOP treatment for each of the four dinners, the unit of analysis in our data is an individual dinner (i,j) combination. The treatment type (t) is identified using dummy variables, with the NO treatment as the excluded category. Allowing for main effects as well as interactions, then, our baseline regression model consists of the following specification:

$$dh_{ij} = \beta_0 + \sum_{t \in HL,TL} \beta_{1t}\delta_{it} + \beta_2\gamma_{ij} + \beta_3\hat{h}_{ij} + \sum_{t \in HL,TL} \beta_{4t}\delta_{it}\gamma_{ij} + \sum_{t \in HL,TL} \beta_5\delta_{it}\hat{h}_{ij} + u_{ij} \quad (3)$$

The key coefficients of interest are the coefficients β_{4t} on the interactions between the treatment dummies and γ. These interactions reveal whether the consumer's response to "bad news" about the nutritional content of a dinner varies with the mode of FOP labeling—this is our best indicator of whether the labels differ in their effectiveness for motivated consumers.

Note that we could run the same regression using the post-treatment health rating h_{ij} as the dependent variable instead of the pre-post-treatment change h_{ij}. The equation is mathematically identical, and all the results would be the same with the exception of the coefficient on the pre-treatment health rating.

In addition to the pre-treatment health rating and the (inverse) proxy for h^* (namely, γ), in some specifications we include controls for basic demographic characteristics of the individual—specifically, gender, age, and education. All variables are interacted with the treatment dummies. By interacting demographics with the treatment types, we can explore how the FOP response may vary by individual characteristics.

In our core estimates, we pool all the data for the four dinners, so there are four observations per subject. By doing so, we take advantage of the variation in reported nutritional content to calculate our proxy for h^*. Because the average responses to the FOP treatments were heterogeneous across dinners, we include dinner dummy variables in some specifications.

Data and Details of Variable Construction

For the dependent variable *dh* we simply take the difference between the pre-and post-treatment responses, each of which is on a 1-9 scale. We thus handle the dependent variable as a cardinal scale and use OLS regression. Later we report results of treating the health rating as an ordinal scale, using ordered logit estimation.

To calculate our index of the implied unhealthfulness of the meal, $\gamma_{ij} = \sum_k \theta_i^k n_{ij}^k$, we need the components θ_i^k and n_j^k. θ_i^k is the importance (specific concern) that individual i attaches to each of the four nutrients reported on the labels: k = calories, fat, sodium, and sugar. In the survey, respondents were asked to report the importance they attach to each of these nutrients on a 1-9 scale. We considered two alternative ways to scale these responses. The first, which we refer to as the "absolute" measure, simply uses the raw reported numerical response. One potential problem with the absolute measure is that different individuals may have a different baseline for nutrient importance. Thus, as an alternative formulation, we constructed a "relative" importance measure, which is the ratio of the absolute response for a particular nutrient to the individual's average across the four components. For any individual, the relative importance numbers average to one. An obvious disadvantage of the relative measure is that it does not allow for variation across individuals in the overall (average) importance each person attaches to these nutrients, which may be unrealistic. Our analysis shows that the results do not differ much between these two alternative measures.

We also need the nutritional content of each meal reported on the labels, n_j^k for each nutrient k and dinner j. We construct two versions of this variable. The "numerical" version of the nutrient content takes the ratio of the nutrient content in meal j to the average of the same nutrient contents in all four meals. For example, in the case of calories, the Meatloaf meal has 680 calories, which we rescale relative to the average calorie counts in all four meals: 680/[(680+180+400+390)/4]. As an alternative, we use a scale based on the low-medium-high (LMH) nutrition labels, assigning 3=high, 2=medium, 1=low. Because the NO treatment does not report the LMH information, we focus on the numerical scale here, which is available to the consumers in every treatment state.

To capture demographic effects, we use binary dummy variables for three main demographic characteristics: female, age 45 or older, and college degree.

A serious potential threat to the validity of this regression model would be endogeneity of the nutrient importance responses to the health rating. This is a concern because in the survey, individuals were asked the nutrient importance questions *after* both the pre- and post-treatment ratings of the dinners. If, for some reason, the process of rating the dinners influenced the responses to the nutrient importance questions, the coefficients on and its interactions could be biased. This problem cannot be ruled out, but it is possible to check whether the nutrient importance ratings vary with the treatments, which were assigned to subjects randomly. Although we control for the treatments, if it were found that nutrient importance was affected by treatment type, it would raise serious concerns about unobserved correlation and thus validity overall. On the other hand, if the treatment process were going to affect nutrient importance responses, one might expect it to depend on treatment, as the HL and TL treatments clearly call extra attention to the health implications of the nutrients. Therefore, a finding of no differential treatment effects on the nutrient importance responses would be reassuring evidence against endogeneity.

Fortunately, there is no evidence that treatment type influenced the nutrient importance responses. Table 4 reports the results of a set of two-sample Kolmogorov-Smirnov tests comparing the distribution of nutrient importance responses for different pairs of treatments. In every case the equality of the distributions is accepted. We therefore feel comfortable proceeding under the assumption that the nutrient importance responses capture consumer preferences that are independent of treatment type.

Table 4. Tests for Treatment Effects on Nutrient Importance Responses: Corrected Combined P-Values for Two-Sample Kolmogorov-Smirnov Tests of Equality of the Response Distributions for Pairs of Treatments.

	HL vs. NO	TL vs. NO	TL vs. HL
Calories	0.932	0.736	0.884
Fat	1.000	0.950	0.811
Sodium	0.996	0.702	0.724
Sugar	0.577	0.569	0.594

Regression Results

Regression results for the adaptive model and for various alternative specifications are presented in Table 5, using the absolute measure of the nutrient importance variables. Because the pooled data include four responses by each individual, standard errors are clustered at the individual level to allow for correlation of errors across individual responses.

In Table 5, specification (1) is a simple baseline model regressing the change in health rating on treatment dummies, the pre-treatment health rating (HRC, same as $\hat{h}$), the unhealthfulness index (gamma), and interactions with treatment dummies. The NO treatment is the excluded category here, so the coefficients on the non-interacted regressors represent the effect of that variable on the change in health rating after the NO treatment.

The coefficients on the treatment dummies themselves, HL and TL, are positive and significant. By themselves, these coefficients are difficult to interpret, because the full treatment effects must also take account of the interaction terms. The coefficient on HRC, the pre-treatment health rating, is negative, on the order of -0.5. The interactions of the HL and TL treatments with HRC are not statistically significant, suggesting that the effect of prior health rating on the change in health rating post-treatment is the same across FOP types in this specification. (These coefficients are actually significant in our preferred fixed-effects specification, discussed below.)

Table 5. OLS Regressions for Adaptive Model.

Variable name	(1)	(2)	(3)	(4)
HL (High-Low)	1.210***			1.131***
	(0.344)			(0.351)
TL x(Traffic Light)	1.444***			1.427***
	(0.339)			(0.357)
HRC (Initial health rating)	-0.497***	-0.569***	-0.592***	-0.499***
	(0.0286)	(0.0307)	(0.0373)	(0.0324)
HRC*HL	-0.0497	-0.0907**	-0.0899**	-0.0643
	(0.0420)	(0.0441)	(0.0428)	(0.0404)
HRC*TL	-0.0470	-0.100**	-0.102**	-0.0511
	(0.0404)	(0.0427)	(0.0421)	(0.0393)
Gamma	-0.0497***	-0.0604***	-0.0183**	-0.00522
	(0.00350)	(0.00360)	(0.00733)	(0.00482)
Gamma*HL	**-0.0165*** **	**-0.0231*** **	**-0.0233*** **	**-0.0196*** **
	(0.00521)	**(0.00534)**	**(0.00523)**	**(0.00494)**
Gamma*TL	**-0.0246***(n.s.)**	**-0.0361***(**)**	**-0.0364***(**)**	**-0.0274***(n.s.)**
	(0.00522)	**(0.00574)**	**(0.00573)**	**(0.00508)**
Lasagna			-0.994***	-0.753***
			(0.122)	(0.0999)
Meatloaf			-2.015***	-2.256***
			(0.272)	(0.168)
Stir Fry			-1.648***	-1.781***
			(0.119)	(0.0847)
Female				-0.167
				(0.120)
Age 45+				-0.379***
				(0.120)
College degree				-0.0422
				(0.125)
Female*HL				0.0826
				(0.154)
Female*TL				0.0721
				(0.149)
Age 45+*HL				0.443***
				(0.159)
Age 45+*TL				0.373**
				(0.151)
College*HL				0.0419
				(0.162)
College*TL				-0.114
				(0.159)
Constant	3.423***	5.270***	5.415***	3.676***
	(0.230)	(0.146)	(0.234)	(0.291)
Subject fixed effects?	No	Yes	Yes	No
Observations	4,052	4,052	4,052	4,052
Adusted R-squared	0.343	0.44	0.488	0.408
# of individuals		1,013	1,013	

*Notes: See text for definitions and interpretations of coefficients. Standard errors are clustered at the individual level. The asterisks in parentheses for the Gamma*TL coefficients refer to the test of equality between the HL and TL interactions with Gamma.*

In the stylized model presented above, the coefficient on HRC can be interpreted as the negative of the weight (p) that individuals place on the information obtained from the Nutrition Only (NO) FOP treatment, as opposed to their prior perception of the healthfulness of the meal. Under this interpretation the weight is about 50-50. As noted, the coefficient on the pre-treatment rating may be expected to be negative to the extent that there is regression toward the mean in perceived healthfulness: an individual whose prior health perception was unusually high (low) might be expected to respond to new information by adjusting her perception downward (upward) toward the average. Because treatment types were assigned randomly, there is no reason to anticipate that this regression to the mean effect should differ systematically by FOP treatment.

The estimated coefficient on gamma represents how the individual's implied assessment of the unhealthfulness of the meal—given their stated nutrient-specific concerns and the nutrient information revealed by the treatment—affects their post-treatment health rating. For the NO treatment (the excluded category), this effect is negative and significant. Finding out that a meal is unhealthy in the ways that are important to the individual leads that individual to downgrade the health rating.

The key coefficients in our analysis are on the interactions between gamma and the HL and TL treatments (β_4 in the equation), which are both negative and significant. Furthermore, the TL interaction is somewhat more negative than the HL interaction, although the difference is not quite statistically significant (p-value of 0.14). These results suggest that when the nutritional information is presented using the HL or TL labels, consumers react more strongly to information that reveals that the meal is unhealthy according to the nutrients that they care about. Put slightly differently, consumers more strongly perceive "bad news" when it is presented in a more salient format.

The specification in column (2) repeats column (1) but includes individual fixed effects, which control for any unobserved individual tendency to react to the treatment in a particular direction. HL and TL coefficients cannot be estimated because they are perfectly collinear with the individual effects. The basic results are quite similar to column (1), but now the coefficients on the HRC*treatment interactions are more precisely estimated, and suggest that the more salient HL and TL treatments reduce the influence of the initial health rating (HRC), compared with the NO treatment, consistent with the prediction of our simple model. Put slightly differently, the more salient FOP labels lead to a larger correction of the individual's pre-treatment impression of the healthfulness in response to new information.

Column (3) adds dummy variables for the dinner to the fixed-effects specification (chicken dinner is the excluded category). The disparate pattern of treatment responses by dinner revealed in the simple means comparisons suggests that basic dinner controls may be important. Indeed, the dinner dummies are significantly different from zero. Importantly, however, dinner dummies do not alter the basic results much, except that the coefficient on gamma is smaller in magnitude and now indistinguishable from zero. The gamma*treatment interactions retain their pattern of being negative and significant, suggesting again that consumers reacted more strongly to the HL label when it provided bad news, and even more strongly to the TL label. In this specification, in fact, the coefficient on gamma*TL is significantly different from the coefficient on gamma*HL.

Column (4) adds the simple demographic dummies and their interactions with treatment type to the specification in column (1), as well as the dinner dummies. Individual fixed effects cannot be used here because there is no variation in the demographics for an individual. The core results are largely unchanged. Among the demographic variables, only age has consistently significant effects. Older consumers tend to react more negatively to the NO treatment, but this effect is reversed for the HL and TL treatments. If the three FOP treatments can be ordered by salience as TL > HL > NO, and under the assumption that more motivated consumers respond more strongly to salient labels, we would expect that the interaction coefficients on Gamma*HL and Gamma*TL would both be negative, and that the TL interaction effect would be greater in magnitude (more negative) than the HL effect. Table 5 shows that the interaction effects are indeed all negative and significant, suggesting that both the HL and TL labels were more salient than the NO label. Furthermore, in every case, the TL interaction coefficient is more negative than the HL coefficient, as predicted. The asterisks in parentheses for the Gamma*TL coefficients refer to the test of equality between the HL and TL interactions with Gamma. The difference can be rejected at the 10% level in most cases, with the results being more precise when we control for individual consumer fixed effects (rows 2 and 3).

To provide a better idea of the magnitude of the key effects, we have graphed the treatment interactions for specification (3) in Figures 6 and 7. Figure 6 presents our core results for the interaction between the implied health rating (gamma) and the treatments, scaling the effects to reflect a one standard-deviation change in the variable. In the figure, the shaded squares are the point estimate and the “whiskers” show a 95% confidence interval. Effects are plotted for both the absolute and relative versions of the gamma variable. Obviously, they are close to identical in magnitude.

The effects are substantial. Consider a consumer confronting two dinners that differ by a standard deviation in the “unhealthfulness” revealed by their nutrient content. Compared to the NO treatment, the TL label will cause this consumer to lower her rating of the less healthy meal by 0.6 more points on the 1-9 scale. This can be compared with the standard deviation of the change in health ratings across the entire sample, which is about 2.

As we noted in Section 3, another implication of our simple adaptive perception model is that the marginal effect of an individual's pre-treatment assessment of the healthfulness of a dinner (HRC) should be negative, and more negative for more salient treatments (greater weight p placed on the new information in Equation (1)). Thus under the hypothesis that the hierarchy of salience of the FOP treatments is TL > HL > NO, we would predict that the coefficients for the interactions HRC*HL and HRC*TL should be negative, and exhibit the same hierarchy as the gamma interactions, with the TL interaction more negative than the HL. To understand why, consider an individual whose initial, pre-treatment health rating of a meal was very high (say, 9). Now suppose the information this individual receives from the FOP label suggests that the meal is actually less healthful than she anticipated, leading to a downward adjustment in her health rating. We predict that this downward adjustment should be greater, the more salient the FOP treatment. That is, a more salient treatment should result in a bigger correction of overly optimistic (or pessimistic) initial assessments of healthfulness. Figure 7 summarizes these results for the same specification as that used in Figure 6. The coefficients are both significantly negative, as predicted, although there is no significant difference between them.

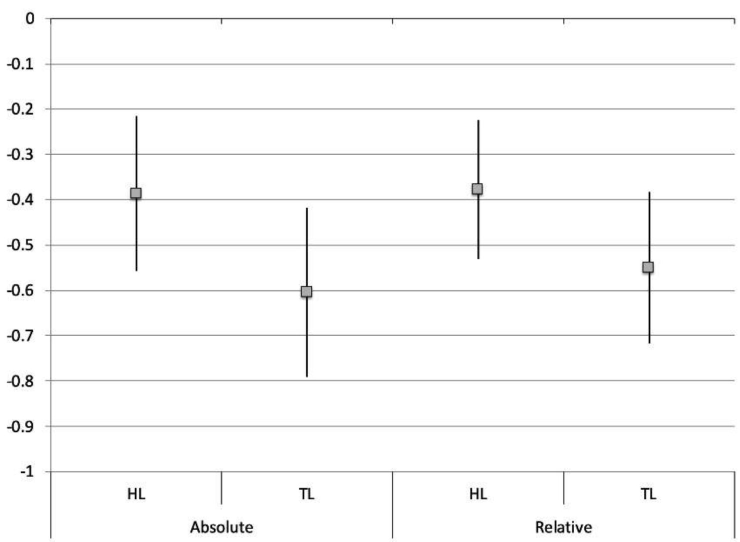


Figure 6. Effect of One Standard Deviation Change in Implied (Negative) Nutrition Rating on HL and TL Treatment Effects Relative to NO, by Importance Scale.

Additional Specifications

We estimated several alternative specifications to check the robustness of our results. The estimates in Table 5 use the *absolute* version of the nutrient importance ratings, allowing some consumers to have higher average levels of concern than others. We also ran the same set of regression specifications as Table 5 using the *relative* rather than absolute version of the nutrient importance ratings, rescaling the nutrient ratings so that the average rating is the same for every individual. The directions and significance of the effects are qualitatively similar (results available from the authors upon request).

A second alternative specification is motivated by the concern that because the responses to the health rating questions are ordinal rather than cardinal, treating the dependent variable as a continuous, linear variable using OLS is inappropriate. As a robustness check we repeated the regression of column (1) in Table 6 using an ordered logit. In this case the dependent variable is the post-treatment health rating. Examining the gamma-treatment interaction coefficients in Table 6, the hierarchy of treatment effects is affirmed in the ordered logit specification.

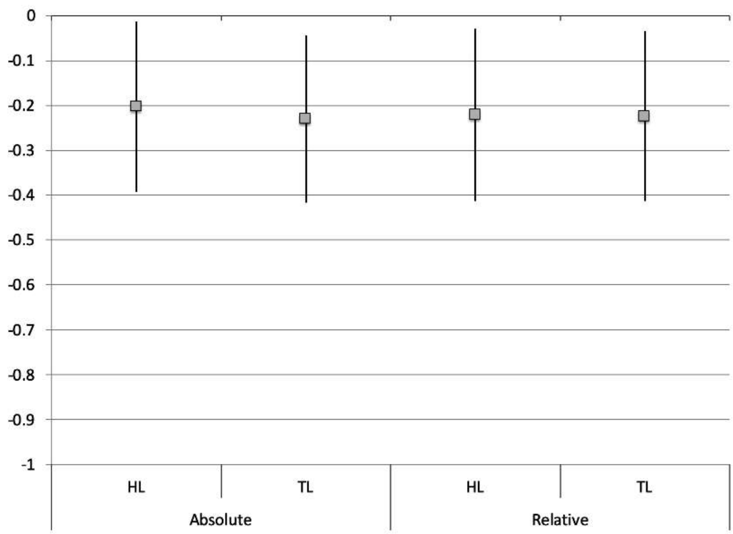


Figure 7. Effect of One Standard Deviation Change in Pre-Treatment Health Rating (HRC) on HL and TL Treatment Effects Relative to NO, by Importance Scale.

Table 6. Ordered Logit Regressions for Adaptive Model.

Variable name	Relative	Absolute
HL	1.814***	1.320***
	(0.3770)	(0.3730)
TL	2.083***	1.555***
	(0.4200)	(0.3690)
HRC	0.596***	0.588***
	(0.0349)	(0.0338)
HRC*HL	-0.0778*	-0.0373
	(0.0450)	(0.0452)
HRC*TL	-0.0608	-0.0308
	(0.0479)	(0.0444)
Gamma	-1.652***	-0.0540***
	(0.10300)	**(0.00364)**
Gamma*HL	**-0.860*** **	**-0.0219*** **
	(0.15600)	**(0.00571)**
Gamma*TL	**-1.249*** **	**-0.0333*** **
	(0.18300)	(0.00577)
Observations	4,052	4,052

Internal and External Validity

The use of a randomized experimental design gives our study strong *internal* validity compared with an observational study. However, two aspects of the survey implementation raise concerns. The first is the potential endogeneity of the after-treatment survey responses eliciting individual concern regarding the respective nutrients. Because we treat these responses as exogenous indicators of heterogeneous respondent tastes, endogeneity could bias the results. Our statistical check (Table 4) suggests that this response was in fact independent of the treatment, and that our interpretation is therefore valid with respect to this threat.

A second concern arises from our modeling assumption that the shopper's decision process is a compensatory process, as if the shopper is calculating a weighted average of either absolute or relative personalized nutrient values (across the product domain). But different decision modes are possible; for example, the decision process might actually be disjunctive (e.g., a cutoff model based only on the most important nutrient to the shopper) or reflect some other mental process. Our experimental design, which elicits nutrient importance ratings on independent Likert scales, does not lend itself to empirical testing of such alternative decision processes.

As for *external* validity, the key threats arise from the substantial differences between the stylized, hypothetical decision process captured in our survey and the complex context of actual shopping decisions. Two features of the real-world context of FOP labeling in particular distinguish it from our experimental setting. First, the store-aisle environment is a complex and information-overloaded situation for the shopper, unlike our survey's simple choice task. The very complexity of real-world shopping is, of course, a key reason behind simplified FOP labeling in the first place: the time-pressed and information-overloaded-shopper who is concerned about avoiding, say, sodium, can just rely on the heuristic rule of not putting any items that are visibly labeled "Red" for sodium content into the shopping cart. But how effectively labeling works when a multitude of choices and stimuli compete for the shopper's attention cannot be determined in a controlled choice exercise.

Second, exposure to actual FOP labeling would not be a one-shot deal, and consumers' responses to labeling are likely to evolve over time. Even if FOP-labels do not "educate" the shopper at the point of purchase, they might act as a reminder, in which case their effectiveness hinges on prior education about the interpretation and use of the nutritional information – education provided by, say, TV advertising, radio announcements, and/or in-store displays about the FOP program itself. Repeated exposure might plausibly increase shoppers' familiarity with and reliance on labeling information, although it is also possible that consumers might tune out information that no longer appeared novel. These observations suggest a dynamic response to labeling that is not captured in our experimental design—nor in any other studies to our knowledge with the marked exception of Moorman's (1996) longitudinal, quasi-experimental analysis of the NLEA Act of 1990 (as noted in Table 1).

Discussion and Policy Implications

We find that FOP-labeling can be effective in communicating nutritional information to motivated consumers, and that alternative labeling schemes vary in their effectiveness once we properly account for heterogeneous, individual nutrient-specific concerns. Our finding is consistent with the more general finding that the usage of the nutritional fact panel and health claims (taken together) had the largest impact among all factors in increasing consumers' diet quality (Smith et al., 2019). However, our research shows that the more salient HL and TL FOP labels have a differentially greater effect on an individual's health perceptions when the information provided suggests that a meal is less healthful with respect to that individual's specific nutrient concerns. For example, the HL and TL labels for a nutrient such as salt would likely have the greatest impact on the perceptions of people who are most concerned about salt intake, such as people with high blood pressure. Methodologically, we show that it is essential to take account of heterogeneity in consumer preferences to estimate the effect of information on consumer perceptions. In our study, the salience of information only matters when consumers have nutrient-specific concerns that render them sensitive to the information provided. Furthermore, studies that focus on average, aggregate treatment effects may miss the importance of labeling format entirely unless the direction of the change in perception is accounted for.

In describing the proposed changes to the Nutrition Facts Label, the FDA states that the label "helps consumers make informed food choices and maintain healthy dietary practices" (Parker and Pace, 2016, p. 456). To this end, labels must provide information that consumers find accessible and meaningful. Common sense suggests that placing key information on the front of the package where it is visible from the aisle without picking up the package and turning it to view the back or side makes information more accessible. Furthermore, a label that provides information that is personally meaningful to consumers is most likely to receive the shopper's attention. An FOP label that indicates a key attribute is high or low (or Red or Green) and that includes an easily interpretable word or symbol next to the nutrition characteristic accomplishes this objective.

Our findings have implications for both the content and the format of FOP labeling, and therefore offer potential guidance to policy makers considering regulations or guidelines for FOP labels. First, in terms of informational content, nutrient-specific FOP labels have an apparent advantage over generic labels (e.g. Smart Choice) because people respond differentially according to their specific nutritional concerns. Labels that address the most prevalent consumer concerns are likely to be the most useful and effective. Second, the format of labels matters: more salient labels have a stronger effect on the perceptions of motivated consumers.

The nature and impact of consumer motivation in mediating the response to nutritional labels is an important issue not only in the research literature but also from the standpoint of regulators. In its 2010 call for research on labeling, one of the FDA's specific interests (Question #20) was to determine "the differences, if any, in consumer response to nutrition symbols among various demographic subgroups, such as subgroups differentiated by… interest in or concern about nutrition and health." **(**Front-of-Pack and

Shelf Tag Nutrition Symbols, 2010). Our key finding relative to the FDA's question is that research regarding the expression of "concern about nutrition and health" should address not only the consumer's concern about general health and nutrition, but also the nutrient-specific concerns of consumers; in our study, consumers who were motivated by nutrient-specific concerns responded more strongly to the more salient FOP labels.

The apparent advantage of TL and HL labels is that shoppers who are motivated to avoid a specific nutrient can use an FOP label to quickly assess a product's content of that nutrient. This might be called the *avoidance approach to shopping*. On the other hand, we show that consumers who are less motivated by nutrient-specific concerns are significantly less responsive to salient FOP labeling. Thus, the goal of inducing uninformed or unmotivated consumers to watch their intake of certain nutrients is not necessarily well served by an FOP labeling regime. To the extent that it is important to encourage consumers to use food labels to achieve either personal or public nutritional goals, labeling should be complemented with educational efforts or other measures as a means of motivating consumers. A related implication is that policymakers should care about whether consumers' motivations are well informed. A motivated consumer who incorrectly perceives that she has a sodium problem when in fact she has a sugar problem will respond in the "wrong way" to an FOP signal (if improved nutrition is the goal). In this instance what succeeds from the viewpoint of consumer sovereignty might fail from the viewpoint of public health policy.

If guidelines for nutrient-specific FOP labels were to be implemented, regulators would need to pay close attention to the evolving nature of dietary science and be flexible in their guidance. For example, recent research suggests concerns about cholesterol may be unfounded. If such findings hold up, it is reasonable that cholesterol would be dropped from the set of mandated or recommended nutrients of concern for FOP labeling. This raises the question of how motivated and unmotivated consumers would respond to shifting information sets in labeling.

In addition to regulators, food companies might also be interested in these results. Companies that sell healthier products, such as low-calorie or low-sodium products, may benefit from a labeling scheme that highlights the attributes that consumers wish to avoid. Conversely, food companies that market products with unhealthy attributes might be at a competitive disadvantage if the negative nutritional attributes were prominently displayed. Such a scheme would likely have the effect of encouraging companies to reformulate their products to avoid the negative labels. However, because there would be no incentive to reduce unhealthy attributes more than necessary to qualify for a more favorable label, the thresholds must be carefully considered.

Directions for Future Research

Future research should address whether our findings hold for positive nutritional attributes that consumers care about, in addition to the negative attributes that were the focus of this study. The Facts Up Front FOP program allows for the display of up to two positive nutrients on the package in addition to negative attributes. Might a prominent display of positive attributes, such as fiber or vitamin content, improve consumers' perceptions of a products' healthfulness relative to conventional labeling? Might the positive attributes reduce the negative change we observe in perceived healthfulness induced by the current label treatments? Might the inclusion of positive attributes add too much clutter so as to reduce the results we report?

Since the Facts Up Front campaign is voluntary for manufacturers, there are some packages in a given category at a retail store that have the labels while others do not. There is an opportunity for research to assess the effect that different labels may have on the *relative* perceptions and sales of items in an assortment where some products have FOP labeling while others do not or even more confusing where competing products have alternative label formats. Such information would be valuable to policymakers in determining whether to implement standardized labels with little or no flexibility to highlight specific characteristics or instead a system that allows for multiple means of conveying nutritional information to consumers

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Journal of Agribusiness 38, 1 (Spring 2020)

Management Succession Lessons Learned from Large Farm Businesses in Former East Germany

A. Edward Staehr

This paper provides a context for recruiting, training, and promoting non-family managers on large farm businesses. Design/methodology/approach - Observing the process of training and recruiting non-family members for management positions on large farms in Brandenburg, and Mecklenburg-Vorpommern, Germany, could provide an example for farm businesses owners in the United States who have not identified a family member as management successor. Findings - Large farm businesses have an opportunity to train key employees from within, for positions that lead to overall management. Recruiting and training a management successor is a multi-year process that requires significant effort.

Key words: Human Resource Risk, Management Succession

Although the majority of farmers manage price and production risk via crop insurance, an area often overlooked by farmers is managing human resource risk; namely, management succession risk. A study conducted by Lobley et al. (2010) indicated that 72% of Iowa farms have not identified a successor. Meanwhile, the average farmer age in the United States is now 58.9 years old for full owners (U.S. Department of Agriculture, 2019). The purpose of this paper is to illustrate a system and approach to recruiting, selecting, and promoting non-family managers on large farms in the areas of Brandenburg and Mecklenburg-Vorpommern, both in former East Germany. Some findings could be incorporated on farms in the United States and, in turn, create opportunities for the next generation of farm managers.

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Factors for Study

As farms become larger and more complex, finding and training a management successor from within the family could present an increasingly difficult challenge. Multiple-owner farms in former East Germany provide an illustration of how a non-family member successor to management is identified and promoted to provide management and leadership in a complex farm business. A key factor in having a management succession process in place in Germany is current farm chief executive officers (CEOs) have identified fixed retirement dates, and view recruiting a viable management successor as a high priority and part of their job. In contrast, a poll conducted by Arbuckle (2015) at Iowa State University Extension and Outreach found that 35.1% of farmers in the United States have not set a retirement date because

> Farming is such an important part of their identify that retirement is very difficult (2015, P.1)

NY FarmNet, a program at Cornell University that provides free and confidential consulting for farm families, works with over 60 farm businesses a year to prepare for management succession and business transfer to the next generation. (Staehr, 2018). Many farms are focused on transferring assets and lack a plan to transfer management, based on NY FarmNet experience. Training the next generation for management should take place before transferring farm business assets. Timely management transfer may provide benefits such as a smoother transition and increased likelihood of business continuity. This study provides an opportunity to observe how management is recruited and trained on large farm businesses in Germany.

Farm Evolution and Transition in Former East Germany

East Germany land reform began in 1945 after World War II and served as a gateway for farm collectivization. Farm owners with land holdings over 100 hectares (247 acres) saw their land expropriated without compensation. Over 2.1 million hectares were distributed to small farmers (Eidson, 2001). Farms with less than 100 hectares owned by war criminals were also expropriated (Wolz, 2013). Farm collectivization began after 1952 with a legal structure of Landwirtschaftliche Produktionsgenossenschaft (LPG), translated to Agricultural Production Cooperative. Another source of land that was transferred into collective farms occurred from 1950 to 1952, when over 5,000 owners of large farms left their land and moved to the West (Bauernkaemper, 1997).

At first, private land-owner farmers worked only their arable land collectively, and all livestock was owned individually. Over time, the state exerted pressure for farmers to join another form of an LPG, termed LPG III. This business structure aided the state in accomplishing a goal that all farms would be collectivized by 1960. An example of the pressure to join collectives occurred when the state refused to sell fertilizer to independent farmers (Eidson, 2001).

During this relatively early phase of development, the LPG management used the estimation of the worth of assets as a political instrument for rewarding or punishing individual farmers, depending upon whether they acquiesced or resisted collectivization. (2001, p. 30).

Farmers who voluntarily entered into LPGs early on derived more benefits than those who waited or were forced to join. Once collectivization was complete, LPG consolidation began. In 1960, there were initially over 19,000 LPGs in East Germany. By the 1980s, the number of such farm businesses declined to approximately 5,110 LPGs (Land, 2000).

To achieve full employment in East Germany, the state placed minimally skilled workers on LPGs. The number of LPG workers declined from 850,000 before German reunification to approximately 160,000 in 1993 (Land, 2000).

Socialist Government Collapse and Transformation to Another Farm Business Structure

In late 1989, the German Democratic Republic collapsed and there was a need for further land reform. The Agricultural Adjustment Act was put into place in July 1990 and served as a foundation for restructuring property ownership and farm business enterprises. Smaller farmers retained title to their land that was previously placed into collective farms. The act stipulated that collective farms had to be dissolved or reorganized by the end of 1991 (Eidson, 2001). West Germans thought that collective farms would be separated and turned into smaller farms, as in the West. However, an LPG successor, Agrargenossenschaft (eG), translated into agricultural cooperative, was viewed as a viable alternative for former collectivized farms.

Many LPG members had reservations about starting their own farms as they viewed farm size as too small to be competitive. Advisors from West Germany encouraged LPG collectives to sell their holdings to investors from the West (Wolz, Kopsidis, and Reinsberg, 2009).

> "This experience with West Germany advisors made them (farmer land owners) indirectly confident that their large scale farms will be competitive in a market economic environment, which proved to be right in the following years" (p.13).

Forming a large-scale farm business enterprise with multiple property owners also provided an opportunity to take advantage of European Union (EU) agricultural subsidies and economies of scale. Wolz Kopsidis, and Reinsberg stated:

> The main factor seems to be that farm managers could make full use of the potential of large-size farms and profit from the economies of scale. During the time of central planning, , their major problem had been the lack of inputs or their availability at the wrong time of the agricultural calendar. Now they can apply them right in time. (2009, p. 16).

Farm Business Characteristics

A key difference among dairy farms observed for this study and those in the United States is diversification among business enterprises. All farms had dairy enterprises between 800 and 3,500 cows. One agricultural cooperative had eight complimentary business enterprises, including a large dairy farm, John Deere equipment dealership, farm store, restaurant, potatoes, and asparagus. For example, there were 18 individual owners and over 130 employees in this agricultural business.

All farms employed a considerable number of employees. The range in this study numbered between 30 and over 300 employees. Vegetable production and harvesting labor requirements resulted in having considerably more employees than a single enterprise dairy farm. For example, one farm grows over 650 hectares of asparagus and over 200 hectares of blueberries, as well as having a dairy. This business is located within a half hour drive of a population of over 3.5 million and, thus, has a viable market for such produce as well as a pool of potential employees.

Some farms in the study, organized as an eG for business purposes, also had complimentary farm businesses structured as Gesellschaft mit beschraenkter Haftung (GmbH), the equivalent of a Limited Liability Company in the United States and other countries. The GmbH business structure originated in Germany in 1892 (Devries and Juenger, 1964) whereas the LLC business structure was first formalized in the United States by the Wyoming State Legislature in 1977 (Hamill, 2005).

As in the United States, many German dairy farms relied on workers who came from another country to milk cows. Immigration policies in the EU allow workers from other member countries, such as Poland, to work legally across borders. Farms make accommodations for workers who are not fluent in German. For example, many instructional signs for workers on farms are in both Polish and German. Such a relatively stable labor supply is critical for all sectors of agriculture requiring labor for milking, and vegetable and fruit harvesting.

General Management Succession Observations

All farm business CEOs (Betriebsleiters) had a minimum of a Bachelor's degree equivalent, and some had Masters' degrees from agricultural universities. Recruitment methods varied for key management positions, but all farm businesses utilize social media to find new management talent. All farms also strive to train management from within and may have multiple apprentices.

The German Apprenticeship Model is highly structured and is a combination of work and vocational school. Apprentices attend vocational training for 13 weeks per year and formal instruction subjects may include: technical calculus, computer science, German, English, and coursework in professional foundations for plant and animal production. On some farms, if an apprentice demonstrates management potential, the farm may pay a room and board stipend at an applied sciences university, with the stipulation that the individual returns to employment at the farm for a set period of time. Tuition at all German public universities is free, and one university visited for this study indicated that a cumulative cost for a student to obtain a Bachelor's degree, converted to U.S. dollars, is approximately $30,000 over four years for room and board at an applied sciences university such as Hochschule Neubrandenburg.

A hybrid, applied sciences university dual study degree program provides students with technical coursework combined with employment on a selected farm. Four key components of a dual study program include: apprenticeship, occupational school, coursework at the university, and applied work on a selected farm.

Dual study semesters involve a multitude of components. The first and second semesters include an apprenticeship and occupational school. Third and fourth semesters include an apprenticeship combined with university coursework from September through February, and occupational school. Fifth and sixth semesters are spent at the university and there is an apprenticeship final exam. During the next two semesters, students attend the university while working on a farm as an employee. The ninth, and final, semester involves working on a farm for six weeks, and coursework that leads to a Bachelor of Science degree (Fuchs, 2016).

Most farms recruit from the local community and hold educational events for school children to expose them to potential career paths on farms. Some farms hold large community events, and one farm business attracts over 1,000 visitors at an annual barbecue and open house. There is also a community connection on some farms that generate electricity to provide power to nearby municipalities. Current farm CEOs view every event as an opportunity to potentially connect with someone who may become a manager in the future.

All farm CEOs in the observational study had a strong connection with faculty at an agricultural university. It is not uncommon for faculty to make referrals and connections between promising students and large farm businesses. In addition, over 8,000 youth and young adults (up to age 36) belong to Junge DLG, a network comprised of young farmers, students, technical students, and professionals. This network hosts events at trade shows such as EuroTier, an animal agriculture exhibition that attracts international attendees and provides seminars for those interested in exploring agricultural careers.

Three Farm-Level Management Succession Observations

One farm observed in this study had a future CEO in training. The next generation studied at Dresden University and visited the farm seeking employment opportunities. He was hired, signed an employment contract, and is under the mentorship of the current CEO. The farm currently has 32 employees, compared to 504 before the Agricultural Adjustment Act (Laurence, 2016). A total of 50 landowners have equity in the farm business and are able to collect EU subsidies because their individual holdings are less than 1,000 hectares.

The future farm business CEO has a performance appraisal four times per year. Moreover, there is daily communication with the current CEO to discuss business issues. This farm business is comprised of over 2,400 hectares and has three operations managers who report to the current CEO. The management succession path is to demonstrate proficiency in managing all three areas before becoming the next CEO over a period of three years as part of a well-developed management transition plan.

A second diversified dairy farm employed a CEO who has a Master's degree in Agricultural Economics and came with experience managing a 2,500-hectare crop farm. His management track involved a five-year evaluation process and the current CEO was recruited by the former CEO. A key component of evaluation included daily meetings and demonstrating management proficiency in each farm business area (Schieban, 2016). There are 18 owners of this 5,300-hectare farm business that employs over 100 workers. The current CEO places a high priority in visiting schools to discuss agriculture and career paths on farm businesses. Moreover, he eats lunch in the farm cafeteria with all staff as a means of providing additional accessibility to employees who wish to discuss farm business operational issues.

A third farm visited for this study had a two-year training and evaluation period for the current CEO, who knew the former CEO. The new manager has a degree from an agricultural university and grew up in the area. He worked in Britain on a hog farm that raised swine outside, and he brought this experience to the current farm business. The farm was able to brand its pigs as Jüterbog Hog , which is sought after by numerous restaurants. Two years ago, a modern dairy complex was added after the management team drove over 45,000 miles to visit numerous farms to decide which technology to utilize in the new dairy enterprise. The management organization for farm three is illustrated in Figure 1.

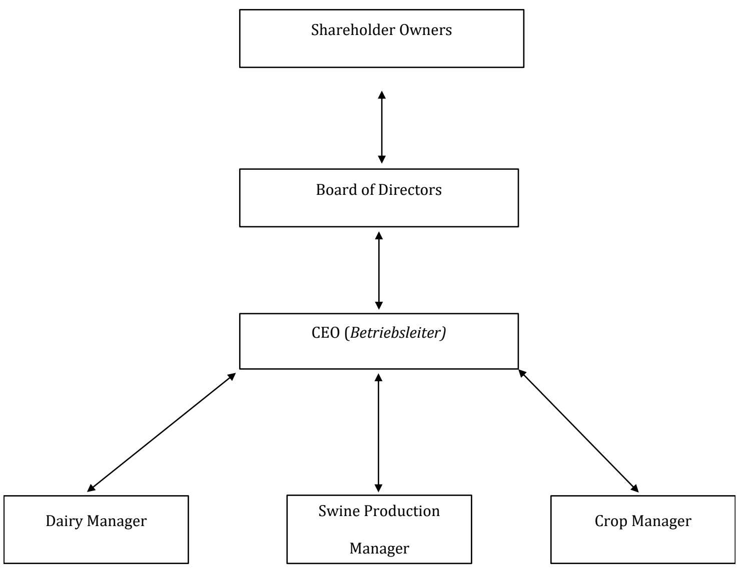

Figure 1. Management Organizational Chart on Farm Three.

Policies to Encourage Farm Business Management Succession

The German government does not want to break up privately owned businesses and has policies in place to encourage business continuity. There is no inheritance tax on up to 26 million Euros for assets in a family-owned business. However, there are conditions to receiving such a benefit. The business must keep the current workforce and utilize retained earnings for productive capital investments related to the business instead of withdrawing funds for uses outside of the business (Maydell, 2016).

There is a separate form of social security for farmers that is obligatory. This program is a self-administered federal corporation within public law. Providing a guaranteed source of income encourages farm business succession to the next generation. In addition to receiving a guaranteed income after retirement, farmers pay a reduced Valued Added Tax (VAT) on products and receive a full refund after tax has been paid. The VAT tax rate is 7% on agricultural products, compared to 19% for other products.

Applicability to Farm Businesses in the United States

Although there are many differences in management succession in Germany and the United States, a multitude of business practices could be incorporated. Frequent and meaningful communication between current and future managers provides a framework for successful management transfer. Moreover, having a defined retirement date could serve as an impetus for current owner/managers to recruit and train their successors.

Incorporating components of a dual study program could also yield benefits for students and farm owners. Currently, a vocational education program and community college based in rural New York State are seeking guidance from the author in offering students increased opportunities to acquire specific on-farm skills, in conjunction with pursuing a degree or certificate.

Taking a proactive approach in communicating with career counselors at pre-secondary schools about careers in production agriculture can be beneficial and encourage more students to explore agricultural careers. Connecting with schools to offer tours for young students would also help stimulate student interest in potential careers on farms. Moreover, utilizing social media to educate the public about modern farming practices and, as an employee recruitment tool, reach more youth who are tech savvy would further enhance desirability of agricultural careers. Certainly, the events of early 2020 and the supply chain challenges manifesting around the global COVID-19 pandemic exposed how essential the entire food supply chain is to U.S. consumers and has shown to be an impetus for increased interest in at least gardening, if not larger-scale farming. (Macias, 2020).

Conclusion

As dairy farms become increasingly larger and complex, recruiting non-family members for key management positions could offer improved potential for farm business continuity and growth. Current farm owners/managers who take innovative approaches in recruiting and cultivating new management as a critical component of their jobs will increase the possibility that their farm businesses will remain viable into the future. Developing a proactive farm management succession plan is especially relevant to helping ensure the future viability of the financially stressed dairy industry in the United States.

Although much information discovered in this study is applicable, there are potential limitations. The first limitation is that participants were selected based on their willingness to be interviewed by the author and not at random. The second limitation is there may be an insufficient sample size for statistical measurement. Future research could take these issues into account and design a study that is devoid of both sample and selection bias by randomly selecting farms to be interviewed and obtaining a sufficient number of participants to yield statistically significant findings.

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Journal of Agribusiness 38, 1 (Spring 2020)

An Online Survey of Chinese Familiarity With and Attitudes Towards Pecans

Chun Du and F. Bailey Norwood

China is an important export market for U.S. pecan producers, yet the little that is known about pecan consumption in China is based mostly on anecdotes. In an effort to better understand this important market, an internet survey of over 900 Chinese residents is conducted, inquiring into how well they can recognize pecans, their consumption of pecans relative to other nuts, the relationship between demographics and pecan consumption, and their general attitudes towards pecans. Results show that pecans are recognized and frequently consumed in China, though not as much as other nuts; that pecan consumption varies little across the vast regions of China; that consumers prefer their pecans to be cooked and flavored; and that pecans are superior to walnuts (a more popular nut) in regards to losing weight, taste, and being easy to crack and eat.

Key words: Exports to China, Nut Consumption in China, Pecan, Pecan Consumption, Pecan Consumption in China

Pecans are the fourth most important tree nut in the United States, each year producing more than $500 million in value (Perez, 2019). While U.S. pecan production in the last five years is only about 10% higher than it was in the early 1980s, reliance on export markets has risen considerably. Average annual exports in the 1980s were only 4.8 million pounds (shelled basis), but, in the last 10 years, the United States has always exported more than 50 million pounds each year, and in the 2017-18 harvest year, exports totaled 113 million pounds (U.S. Department of Agriculture (USDA), Economic Research Service (ERS), 2020). China is currently the largest export market (Arn, 2018), making understanding this market essential for the sustainability of U.S. pecan exports.

Little is known about the nature of pecan production in China. While nuts in general seem to have been an important Chinese food for some time, especially during spring festivals (Zhao, Gangliu, and Wang, 2015), pecans have only recently been included. Consumption of pecans is thought to have risen considerably in 2008 when a shortage of walnuts in China and a surplus of pecans in the United States induced Chinese consumers to substitute pecans for walnuts (Hargreaves, 2013; Zhang, Peng, and Li, 2015). Pecans are now a well-known food in parts of China, which is remarkable given that they were virtually unknown 10 years prior.

The first U.S. pecan exporter to China is thought by the U.S. pecan industry to have been the Hudson Pecan Company LLC. Frustrated with low domestic pecan prices, Randy Hudson sought to sell in China. He first attempted to work through official government and industry channels, but

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this proved fruitless because Chinese importers did not know what a pecan was. There was no Chinese word referring to pecans, despite the fact that U.S. government programs had funded pecan marketing programs aimed at Asia, though most of those programs focused on exporting to Japan (Onunkwo and Epperson, 2000). Hickory, almonds, and cashews did have a place in both Chinese vernacular and in its stores, but pecans did not. The best indicator of pecan's absence from China was its absence from the Red Book, a document listing tariffs applying to Chinese imports. When Hudson took some of his pecans to a trade show around 1999 and told Chinese attendees they were pecans, many tried to correct him and said they were actually hickory nuts. There was no evidence that anyone in China, save for those who had traveled abroad, ever saw, ate, or knew of the pecan.

One Shanghai buyer at the show was particularly interested in importing pecans, but was more interested in a trade than a purchase, so Hudson agreed to trade one shipping container (39 m3) of pecans for a half container of walnuts. In hopes of acquiring a permanent buyer, Hudson sent only high quality pecans, those of the Desirable variety. The buyer apparently liked the pecans and found a market for them, for he purchased more and, with persistent effort at Chinese trade shows by growers and the Southern United States Trade Association, Hudson and other growers now export large volumes of pecans to China (Hudson, 2017).

U.S. pecans now have a permanent home in China. Of the 294 million lbs. of pecans produced in the 2017-18 marketing year, on an in-shell basis, 38% were exported with 36% of those exports going to China (mainland and Hong Kong) specifically (American Pecan Council, 2019; ERS, 2020). China is considered a promising market because of growing exports, increasing trade liberalization between the United States and China, the prominence of nuts in the Chinese diet, and its high population.

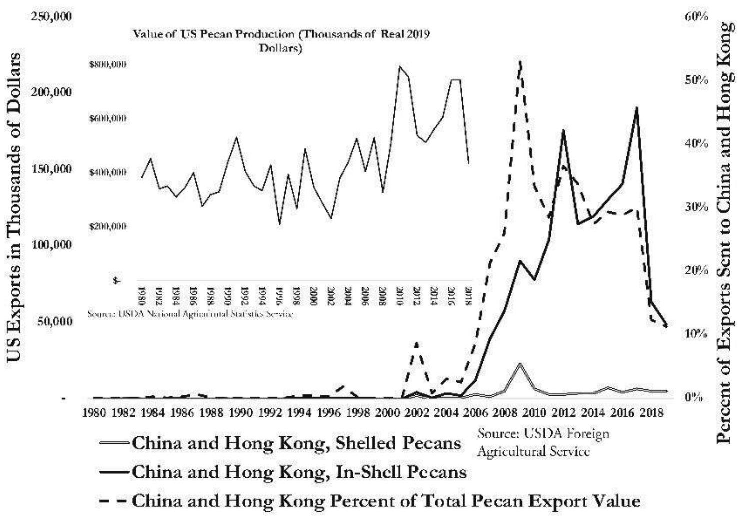


Figure 1. Importance of Chinese Export Market to the U.S. Pecan Industry.

Figure 1 shows U.S. pecan exports to mainland China and Hong Kong, illustrating that most exports are in the form of in-shell pecans. Chinese consumers most commonly purchase pecans in cracked shells (cracked to make peeling the shell easier), which are already flavored in brine and roasted (Medrano, 2012). While nuts are consumed year-round, they are especially favored as gifts during Chinese New Year celebrations (Zhao, Gangliu, and Wang, 2015). Figure 1 demonstrates that exports to China can be particularly volatile, comprising half of all exports in one year and only 10% of exports 10 years later. Notice also that, in recent years, the value of U.S. pecan production tends to rise and fall with exports to China, demonstrating the importance of this market to U.S. pecan producers, who lately have been losing market share to Mexico (USDA, Foreign Agricultural Service (FAS), 2020).

The recent and speedy success of United States exports to China verifies Onunkwo and Epperson's (2000) estimates that promotion of U.S. pecan exports to Asian countries can experience high returns, a finding that arises for other U.S. nuts like almonds as well (Onunkwo and Epperson, 2001). Indeed, in describing the 2000% increase in U.S. pecan exports since 1980, one author describes the opening of the Chinese market as "the most significant" event (Wells, 2014, p. 475), and was attributed to China's growing middle class. This matches previous literature in the 1980s suggesting the failure of pecan exports to grow as almonds did was due to pecan's higher price and the almond industry's greater efforts to develop new export markets (Glover and Miller, 1986).

The United States is not the only country interested in exporting pecans to China. Nadler, Chen, and Lu (2017) report that Australia and South Africa have also found a market for pecans in China due to their lower shipping costs and their unique ability to provide fresh nuts during China's spring festivals, during which nut consumption rises considerably. China's role in the U.S. pecan industry has provided a profitable market but its potential loss to rivals introduces uncertainty in the pecan industry. The profitability of a pecan oil and flour extraction company in the United States, for example, depends on whether China's pecan demand continues to place upward pressure on U.S. pecan prices (Cockerham et. al., 2012). China's role in the pecan industry thus affects pecan producers and food processors alike.

Given that pecan consumption in China went from non-existent to millions of pounds in just 20 years, and given its importance as a market for U.S. pecans, it is worth exploring the state of pecan consumption in China. A pecan is not a generic commodity. Its attributes can vary considerably across pecan varieties and environmental conditions (Silva et al., 1995; Magnuson et al., 2016). This is known by consumers, who, in United States experiments, are shown to value pecans differently according to whether they are natives or improved varieties, the pecan size, and its country of origin (Palma, Collart, and Chammoun, 2014).

China is a peculiar pecan market, one of the few (along with Italy, Vietnam, and Mexico) to import more in-shell U.S. pecans than shelled U.S. pecans (FAS, 2020), and so the characteristics of Chinese pecan demand deserves special attention. To what extent are pecans a familiar food in different regions of China? How does pecan consumption compare to consumption of other nuts? What demographic factors are associated with higher pecan consumption? How do Chinese view the pecan in terms of healthfulness and other considerations? A better understanding of the China market is important to preserving it, for there will be increasing competition for its consumers, both from other exporters and the growing China pecan industry (Zhu, 2018). We explore these questions through an internet survey of over 900 Chinese consumers.

Objectives

This is an exploratory survey, seeking to document the nature of pecan consumption in China to aid U.S. exporters in understanding their market. The main questions asked are as follows. How well can Chinese consumers identify pictures of pecans relative to other popular nuts? How does pecan consumption vary across demographic variables in China? How frequently do Chinese consumers eat pecans relative to other popular nuts? What are their general attitudes towards pecans in regard to healthfulness, how pecans are consumed, and other considerations?

A few terms have specific definitions and, thus, are worthy of stating explicitly here. Respondents—the first question of the survey asks whether the respondent is born and raised in China, and only those who answer yes are administered the survey. No attempt is made to verify citizenship, length of residence in China, or whether the person had traveled abroad. No data are collected on ethnic identity. Also, individuals above the age of 50 and below the age of 18 are excluded from the sample due to their low sample sizes, so the targeted 'respondents' only includes those between the age of 18 and 50. All respondents claim to be located in one of the mainland Chinese provinces and, thus, do not include residents of Hong Kong, Taiwan, or Macao.

Weighted statistic—the demographics of the sample are not identical to those of the China population. When a weighted statistic is employed that means the respondent's observation was assigned a weight generated by a sample balancing mechanism to force the sample to behave as if the distribution of their age (among those 18 to 50), region, household size, and gender is identical to that of mainland China, as reported by the 6th Chinese Demographic Census conducted in 2010.

Nut—there is a botanical and a culinary definition of a nut, and this research uses the culinary definition. Botanically, a nut is a seed which does not naturally detach itself from its shell, so the fruit and the seed remain attached. Peanuts are actually legumes, and cashews are seeds that have separated from the tree fruit, so these are not botanical nuts. Many foods referred to in a culinary sense as a nut are botanically something else. However, in this study a food is referred to as a nut whenever the common vernacular dictates.

The rest of the paper is organized as follows. The next section describes the survey instrument and is followed by a section describing the survey respondents. Then, a separate section showing the results of each objective is provided. The final section briefly summarizes the important findings for the U.S. pecan industry.

Survey Design

The survey instrument is divided into five parts (1) a nut identification test, (2) questions regarding the frequency of pecan and other nut consumption, (3) questions regarding how pecans are consumed, (4) questions about attitudes towards pecans, and (5) a set of demographic questions.

An example of the nut identification test is shown in Figure 2. The test was designed to assess how well respondents could identify almonds, hickory nuts, macadamia nuts, pecans, and walnuts from a picture. Figure 2 shows what the test looked like for in-shell pecans, and similar tests were conducted for the other nuts within the shell. A separate test is then given where the nuts are shelled. After being presented the picture, respondents were asked to select the name of the nut, where the options are almonds, hickory nuts, macadamia nuts, pecans, walnuts, and hazelnuts (hazelnuts were always an option, but never the correct answer).

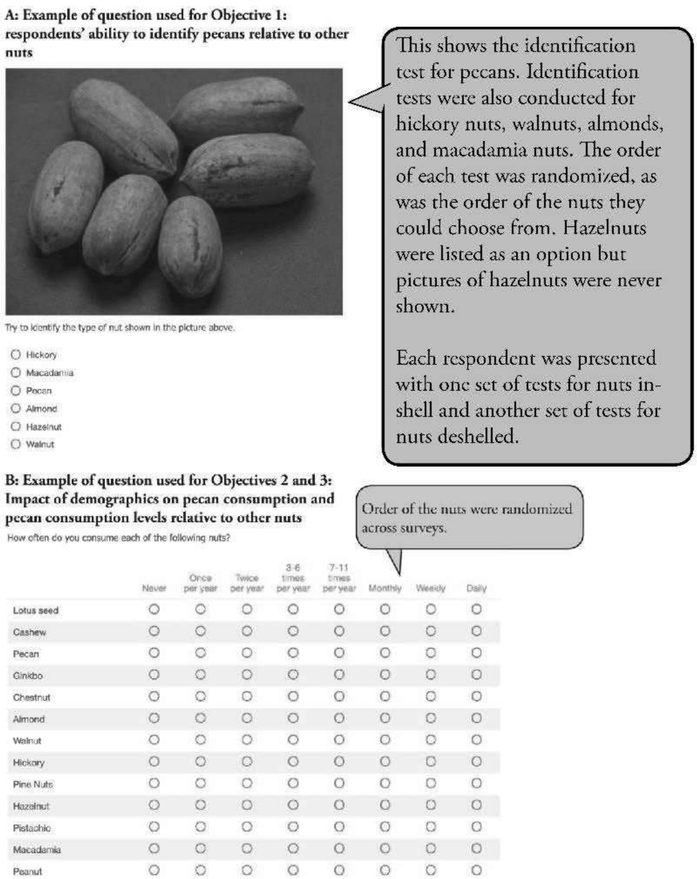


Figure 2. Illustration of Survey Questions as They Appeared on the Instrument.

Thus, the identification test contains 10 total questions, five for in-shell nuts and five for shelled nuts. Respondents are first presented the five questions for in-shell nuts and then the five questions for shelled nuts. Within each test, both the order of the nuts and the order of the possible answers are randomized. That is, when a respondent is presented with the identification test for in-shell nuts each nut has an equal probability of being shown first, second, third, fourth, or fifth. Also, the order in which the nut names appear as answers is randomized, such that each nut has a one-sixth chance of being shown first, second, third, fourth, fifth, or sixth. Note that the type of shelled nuts consumed in China are often different from those in the United States. The most popular varieties may be different and, in China, the shells are often cracked whereas, in the United States, this is rarely the case. To account for different possible pecan appearances, for the in-shell nuts, half the time the picture shows a typical un-cracked American pecan and half the time it shows a typical cracked Chinese pecan.

The second part of the survey concerns the frequency of nut consumption, both in an absolute sense and relative to other nuts. Respondents are asked how often they consume each of the following 13 nuts: pecan, almond, walnut, macadamia, hazelnut, hickory, cashew, pine nuts, pistachio, chestnut, ginkgo, lotus seed, and peanut. This list was intentionally expansive so that there would be many benchmarks by which to compare pecan consumption. Some, like pine nuts and peanuts, do not always compete for market share with pecans. For example, peanuts are often consumed in the form of peanut butter but there is no equivalent butter spread for pecans, and when individuals indicate their level of peanut consumption it is unclear whether they are including processed products like peanut better. The eight levels of consumption frequency are: “never,” “once per year,” “twice per year,” “three to six times per year,” “seven to eleven times per year,” “monthly,” “weekly,” and “daily.” Part B of Figure 2 shows the question used to elicit the frequency of pecan and other nuts’ consumption. The order of the 13 nuts is randomized across surveys.

Pecans are frequently used as a recipe ingredient in the United States, such as pecan pie. It is not clear if pecans are used in this manner in China, or if they consume pecans exclusively as a direct snack. Thus, a survey question is provided eliciting this information, where we list five different forms of eating: raw and already shelled pecans; raw but not already shelled pecans; cooked, flavored, and shelled pecans; cooked and flavored but not shelled pecans; and a recipe or dish containing pecans. For each pecan type, respondents were given the statement, “When you consume pecans, you tend to eat them as,” and they were asked to select the appropriate response. Response options are: “strongly disagree,” “disagree,” “somewhat disagree,” “neither agree nor disagree,” “somewhat agree,” “agree,” “strongly agree,” and “I do not eat pecans.”

Respondents’ attitudes towards pecans could have effects on their preferences for and consumption of pecans. These attitudes are measured through a series of agree/disagree and true/false questions, eliciting the perceived relationship between pecans and weight loss, bone health, and other outcomes. A few questions also ask the respondent to compare pecans and walnuts in their healthiness, price, convenience, and the like. In all such questions, respondents are presented with either a positive or a negative statement. For instance, half are asked to answer true/false to the statement “Eating pecans is good for bone health,” while the other half are presented with the statement “Eating pecans is bad for bone health.” The combination of positive and negative statements should produce responses that are free of bias from positive/negative statements, such as acquiescence bias, where individuals prefer to agree with statements.

The final section of the survey contains a series of demographic questions, including the respondents' age, gender, region, family income, household size, number of children, and educational background. These questions are needed both for the sample balancing algorithm and to evaluate how pecan consumption varies across demographic profiles.

Table 1. Statistics of Internet Survey Sample Before Sample Balancing and the 6th Chinese Demographic Census.

Demographic	**Internet Survey Sample Before Sample Balancing (N=1000)**	**The 6th Chinese Demographic Census (2010)**
Gender	*Percent of Sample*	*Percent of Population*
Male	51	51.19
Female	49	48.81
Age		
Under 18	0.3	20.93
18-30	41.5	21.73
31-40	34.9	16.78
41-50	16.5	16.29
51-65	6	16.03
Above 65	0.8	8.24
Highest Education		
Junior College degree	24.4	5.15
Graduate degree	6.8	0.31
Primary school diploma	0.1	26.8
Middle school diploma	1	38.88
High school diploma	7.4	14
Bachelor's degree	60.3	3.42
Household Size		
1 person	3.4	14.56
2 people	10.1	24.42
3 people	55.1	26.92
4 people	17.1	17.6
5 people	10.7	10.06
6 and above 6	3.6	6.43

Respondents

The survey was administered over six days in September 2017 in the Mandarin language, written by one of the authors, a Chinese native. The Survey Sampling International (SSI) company was responsible for recruiting respondents, using an opt-in panel where volunteers take surveys in return for rewards like airline miles, cash, gift certificates, and the like. While SSI can provide a representative sample in terms of some demographics like gender, and can provide respondents throughout all regions of China, the sample will not be truly representative as it does not employ probability sampling and relies only on opt-in panels. The company uses a quota procedure to select respondents, sending invitations to panelists in such a manner that it includes respondents covering many demographic categories and regions.

The demographics of the sample compared to the population is shown in Table 1 and Figure 3. The gender profiles match closely. As is typical in surveys, the younger population is over-sampled, as are those with a higher education. As well, the sample contains considerably more three-person households than the population. In regard to regions, the 29 provinces and autonomous regions of China are aggregated into six regions in Figure 3. The survey over-samples the eastern and northern regions, under-sampling other regions.

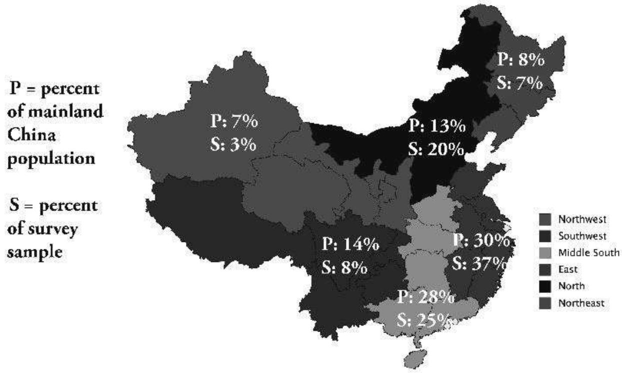


Figure 3. Percent of Survey Sample and Chinese Population in Six Regions.

As no respondents were supposed to be under the age of 18 and, given so few respondents above the age of 51, this study only includes the observations of those 18-50 years of age, reducing the sample size to 929. Otherwise, a sample balancing algorithm would assign a disproportionally large weight to the few people older than 50, and these large weights would increase the variance of statistics considerably. The sample balancing algorithm used by Lambert et al. (2014) is used to make the sample behave more like a representative sample. This algorithm calculates a weight for each observation, such that the demographic profile of the sample mimics the population in terms of gender, age distributions in the 18-50 category, region, and household size. For example, while only 3% of the sample resides in the northwest region, the weighted percent of respondents residing in the northwest region is 7%, identical to the population percentage. After these weights are calculated, they are "trimmed" such that the maximum (minimum) weight is no more (less) than the 95th (5th) percentile. All statistics reported as a "weighted" statistic are computed using sample balancing.

Results

Objective 1 Results

The first objective was to assess the extent to which Chinese consumers can recognize pecans from pictures. Table 2 shows the percentage of respondents who identify each nut correctly. Approximately 60% of respondents correctly identified the in-shell pecan, indicating it is a familiar nut in China. This percentage differs little depending on whether it is a picture of the pecan as they often appear in the United States or as they often appear in China. Though more than half of respondents could not properly identify the pecan, they tended to perform just as well or better identifying other nuts in-shell. Walnuts are the most recognizable nut, but this is not surprising given their unique appearance and widespread appeal in China.

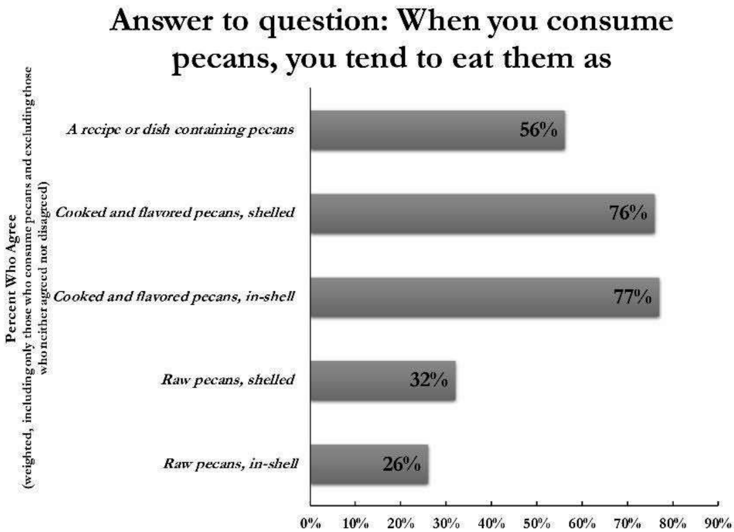
Table 2. Results of Nut Identification Test.

Nut Type	Percent of sample correctly identifying nut	
	In-shell	*Shelled*
Pecan	57-60[a]	43
Hickory	63	58
Almond	70	88
Macadamia	58	56
Walnut	95	87

Notes: Respondents are shown pictures of the nuts in a random order and are asked to select the correct nut from a list of the following six nuts: pecan, hickory, almond, macadamia, walnut, and hazelnut. Results are from 929 respondents from China between 18 and 65 years of age. Percentages are calculated using weights acquired from a sample balancing algorithm. a 57% using picture of typical pecans in the United States and 60% using picture of cracked pecan taken from a Chinese retailer.

The ability of respondents to identify the pecan drops considerably when viewing them shelled. Less than half could identify the pecan absent its shell. This might be due to the fact that the pecan and hickory nut resemble each other without their shells, so respondents were perhaps confused by the two nuts, especially since hickory nuts are popular in China. Walnuts are still highly recognizable without the shell, and the percent who could identify the almond rises when the almond is shelled.

What do these results imply? Since there are only six options, they should be able to identify the nut correctly 1/6 of the time if they choose randomly. Yet most nuts are identified roughly 50% of the time or more, indicating Chinese are familiar with the five nuts. Perhaps the most important result is that pecans are much more recognizable within the shell, suggesting that is how Chinese typically purchase pecans. However, Figure 4 (discussed shortly) suggests they purchase pecans in-shell about as much as they purchase pecans without the shell, so there remains ambiguity as to the form of pecans most widely purchased in China.



Notes: Respondents are asked whether they agree with each statement on a 1 to 7 scale (1 = strongly disagree, 4 = neither agree nor disagree, 7 = strongly agree). They are said to "agree" if the scale value is greater than 4, so 26% provided an answer of 5, 6, or 7 to the statement that they eat pecans raw and in-shell. Percentages above are weighted statistics using weights from a sample balancing algorithm.

Figure 4. How Pecans Are Consumed.

Objective 2 Results

To better understand consumers of U.S. pecan exports in China, variations in pecan consumption levels are studied by demographics. Recall that respondents indicate their level of average pecan consumption by indicating 1 = never, 2 = once per year, …, and 8 = daily. As this is a discrete variable where a larger number indicates greater consumption, it is used as the dependent variable in an ordered logit regression. Explanatory variables include gender, age, education, family income, household size, number of children, and region. The ordered logit estimates are shown in Table 3.

There are no detectable variations in pecan consumption across the six regions, suggesting that, despite its enormous size, pecans have reached every part of China and have similar levels of per-person consumption across regions. This is perhaps surprising, given the large amount of pecans that enter China from its eastern shores, and the short period of time in which pecans have been available. It may be that the Chinese infrastructure allows for inexpensive transportation and that its inter-regional cultures can adopt new foods at similar rates.

Females tend to consume more pecans than males, and the young consume more than their older counterparts. Pecans are generally considered a more expensive nut, so it is not surprising that higher income levels lead to higher consumption rates, verifying the claim by Wells (2014) that rising pecan consumption in China is due to its growing middle class. Education is correlated with higher consumption also, but that might be partially due to the positive correlation between education and income (note, the reverse could be said as well). Households with one child consume more than households with more than one child or no child, and household size seems to have no influence on consumption.

Table 3. Ordered Logit Estimates for Frequency of Pecan Consumption.

Indicator Variable	Ordered Logit Coefficients	Standard Error
Gender		
Female	0.4227*	0.1206
Age		
Age 31-40	-0.4040*	0.1403
Age 41-50	-0.5262*	0.1843
Education		
bachelor and above bachelor's degree	0.7521*	0.1362
Family income		
30,000 yuan < a ≤ 100,000 yuan	0.4085*	0.1956
Above 100,000 yuan	0.8270*	0.1999
Household Size		
3 or 4 people	-0.119	0.2168
5 and above 5	-0.2782	0.274
Number of children		
1 child	0.7687*	0.1682
2 and 2 more children	0.3312	0.2484
Region		
Northeast China	-0.1364	0.2703
East China and	0.1545	0.1654
Middle-of-south China	-0.1248	0.1777
Southwest China	0.068	0.2413
Northwest	-0.0692	0.4036

*Notes: Dependent variable is the stated level of pecan consumption, where 1 = never, 2 = once per year, ..., and 8 = daily (see Figure 3). All variables in the table are indicator variables, so the '3 or 4 people' variable equals one for household sizes of 3 or four people and zero otherwise. Indicator variables for 18-30 years of age, not having a bachelor's degree, income less than 30,000, household size of 2 or less, having no children, and being in the northwest region are excluded to make the model tractable. Threshold parameters for the ordered logit models are not shown. * denotes statistical significance at the 5% level.*

Overall, these results suggest that the popularity of pecans has crossed regional borders but not certain cultural borders. The young, educated, and wealthy consume more pecans than their counterparts; the young are expected to maintain their consumption as they age, to be replaced by a new generation that also consumes pecans. Moreover, education and wealth levels are expected to rise, so all indications suggest that pecans will become even more popular in the future.

This is in addition to the popularity they have already received; about half of the respondents (using weighted statistics) said they consume pecans three or more times each year, and 35% said they consume pecans at least once a month. For an understanding of how large the demographic impacts can be, consider the difference in consumption across genders, where 17% of males indicate they never consume pecans, compared to only 8% of females.

Objective 3 Results

It was previously reported that about half of the Chinese respondents consume pecans three or more times per year, but how does that compare to other nuts? Recall that respondents are asked not only about their pecan consumption, but consumption of many other nuts, including lotus seeds, cashews, chestnuts, hazelnuts, and peanuts. To evaluate the level of pecan consumption compared to 12 other nuts, an ordered logit model is used where the dependent variable is the level of consumption (1 = never, 2 = once per year, …, and 8 = daily) and the explanatory variables are indicator variables for the type of nut. Estimation results are shown in Table 4.

Table 4. Weighted Ordered Logit Estimates for Frequency of Nut Consumption.

Indicator Variable	Ordered Logit Coefficients	Standard Error
Ginkgo	-2.546	0.1305
Macadamia	-2.143	0.128
Pecans	-2.105	0.1329
Hazelnuts	-1.981	0.1305
Pine nuts	-1.919	0.1198
Lotus seed	-1.915	0.1213
Hickory	-1.843	0.1269
Cashews	-1.683	0.1202
Pistachios	-1.451	0.1191
Chestnuts	-1.447	0.117
Almonds	-1.415	0.1189
Walnuts	-0.527	0.1365
Peanuts	0	------

Notes: Dependent variable is the stated level of nut consumption, where 1 = never, 2 = once per year, …, and 8 = daily (see Figure 2). The variable pecan equals one if the nut being considered is a pecan and zero otherwise. All parameters were statistically significant at the 5% level. The weights used are those from a sample balancing algorithm. The coefficient for peanuts is normalized to zero for model identification. Threshold parameters are not shown.

The most frequently consumed nut is the peanut, and the ginkgo seed is the least frequently consumed. The list of nuts in order of highest to lowest consumption are

1. Peanuts (highest consumption)
2. Walnuts
3. Almonds
4. Chestnuts
5. Pistachios
6. Cashews
7. Hickory Nuts
8. Lotus Seeds
9. Pine Nuts
10. Hazelnuts
11. Pecans
12. Macadamia Nuts
13. Ginkgo Seeds (lowest consumption)

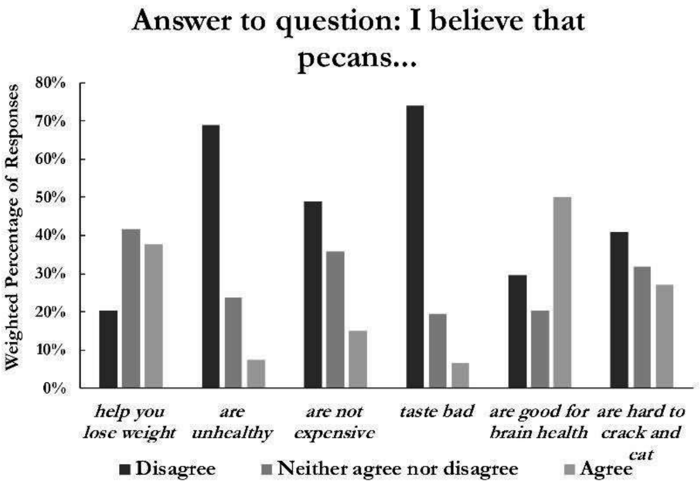
Although previous results suggested that pecans are regularly consumed all across China, these results show that pecans are far from being the most popular nut. Hypothesis tests show that macadamia nuts, hazelnuts, pine nuts, hickory nuts, and lotus seeds all have consumption levels that do not differ significantly from pecans. ginkgo seeds are consumed less frequently, and all the other nuts are consumed more frequently.

What is preventing pecans from rising to among some of the most popular nuts? This can be partially assessed by investigating how pecans are used and some general attitudes towards pecans. Thus, we move to Objective 4.

Objective 4 Results

The fourth objective concerned some general attitudes and beliefs about pecans, both in an absolute sense and in relation to other nuts. First consider a previously mentioned result that pecans rank relatively low in relation to other nuts in terms of consumption. Then consider the answers to a variety of questions shown in Figures 4-7. Figure 4 provides a variety of insights, one being that the respondents say they prefer pecans to be cooked and flavored. Raw pecans are less popular. There seems little difference in their preference for the pecans being in-shell or shelled, and more than half indicated they use pecans as a dish or recipe.

The previous section demonstrated that walnuts are one of the most popular nuts in China, so it is helpful to consider how they view the attributes of pecans relative to walnuts. As Figure 5 shows, consumers generally said pecans have a better taste, are easier to crack and eat, and are better for losing weight. Most said that walnuts cost less money and are better for brain and physical health. Pecans and walnuts, then, may not be close substitutes for one another, and pecans are considered more of a luxury nut, where a higher price must be paid, but for a better taste.

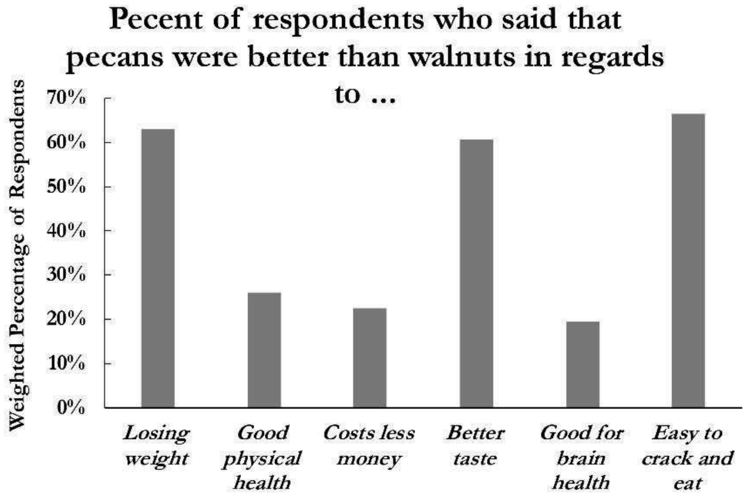


Notes: Respondents are asked whether pecans or walnuts are superior in terms of each trait, so more than 60% said pecans were superior to walnuts in terms of weight loss. Percentages above are weighted statistics using weights from a sample balancing algorithm.

Figure 5. Attitudes Towards Pecans as Compared to Walnuts.

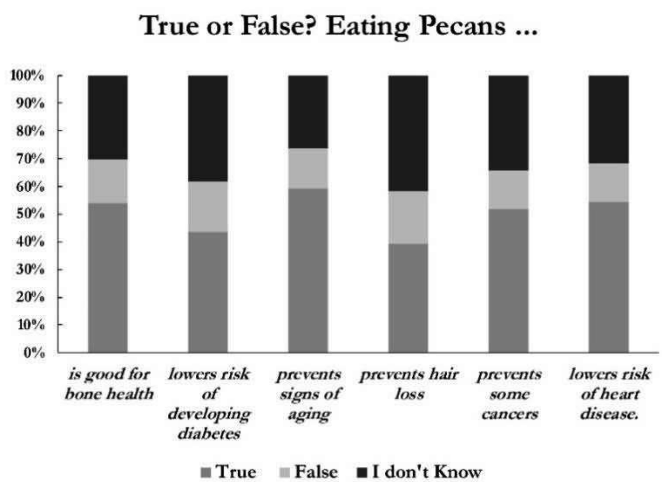
While walnuts may be considered healthierhy, pecans are still considered healthy in an absolute sense, as over 70% of the respondents disagree with the statement that pecans are unhealthy (Figure 6). When given a variety of ways in which pecans could improve health (Figure 7), more people said it was good for that health trait than bad, except for preventing hair loss, where the result was about even.

It is commonly said that the appearance of a food is particularly important to Chinese consumers. Walnuts are said to be good for brain health because the nut's appearance looks like a brain, and it is believed that whatever body part a ginseng root resembles, that is the part of the body it will help. The actual shape and size of a pecan can differ across varieties. To investigate how shape and size impact anticipated taste, consider Figure 8. Here respondents were shown two pecans of the same total size, but one was tall and skinny while the other was short and fat. A strong majority of the respondents believe the tall and skinny pecan would taste better. Most also believe that a large pecan will taste better than a small pecan with the same shape. It is unclear why this would be the case, but it should be noted that appearance has often been mentioned to not only impact the anticipated taste of food, but the actual reported taste (Spence, 2017). So pecans that are taller and skinnier may sell better in China than their fatter and shorter counterparts.



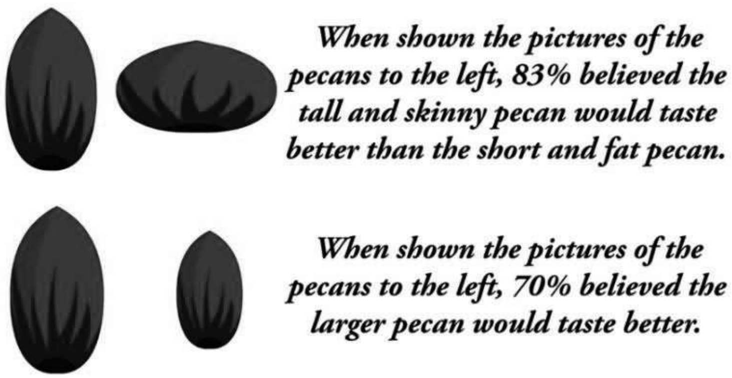
Notes: Respondents are asked whether they agree with each statement on a 1 to 7 scale (1 = strongly disagree, 4 = neither agree nor disagree, 7 = strongly agree). They are said to "agree" if the scale value is greater than 4 and disagree if less than 4, so 20% provided an answer of 1, 2, or 3 to the statement that they believe pecans help you lose weight. Percentages above are weighted statistics using weights from a sample balancing algorithm.

Figure 6. Attitudes Towards Pecans.



Notes: Respondents are given three choices for each statement: "true," "false," or "I don't know.". Percentages above are weighted statistics using weights from a sample balancing algorithm.

Figure 7. Beliefs About Pecans and Health.



Notes: Percentages above are weighted statistics using weights from a sample balancing algorithm.

Figure 8. Relationship Between Pecan Shape and Size and Its Anticipated Taste.

Implications for the Pecan Industry

This survey was conducted with the intention of helping the U.S. pecan industry better understand an important export market—China. So what did we learn? A few highlights are as follows.

First, pecan consumption is roughly the same across regions in China, so producers should not expect greater exports to result from better access to regional markets in China. Second, the young, educated, and wealthy consume pecans at a higher rate, so one would expect pecan consumption in China to rise over time. Third, while half of respondents consume pecans at least three times a year, suggesting pecans have found a home in the Chinese diet, pecan consumption is considerably lower than other nuts such as cashews, almonds, and especially walnuts. This is because pecans are thought to be a particularly expensive—though a better tasting—nut, at least compared to walnuts. Finally, Chinese consumers generally have a favorable opinion of pecans, believing them to be healthy and, unlike in the United States, China prefers the pecans to be cooked and flavored.

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Journal of Agribusiness 38, 1 (Spring 2020)

Targeted Advertising and Promotion Campaigns: A Case Study of the National Pork Board

Oral Capps Jr.

Previous studies in the economic literature dealing with evaluation of the effectiveness of agricultural checkoff programs typically have not centered much attention on impacts in ***individual*** cities, regions, countries, or markets. To fill this research void, the distinct contribution of this work is the presentation of a case study of ***targeted*** promotion by the National Pork Board that took place in Atlanta, Chicago, Dallas, Denver, Philadelphia, and Sacramento. This campaign, in addition to the national campaign, ran from March 2005 to November 2005. Econometric analysis based on a seemingly unrelated regression (SUR) model revealed that the targeted program was successful in the various cities except for Sacramento, generating average benefit-cost ratios at the retail level ranging from 1.26 to 1 to 4.06 to 1. This case study clearly supports the use of targeted promotion in agricultural checkoff programs to stimulate retail sales of pork for at-home consumption.

Key words*:* National Pork Board, SUR Model, Targeted Advertising and Promotion

Virtually every U.S. agricultural commodity is associated with some type of organization dedicated to promoting the economic welfare of its producers through retail level, generic advertising programs funded through check-off fees imposed on sales by producers and sometimes others in the marketing chain (Forker and Ward, 1998; Kaiser *et al.*, 2005). While mandated under the 1996 Farm Bill (Federal Agriculture Improvement and Reform Act of 1996), periodic evaluations of promotion effectiveness can provide critically needed information for effective program management for commodity groups and marketing orders. These evaluations: (1) help improve the efficiency and effectiveness of promotion programs; (2) assist in the design and adjustment of long-run strategic plans; (3) provide feedback to contributors, industry, and other stakeholders; and (4) support a timely and appropriate response to any legal challenges (Williams and Nichols, 1998). The extant literature is replete with studies concerning the effectiveness

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of generic advertising and promotion programs. Examples include but are not limited to the following: (1) Crespi and Sexton (2000) and Malina, Doerr, and Gates (2005) for almonds; (2) Carmen, Li, and Sexton (2009); Carmen, Saitone, and Sexton (2013); and Ambrozek, Saitone, and Sexton (2018) for avocados; (3) Richards and Kaiser (2012) for potatoes; (4) Ward (2012) for eggs; (5) Alston, Medellin-Azuara, and Saitone (2014) for cranberries; (5) Ghosh and Williams (2014) for lamb; (6) Kaiser (2014) for peanuts and peanut products; (7) Ward (2014) for honey; (8) Williams, Capps, and Lee (2014) for soybeans; (9) Kaiser (2015a) for blueberries; (10) Kaiser (2016a) for beef; (11) Capps, Williams, and Hudson (2016) for cotton; (12) Ward (2016) for mangos; (13) Capps, Bessler, and Williams (2016) for orange juice; (14) Campbell, Shonkwiler, and Wolfe (2018) for Vidalia onions; (15) Srivastava and McQueen (2018) for tart cherries; (16) Van Sickle and Zhang (2018) for Florida tomatoes; (17) Richards (2016), for mushrooms; and (18) Kaiser (2016b), for watermelons.

The focus of the aforementioned studies in the vast literature related to agricultural checkoff programs was on the U.S. market, using time-series data in econometric applications to evaluate the effectiveness of generic advertising and promotion activities. A few past studies considered impacts of checkoff programs regionally including Kinnucan (1986) pertaining to the impact of monthly media advertising expenditures in the New York City metropolitan area; Lenz, Kaiser, and Chung (1997) concerning the responsiveness of fluid milk sales to milk advertising collectively in five New York markets—New York City, Albany, Syracuse, Rochester, and Buffalo; Thompson and Eiler (1974) concerning the response of per capita fluid milk sales in individual standard metropolitan statistical areas associated with New York City, Albany, and Syracuse; Thompson (1979) concerning the response of fluid milk sales to generic advertising in New York state based on data collectively from New York City, Albany, and Syracuse; Kinnucan and Fearon (1986) in analyzing impacts of the effect of advertising on cheeses sales in the New York City market; Capps and Schmitz (1991) in analyzing the impacts of generic expenditures for television and radio advertising on fluid milk sales in the Texas Market Order; and Richards (2016) concerning the response of the share of retail sales of organic and conventional variants of mushrooms to the number of impressions or marketing intensity measures in each of eight regions of the United States.

Other prior research studies employed the use of panel data by city or by country over time. For example, work dealing with the effectiveness of domestic promotion activities for avocados explicitly used pooled data from selected cities (Carmen, Li, and Sexton, 2009; Carmen, Saitone, and Sexton, 2013; Ambrozek, Saitone, and Sexton, 2018) and work dealing with the effectiveness of export promotion activities for salmon explicitly used pooled data from selected countries in the European Union (Kaiser, 2015b). In addition, Dong, Schmit, and Kaiser (2007) estimated a fixed-effects panel data demand model from five New York state markets to determine the differential impacts of generic fluid milk advertising by media type. Ward and McDonald (1986) estimated a pooled cross-sectional time-series model to evaluate the effectiveness of advertising of fluid milk in a 10-market region, and Kaiser (2016b) estimated a pooled cross-sectional time-series to evaluate the effectiveness of promotion expenditures for watermelon across eight regions of the United States. Importantly, with the exceptions of Thompson and Eiler (1974) and Richards (2016), previous studies in the economic literature dealing with evaluation of the effectiveness of agricultural checkoff programs have not centered much attention on impacts in individual cities, regions, countries, or markets.

Objective

To fill this research void, the sole objective is to conduct a case study of targeted promotion in six U.S. cities featuring the efforts of the National Pork Board (NPB). The NPB was implemented in 1986 and is designed to increase the overall demand (both domestic and foreign) for U.S. hogs and pork products, decrease farm production costs, improve farm efficiency, and improve the overall profitability of hog and pork production. The NPB is funded by a mandatory assessment of 0.4% of the market value of all hogs sold in the United States. In addition, this program collects assessments on hogs and pork products from foreign markets imported into the United States. According to the recent financial statements for 2018 and 2019, this program had expenses of close to $75 million (https://www.pork.org/about/financials/).

Evaluations of the research and promotion activities of the Pork Board historically have been conducted by Davis et al. (2001), Beach et al. (2007), Kaiser (2012), and Kaiser (2017). These studies concluded that the checkoff program for pork was successful in generating positive returns to producers. Park and Capps (2002) also found that advertising expenditures were positively associated with shifting the demand for U.S. pork.

Despite the success achieved by the NPB in generating positive returns associated with its promotion and research activities, none centered any attention on the effectiveness of targeted advertising and promotion. In March 2005, the NPB launched a campaign featuring advertising and promotion in six U.S. markets, namely Atlanta, Chicago, Dallas, Denver, Philadelphia, and Sacramento. This campaign, in addition to the national program, ran from March 2005 to November 2005. Despite the dated time frame of this analysis, due to the fact that attention generally has not been paid to targeted promotion in specific markets, this work adds to the vast literature associated with the impacts of agricultural checkoff programs.

Model Development

To investigate the effect of the checkoff-funded advertising and promotion campaign, we developed a demand model of per capita at-home pork consumption for each of the previously mentioned markets. To analyze specific effects for each of the markets under investigation, unlike previous studies, we employ a seemingly unrelated regression (SUR) model (Zellner, 1962). This model consists of six equations, each associated with the particular market area or city. The SUR model accounts for the correlation of factors embedded in the disturbance terms which are common to all equations. As such, the SUR model provides more precise estimates of the structural parameters than achieved through the estimation of each equation separately. With the use of the SUR model, this research then is distinct from previous research efforts in regard to analyzing the impacts of generic marketing and promotion activities across specific cities.

The process of statistically isolating the effects of any commodity promotion program on market variables like industry sales requires that the effects of other factors that may affect the market besides the advertising and promotion program be explicitly accounted for. In this analysis, we account for the price of pork, the price of fresh beef, the price of chicken, national pork advertising expenditures, seasonality, inflation, and population, in addition to the targeted promotion campaign expenditures in the six respective markets. This latter piece of information is instrumental in ultimately calculating the "payoff ratio" (or benefit-cost ratio) of the advertising and promotion campaign associated with each targeted market.

The analysis specifically focuses on per capita at-home consumption of pork in the six targeted markets. The primary data, which correspond to weekly supermarket scanner data, came from Information Resources, Inc. (IRI). The time frame in question was the week ending January 6, 2002, to the week ending January 1, 2006. These weekly data were aggregated to form 48 monthly observations from January 2002 to December 2005. This aggregation allowed us to combine these data with monthly data pertaining to national pork expenditures, prices of beef and chicken, income, inflation, and population.

The SUR model for this analysis is expressed as:

(1) Per capita at-home consumption of pork$_{it}$ = f(real pork price$_{it}$, real per capita income$_{it}$, real targeted advertising and promotion expenditures$_{it}$, real national NPB advertising and promotion expenditures$_{t}$, real beef price$_{t}$, real chicken price$_{t}$, and seasonality), where i=1,…,6 and t=1,…,48.

Richards (2016) estimated a random-parameters logit model in considering the share of retail sales of organic and conventional variants of mushrooms in each of eight regions of the United States. As well, the measure of the level of marketing activity in the Richards study was the number of impressions and not dollars expended on promotion as is the case in our study. Thompson and Eiler (1974) estimated single-equation per capita demand models for three SMSAs from the state of New York. Our analysis, however, considers per capita at-home consumption of pork in six U.S. cities via the use of a multi-equation SUR model. Importantly, we add degrees of differentiation in terms of the model chosen, the focus on six selected U.S. cities rather than eight U.S. regions or three SMSAs within the state of New York, the accounting of the national advertising campaign, and the metric associated with the level of marketing activity. Hence, this research contributes to the extant literature related to agricultural checkoff programs.

Data

Descriptive statistics of the variables indigenous to this analysis are exhibited in Table 1. For each targeted city, we provide information on per capita at-home consumption of pork, real pork prices, real beef and chicken prices, real national NPB advertising and promotion expenditures, real targeted advertising and promotion expenditures, real per capita income, and population. To derive real or inflation-adjusted measures, we divide the respective nominal measures by the Consumer Price Index for all items (1982-84=1.00).

Average per capita at-home consumption of pork varied from 1.04 pounds (Chicago) to 1.96 pounds (Denver). Monthly per capita at-home consumption of pork for each market area is depicted graphically in Figure 1. Seasonality is quite evident from these graphs. Based on standard deviations, at-home consumption of pork was most volatile for Denver but least volatile for Chicago. Over the period January 2002 to December 2005, real pork prices, on average, ranged from \$1.48 per pound in Dallas to \$1.81 in Philadelphia. Based on standard deviations, real pork prices were more volatile in Philadelphia, Denver, Chicago, and Sacramento than in Atlanta and Dallas.

Table 1. Descriptive Statistics Associated with All Variables in the Econometric Analysis, January 2002 to December 2005.

Per Capita At-Home Consumption of Pork in Targeted Markets					
Variable Name	Mean	Median	Standard Deviation	Minimum	Maximum
Per Capita At-Home Consumption of Pork Sales- Atlanta	1.27	1.25	0.14	1.04	1.76
Per Capita At-Home Consumption of Pork-Chicago	1.04	1.03	0.12	0.76	1.39
Per Capita At-Home Consumption of Pork-Dallas	1.29	1.28	0.13	1	1.7
Per Capita At-Home Consumption of Pork-Denver	1.96	1.93	0.26	1.54	2.84
Per Capita At-Home Consumption of Pork- Philadelphia	1.45	1.39	0.19	1.22	1.96
Per Capita At-Home Consumption of Pork- Sacramento	1.31	1.28	0.16	1.09	1.88
Inflation-Adjusted Pork Prices in Targeted Markets in 1982-84 Dollars Per Pound					
Variable Name	Mean	Median	tandard Deviatio	Minimum	Maximum
Real Pork Prices- Atlanta	$1.59	$1.61	$0.08	$1.39	$1.75
Real Pork Prices- Chicago	$1.78	$1.78	$0.10	$1.56	$1.94
Real Pork Prices- Dallas	$1.48	$1.48	$0.06	$1.31	$1.61
Real Pork Prices- Denver	$1.63	$1.64	$0.10	$1.35	$1.78
Real Pork Prices-Philadelphia	$1.81	$1.82	$0.10	$1.59	$2.00
Real Pork Prices-Sacramento	$1.75	$1.76	$0.11	$1.42	$1.93
Inflation-Adjusted Prices of Fresh Beef and Chicken for the United States in 1982-84 Dollars Per Pound					
Variable Name	Mean	Median	tandard Deviatio	Minimum	Maximum
Real Fresh Beef Prices for the United States	$1.82	$1.83	$0.10	$1.66	$2.00
Real Chicken Prices for the United States	$0.90	$0.89	$0.02	$0.86	$0.94
Inflation-Adjusted National Pork Board Advertising and Promotion Expenditures in 1982-84 Dollars					
Variable Name	Mean	Median	tandard Deviatio	Minimum	Maximum
Real Advertising And Promotion Expenditures	$872,030	$855,269	$170,090	$414,735	$1,177,771
Inflation-Adjusted Targeted Advertising and Promotion Expenditures in 1982-84 Dollars, March 2005 to November 2005					
Variable Name	Mean	Median	tandard Deviatio	Minimum	Maximum
Real Targeted Promotion Expenditures- Atlanta	$41,963	$36,847	$35,162	$3,690	$101,329
Real Targeted Promotion Expenditures- Chicago	$57,640	$49,810	$39,042	$4,988	$119,793
Real Targeted Promotion Expenditures- Dallas	$44,075	$37,519	$37,449	$3,757	$105,046
Real Targeted Promotion Expenditures- Denver	$25,006	$20,269	$21,901	$2,030	$58,661
Real Targeted Promotion Expenditures- Philadelphia	$46,423	$41,326	$29,391	$4,111	$89,361
Real Targeted Promotion Expenditures- Sacramento	$17,275	$16,342	$13,347	$1,637	$37,965
Inflation-Adjusted Per Capita Income in 1982-84 Dollars					
Variable Name	Mean	Median	tandard Deviatio	Minimum	Maximum
Real Per Capita Income-Atlanta	$17,909	$17,821	$247	$17,609	$18,625
Real Per Capita Income-Chicago	$19,735	$19,706	$152	$19,448	$20,150
Real Per Capita Income-Dallas	$18,833	$18,816	$188	$18,509	$19,222
Real Per Capita Income-Denver	$21,457	$21,490	$255	$21,023	$22,008
Real Per Capita Income-Philadelphia	$20,378	$20,413	$349	$19,928	$21,059
Real Per Capita Income-Sacramento	$17,677	$17,704	$371	$17,197	$18,305
Population by Targeted Market					
Variable Name	Mean	Median	tandard Deviatio	Minimum	Maximum
Population- Atlanta	4,756,592	4,748,571	159,132	4,490,990	5,040,725
Population- Chicago	9,359,721	9,360,257	67,367	9,242,615	9,471,180
Population- Dallas	5,641,825	5,635,447	136,750	5,415,496	5,897,756
Population- Denver	2,314,433	2,311,872	35,190	2,249,674	2,381,237
Population- Philadelphia	5,772,634	5,774,267	26,905	5,725,208	5,814,687
Population- Sacramento	1,986,277	1,992,298	46,196	1,896,849	2,052,253

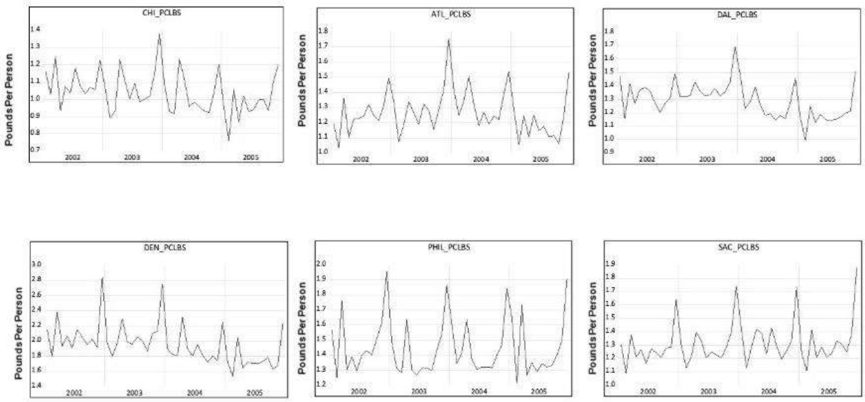

Figure 1. Per Capita At-Home Pork Consumption by Targeted City, January 2002 to December 2005.

Corresponding prices for beef and chicken for each targeted market were not available. But based on information from the Livestock Marketing Information Center (LMIC), adjusting for inflation, beef and chicken prices for the United States were on average $1.82 per pound and $0.90 per pound, respectively. Importantly, average real beef prices for the United States generally were on par with the average real pork prices for the targeted markets. By the same token, average real chicken prices for the United States were roughly half the average real pork prices for the targeted markets.

Nominal national program advertising and promotion expenditures averaged $1.63 million per month, or roughly $19.6 million annually. The range over the 48-month period was $756,062 per month to $2,284,876 per month. Adjusting for inflation, this range was $414,735 per month to $1,177,771 per month. On average, real national program advertising and promotion expenditures were about $872,000 per month. Targeted promotion expenditures over the period March 2005 to November 2005 were slightly more than $4 million cumulatively. These targeted expenditures were highest in Chicago, Philadelphia, Dallas, and Atlanta, in that order, and lowest in Denver and Sacramento in that order. The breakdown of the share of advertising expenditures by market was as follows: (1) Atlanta—18.1%; (2) Chicago—24.8%; (3) Dallas—19.0%; (4) Denver—10.8%; (5) Philadelphia—20.0%; and (6) Sacramento—7.4%. In all other months and years, these targeted expenditures were zero.

The data associated with real per capita income came from the U.S. Department of Commerce and correspond to the metropolitan statistical area (MSA) associated with the particular targeted market. The respective MSAs for each of the targeted markets were: (1) Atlanta-Sandy Springs-Marietta (MSA); (2) Chicago-Naperville-Joliet (MSA); (3) Dallas-Fort Worth-Arlington (MSA); (4) Denver-Aurora (MSA); (5) Philadelphia-

Camden-Wilmington (MSA); and (6) Sacramento-Arden-Arcade-Roseville (MSA). On average, across the six targeted areas, real per capita income ranged from $17,677 (Sacramento) to $21,457 (Denver).

The data concerning population by targeted market came from the U.S. Census Bureau and corresponded to the aforementioned MSA associated with the particular targeted market. On average, across the six targeted areas, population varied from 1.99 million (Sacramento) to 9.36 million (Chicago). On average, total population across the targeted markets was roughly 29.8 million. Thus, the population in the respective targeted markets constituted approximately 10 percent of the population in the United States over the period January 2002 to December 2005.

Functional Form, Seasonality, and Carryover Effects

The functional form chosen for this analysis is the linear in logarithms specification. With this functional form, we assume that the own-price, cross-price, income, and national NPB advertising and promotion elasticities are constant over the period January 2002 to December 2005. Also, the use of the logarithmic transformation insures that diminishing marginal returns in regard to national program expenditures is met. However, for the targeted advertising expenditures, the only non-zero observations are for the period March 2005 to November 2005. To insure diminishing marginal returns for the targeted advertising expenditures, we employ a square root specification for this variable. We also model seasonality through the use of monthly indicator (dummy) variables.

To account for delays and carryover effects associated with the national advertising program, we rely on the use of a polynomial distributed lag (PDL) procedure. The use of the PDL procedure is commonplace in the extant literature (Clarke, 1976; Lee and Brown, 1992; Simon and Arndt, 1980), as well as in the majority of the previously mentioned studies concerning agricultural checkoff programs. The attractive features of the PDL include: (1) a flexible representation of the lag structure allowing for the possibility of hump-shaped or monotonically declining lag weight distributions; and (2) a parsimonious representation of the lag structure. The search for the polynomial degree and lag length associated with the carryover effects along with the search for any delay in the impact of the national program involves a series of regression estimations with various lags. Time delays of up to 12 months, and carryover effects of up to 12 months, were considered in the econometric analysis. Second and third degree polynomials also were considered for the six-market SUR model.

Table 2. Econometric Results Associated with the SUR Model of Targeted Markets.

	Atlanta		Chicago		Dallas		Denver		Philadelphia		Sacramento	
	Estimated Coefficient	p-Value	Estimated Coefficient	p-Value	Estimated Coefficient	p-Value	Estimated Coefficient	p-Value	Estimated Coefficient	p-Value	Estimated Coefficient	p-Value
Intercept	-13.1831***	0.0014	-12.7232***	0.0002	-14.5965***	0.0004	-6.8156	0.1492	5.1570***	0.001	-3.3953	0.3443
Real Price of Pork (t)	-1.2722***	0	-1.7432***	0	-1.5719***	0	-1.3974***	0	-1.4706***	0	-0.3211**	0.0314
Real Per Capita Income (t)	1.52055***	0.0008	1.2516***	0.0004	1.7642***	0.0001	0.9796*	0.0521	-0.5470***	0.0004	0.6485*	0.064
Real Price of Fresh Beef (t)	-0.2998	0.4286	0.2876	0.3148	-0.2641	0.4927	0.4422	0.38	0.3504***	0	0.4764***	0
Real Price of Chicken (t)	0.0514	0.8904	0.2034	0.4245	0.0718	0.8495	-0.0244	0.9519	1.6673***	0	-0.8038**	0.0372
Real Targeted Spending (t)	0.0008	0.3563	0.0001**	0.0311	0.0001*	0.0903	0.0001	0.5871	0.0001**	0.0113	-0.0005***	0.001
Real National Spending (t-11)	-0.0131	0.532	0.0260*	0.1241	-0.0389*	0.0549	-0.0419*	0.0689	0.0367***	0.0011	-0.0583***	0.0086
Real National Spending (t-12)	-0.0174	0.532	0.0347*	0.1241	-0.0519*	0.0549	-0.0559*	0.0689	0.0489***	0.0011	-0.0777***	0.0086
Real National Spending (t-13)	-0.0131	0.532	0.0260*	0.1241	-0.0389*	0.0549	-0.0419*	0.0689	0.0367***	0.0011	-0.0583***	0.0086
January	-0.1028***	0	-0.0431**	0.0274	-0.1092***	0	-0.1065***	0.0001	-0.0663**	0.0229	-0.2772***	0
February	-0.2528***	0	-0.1707***	0	-0.2327***	0	-0.2607***	0	-0.2516***	0	-0.4488***	0
March	-0.1710***	0	-0.1571***	0	-0.1441***	0	-0.1275***	0.0001	-0.1866***	0	-0.2352***	0
April	-0.1836***	0	-0.1299***	0	-0.1432***	0	-0.1200***	0.0002	-0.2491***	0	-0.2004***	0
May	-0.1264***	0.0001	-0.0477**	0.043	-0.1015***	0.0031	-0.0736*	0.0327	-0.2182***	0	-0.1862***	0
June	-0.1618***	0	-0.0487**	0.0421	-0.0883***	0.0073	-0.0636**	0.0435	-0.2485***	0	-0.2909***	0
July	-0.1146***	0.0001	-0.006	0.7982	-0.0764**	0.0215	-0.0043	0.8932	-0.1944***	0	-0.2270***	0
August	-0.1272***	0.0001	-0.0346	0.1541	-0.0748**	0.0286	-0.0291	0.3742	-0.2029***	0	-0.2268***	0
September	-0.1700***	0	-0.0558**	0.0171	-0.0992***	0.0022	-0.0768**	0.0176	-0.2213***	0	-0.2673***	0
October	-0.1693***	0	-0.1090***	0	-0.1176***	0.0001	-0.0688**	0.0277	-0.2230***	0	-0.2311***	0
November	-0.1397***	0	-0.0860***	0	-0.0816***	0	-0.0954***	0	-0.2023***	0	-0.2019***	0
R^2	0.9391		0.9709		0.9373		0.9412		0.9755		0.9106	
Adjusted R^2	0.8744		0.9399		0.8707		0.8788		0.9495		0.8156	
SER	0.0398		0.029		0.0387		0.0429		0.0275		0.0497	
Durbin-Watson	2.6073 0.9403***		2.5569 0.9420***		2.4726 0.9350***		2.6302 0.9164***		1.4791		1.8749	
AR(1)									0.6373***		0.2032***	

*Source: Use of the Software Package EVIEWS, Version 10.0. Note: SER denotes standard error of the regression. Note: * if significant at the 0.10 level, ** if significant at the 0.05 level, and *** if significant at the 0.01 level.*

Based on the Akaike Information Criterion (AIC) and on the Schwarz Information Criterion (SIC), the optimal delay effect was 11 months for the national program, and the optimal carryover effect was two months. As well, based on the AIC and SIC metrics, both head and tail endpoint restrictions were employed using a second degree polynomial. Only contemporaneous effects of the targeted advertising program were considered due to the fact that only nine non-zero monthly observations corresponding to these expenditures were in existence.

Econometric Results for the SUR Model of the Targeted Markets

The econometric results for the model of the six targeted market areas are exhibited in Table 2. In this analysis, the homogeneity condition was imposed in all equations of the SUR model. That is, the own-price elasticity of pork, the income elasticity of pork, and the cross-price elasticities of pork with respect to beef and chicken were restricted to sum to zero in each equation. In addition, a first-order serial correlation process was evident in the residuals in each equation. As such, we account for serial correlation in the estimation of the SUR model. The estimated coefficients associated with the first-order autocorrelation of the residuals are labeled as AR(1) in each of the respective equations. The majority of the signs of the estimated coefficients conform to prior expectations, and most of the estimated coefficients are statistically significant at the 0.10 level. The goodness-of-fit (R^2) metrics for the six-equation specification range from 0.9106 (Sacramento) to 0.9755 (Philadelphia), meaning that the SUR model accounts anywhere from 91 percent to 98 percent of the variability in per capita at-home pork consumption across the targeted market areas.

Except for Sacramento, the own-price elasticities for pork were estimated to be in the range of -1.27 (Atlanta) to -1.74 (Chicago). The own-price elasticity of pork for the market area of Sacramento was estimated to be -0.32, far different from the own-price elasticities for the other five market areas. That said, all own-price effects were statistically different from zero. Except for Philadelphia, the estimated income elasticities for pork were positive, ranging from 0.65 (Sacramento) to 1.76 (Dallas). The income elasticity for the Philadelphia market was estimated to be -0.55. The respective estimated own-price and income elasticities in our analysis are, for the most part, larger than those reported in the extant literature. Using quarterly data from 1982 to 2005, Beach et. al (2007) reported the own-price elasticity for pork to be -0.64 and the expenditure elasticity for pork to be 1.16. Based on annual data from 1976 to 2015, Kaiser (2017) reported the own-price elasticity for pork to be -0.41 and the income elasticity for pork to be 0.54. The differences are likely attributed to geographical dispersion, that is, individual market areas as opposed to the national market.

The cross-price elasticities of pork with respect to beef and chicken were statistically significant only for the market areas of Philadelphia and Sacramento. In the Philadelphia market, the cross-price elasticity of pork with respect to beef was estimated to be 0.35, and the cross-price elasticity of pork with respect to chicken was estimated to be 1.68. In the Sacramento market, the cross-price elasticity of pork with respect to beef was estimated to be 0.48, and the cross-price elasticity of pork with respect to chicken was estimated to be -0.80. Hence in these two markets, pork and beef were found to be substitutes. In the Philadelphia market, pork and chicken also were found to be substitutes, but in the Sacramento market, pork and chicken were found to be complements.

The national program expenditures positively affected per capita at-home pork consumption, but only for the Chicago and Philadelphia market areas. The short-run advertising elasticities for the national program in these two market areas were estimated to be 0.0260 for Chicago and 0.0367 for Philadelphia; the long-run advertising elasticities for these markets were estimated to be 0.0866 for Chicago and 0.1224 for Philadelphia. To provide perspective on these promotion elasticities, Davis et al. (2001), Beach et al. (2007), and Kaiser (2017) reported the long-run elasticity of domestic promotion to be 0.11, 0.02, and 0.03, respectively. Our long-run promotion elasticities are similar to those of Davis et al. (2001). Importantly, evidence exists to indicate that the national advertising and promotion program was not effective for Atlanta, Dallas, Denver, and Sacramento over the period January 2002 to December 2005.

On the other hand, evidence exists to indicate that the targeted program positively affected per capita at-home consumption of pork in all targeted markets except for Sacramento. The estimated coefficients associated with the targeted promotion expenditures were statistically different from zero for Chicago, Dallas, and Philadelphia. The promotion elasticities associated with the targeted program were calculated to be 0.0073 for Atlanta, 0.0144 for Chicago, 0.0133 for Dallas, 0.0046 for Denver, and 0.0124 for Philadelphia. Notably, the promotion elasticities are not constant over the period March 2005 to November 2005. Consequently, the reported elasticities represent the average across this period of time. The magnitudes of the respective estimates of the advertising and promotion elasticities across these market areas are consistent with the economic literature (see, for example, Williams and Nichols (1998)).

Finally, at-home pork consumption without question exhibited a seasonal pattern. For each targeted market, December at-home pork consumption was the highest than in any other month. In Atlanta, relative to December, at-home pork consumption was lower by 9.77% to 22.34% in other months; in Chicago, at-home pork consumption was lower by

0.59% to 15.70% in other months relative to December; in Dallas, at-home pork consumption was lower by 7.20% to 20.76% in other months relative to December; in Denver, at-home pork consumption was lower by 0.43% to 22.95% in other months relative to December; in Philadelphia, at-home pork consumption was lower by 6.42% to 22.24% in other months relative to December; and in Sacramento, at-home pork consumption was lower by 16.99% to 36.16% in other months relative to December.

Importantly, the non-zero elements of the residual correlation matrix presented in Table 3 offer evidence that the SUR model, which treats the targeted markets as a group, was statistically superior to estimating a model for each market separately. Also, the SUR model offers gains in statistical efficiency in the estimation of the structural parameters. That is, the standard errors of the parameters in the SUR model are lower than comparable standard errors generated from estimating each equation individually with ordinary least squares (OLS).

Table 3. Correlations of the Error Terms from the SUR Model.

Equation	Atlanta	Chicago	Dallas	Denver	Philadelphia	Sacramento
Atlanta	1	0.5527	0.8601	0.9087	-0.1167	0.5084
Chicago	0.5527	1	0.5247	0.4661	0.02	0.5381
Dallas	0.8601	0.5247	1	0.8976	-0.1893	0.6014
Denver	0.9087	0.4661	0.8976	1	0.0342	0.4246
Philadelphia	-0.1167	0.02	-0.1893	0.0342	1	-0.0696
Sacramento	0.5084	0.5381	0.6014	0.4246	-0.0696	1

Average Benefit-Cost Ratios of the Targeted Program at the Retail Level

Based on the previously discussed econometric analysis, we are in position to calculate for each market area the incremental nominal retail sales of pork attributed to the targeted campaign. This set of calculations involves the product of the impact of real targeted promotion expenditures in each market on the per capita at-home consumption of pork, population, and the nominal price of pork. Over the period March 2005 to November 2005, the respective incremental nominal retail sales of pork attributed to the targeted campaign excluding Sacramento were as follows: (1) Atlanta, $1,176,721 or 0.73% of total retail sales; (2) Chicago, $4,104,967 or 1.44% of total retail sales; (3) Dallas, $2,322,669 or 1.33% of total retail sales; (4) Denver, $551.569 or 0.46% of total retail sales; and (5) Philadelphia, $3,237,565 or 1.25% of total retail sales.

Subsequently, by taking the ratio of the respective cumulative incremental nominal retail sales of pork attributed to the target campaign to the cumulative cost of the program, we are in position to calculate the average benefit-cost ratios at the retail level for each of the respective market areas. The respective average benefit-cost ratios were calculated to be as follows: (1) for Atlanta 1.60 to 1; (2) for Chicago 4.06 to 1; (3) for Dallas 3.00 to 1; (4) for Denver 1.26 to 1; and (5) for Philadelphia 3.97 to 1. The benefit-cost ratios were not uniform across the targeted markets. Excluding Sacramento, these ratios exceed one in each market area. On this basis, the targeted program was economically feasible, particularly for Chicago, Philadelphia, and Dallas, and less so for Atlanta and Denver. Importantly, these benefit-cost ratios deal exclusively with the targeted program, separate from the national program. For the national program, Beach et al. (2007), Kaiser (2012), and Kaiser (2017) reported benefit-cost ratios of 13.8, 17.4, and 25.5. As such, the benefit-cost ratios for the targeted markets were smaller than those associated with previous studies of the national program.

Concluding Remarks

The focus of the vast extant literature related to agricultural checkoff programs has been primarily on the domestic national market. A few prior studies considered impacts of checkoff programs regionally. Previous studies in the economic literature dealing with evaluation of the effectiveness of agricultural checkoff programs typically have not centered attention on impacts in individual cities, regions, countries, or markets. The distinct contribution of this work is the presentation of a case study of targeted promotion that took place over the period March 2005 to November 2005 in six U.S. cities. Importantly, we add degrees of differentiation in terms of the model chosen, the accounting of the national advertising campaign, and the metric associated with the level of marketing activity.

Based on econometric evidence through the estimation of a SUR model, this targeted program was successful in each city with the exception of Sacramento, generating average benefit-cost ratios at the retail level ranging from 1.26 to 1 in Denver to 4.06 to 1 in Chicago. This case study points to the successful implementation of the targeted advertising and promotion campaign by the NPB for these cities during the nine-month time period in 2005. Despite the dated time frame of this analysis, due to the fact that attention generally has not been paid to targeted promotion in specific markets, this city-by-city analysis unequivocally adds to the vast literature associated with the impacts of agricultural checkoff programs.

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Journal of Agribusiness 38, 1 (Spring 2020)

The Potential for Restaurants in Expanding Markets for Locally Grown Food

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This study used primary data to characterize New Hampshire food service establishments sourcing local food products and assess potential for increasing intermediate purchase of local food. Recent studies imply New England consumers are not overly keen to purchase directly from farmers, but still want to consume locally grown food. Increasing local sourcing to intermediate channels may lower opportunity costs of buying local. Statewide surveys assessed practices, characteristics, and perceptions affecting purchasing of local food. We examined which variables affect the likelihood restaurants will buy local. Using binary logistic analyses (the dependent variable defined local purchasing as $\geq$ 41% of total), we found restaurants serving less than 750 meals/week were less likely to purchase locally produced food, and restaurants making food purchasing decisions longer than two years have a negative propensity to buy local. Advocating the importance of knowing who and where their food comes from may help increase intermediate purchases.

***Key words**:* Local Agriculture, Logit, New England, Restaurants, Survey

Local agriculture in the United States has expanded substantially in recent years. Local food sales accounted for $4.8 billion in 2008, with $2.7 billion spent through intermediary channels such as restaurants (Low and Vogel, 2011). In 2015, farmers sold $8.7 billion of edible food commodities directly to consumers, retailers, institutions, and a variety of local food intermediaries (Census of Agriculture Highlights, 2016). These channels have been somewhat neglected despite being a large part of local food distribution, and most U.S. research on the topic has focused on the Midwest and West. Many restaurants do not realize that local producers often provide equivalent or higher quality goods, and local food products can directly benefit restaurants via improved customer perception (Starr et al., 2003; Brain, Curtis, and Hall, 2015). Serving local food in restaurants benefits farmers who receive more of the goods' final prices, and recent New England research has shown consumers want options besides purchasing directly

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from farmers (Werner et al., 2019). In short, it would be to the mutual benefit of producers and restaurants if they were better connected, and increasing local sourcing may help lower the opportunity cost of buying local.

Currently, an information gap exists between New Hampshire restaurants and local food producers. This study examines what affects the likelihood that a New Hampshire restaurant will make local food purchases. A statewide survey explores practices, characteristics, and perceptions affecting restaurant purchasing of local food products. Results provide missing information on purchasing trends, inform policy initiatives, and assist expansion plans in local food economies.

Research Questions and Approach

This study seeks an empirical understanding of factors affecting decisions to purchase local food products. Our research goals are to:

1. Identify factors that impact New Hampshire restaurants' abilities and decisions to purchase local food products through logistic analysis
2. Uncover restaurant purchasing trends, perceptions, and restraints to local sourcing in New Hampshire
3. Propose strategies for increasing indirect purchases of locally grown food products in Northern New England

We used a statewide survey informed by a pilot study of New Hampshire's Seacoast restaurants. The pilot study provided insight on what was considered valuable information for farmers, local food distributors, and restaurant owners and chefs. The survey gathered data about restaurant perspectives on local sourcing and barriers to increasing local purchases.

What is "Local?"

According to Low et al. (2015), local food systems refer to place-specific clusters of agricultural producers, along with consumers and institutions involved with producing, processing, distributing, and selling foods. The U.S. Department of Agriculture (USDA) considers food that travels 400 miles or less, or that is sold within the state where it is grown, to be locally and/or regionally sourced (Martinez et al., 2010). A recent New Hampshire study found a majority of residents defined "local" as grown or produced within a 50-mile radius (Pyburn et al., 2016). Since the definition of "local" remains ambiguous, focusing on the two different types of local markets helps direct empirical research (Martinez et al., 2010). Local food market transactions can be made directly or indirectly; this study focuses on the latter. Here, "local" is defined as grown or raised within New England (a definition attributed to the New England 50/60 Food Vision).

Intermediate Markets

Local food products may be distributed to a variety of intermediate buyers including grocery stores, food service establishments, food hubs, retail stores, and state or federal institutions. Distribution to grocers can pose extra challenges as many stores require price look-up and universal product codes, and produce must meet grading standards (Moldovan, 2016). Nonetheless, expansion of indirect food sales and local branding initiatives has been rising with retailers, such as Wal-Mart and Hannaford, therefore increasing support for locally grown produce (Martinez et al., 2010). Identifying specific needs of intermediate buyers can be time-consuming for producers but is essential to developing long-term business relationships.

It is unclear which channel has the greatest potential. Restaurants offer greater flexibility since they can change menus based on seasonal or weekly availability of local food (Moldovan, 2016; Washington State Department of Agriculture (WSDA), 2010). On the other hand, restaurants rely on timely deliveries and adequate supply, whereas grocery stores can direct consumers to other readily available products if a local distributor falls short. Moreover, local producers have the ability to supply intermediate markets, and restaurants in particular, with a diverse variety of high-quality products as well as a competitive edge through product differentiation.

Our research helps develop a better understanding of obstacles to local sourcing in intermediate channels, and aids in highlighting key distributor perceptions and how those match up with buyers. Understanding information gaps is key to increasing market efficiency. Further, statewide surveys provide information on perceptions of local food sourcing and impacts beyond the transaction. Identifying food- and supplier-related attributes helps inform marketing strategies for distributors and producers. Qualitative input from respondents also helps steer possible solutions to bridge the gap between producer and buyer.

Policies Supporting Local and Regional Food Systems

Empirical research finds that expanding local food systems can increase employment and income within a community (Martinez et al., 2010). Thus, a number of state and federal policies have been passed to support local food movements: the Agricultural Act of 2014

(USDA, 2014, Farm Bill, P.L. 113-79) includes provisions to help support local and regional food systems (Low et al., 2015), with expansions to the Bill since its approval including the Farmers' Market Promotion Program (FMPP, Sec. 10003), Specialty Crop Block Grants (SCBG, Sec. 10010), and Value-Added Producer Grants (Sec. 6203). Changes to the Farm Bill were designed to help market local food through direct-to-consumer outlets, indirect channels, funding for projects related to regionally marketed food, and farm-based "value-added" products (Low et al., 2015). At the state level, local initiatives such as the New England Food Vision encompass a vision for the region to produce 50% of its own food by 2060, to increase the amount of food-producing land from 5% to 15%; and for policy changes expanding farm-to-plate programs, increasing protection for farmland, and promotion of farmland access and training programs (Donahue et al., 2014). The Granite State Farm to Plate Food Policy and Principles Bill promotes "local food producers, farming, and fisheries, including businesses engaged in agriculture…and the associated local and regional businesses that process, purchase, distribute, and sell such food…" (Sec 425:2-a). Vermont's Farm to Plate Initiative seeks to "increase economic development in Vermont's farm and food sector, create jobs in the farm and food economy, and improve access to healthy local food for all Vermonters" (Kahler et al., 2013; Sec. 35. 10 V.S.A chapter 15A § 330).

Previous Research

A growing body of research is analyzing local food sourcing. Ortiz (2010) surveyed customers' willingness to pay premiums for locally sourced menu options. Over six trial days, 44% of participants selected local menu options and indicated they would pay a premium for locally sourced menu choices. The Food Processing Center (2003) surveyed members of the Chefs Collaboration and found respondents preferred to purchase directly from farmers. How a product was grown, freshness, and quality were highly valued, while availability and delivery were obstacles to local sourcing. If greater variety or quantity was provided, 38% of respondents would increase local food purchases; 33% would increase purchases only if a larger variety were available. Curtis and Cowee (2009) surveyed Nevada restaurants and found chefs bought locally sourced products for quality, taste, and freshness. An obstacle for 75% of respondents who did not purchase locally was unawareness of local options. Chefs concerned with production issues, knowledge of the farmer, and representing gourmet and independently owned restaurants were more likely to purchase local foods. The Gregoire et al. (2005) Iowa survey revealed only 25% of producers were selling to food service operations, while 44% had never sold to one, noting unreceptive buyers or farmers could not keep up with quantity and year-round demand. Lack of knowledge for purchasers and suppliers impeded local sourcing to intermediate operations.

Schneider and Francis (2005) surveyed farmers and consumers in Nebraska on the potential of the local food system. Results revealed low farmer interest for providing to local markets even though there was a high level of consumer interest in purchasing local food. Sharma, Gregoire, and Strohbehn (2009) conducted face-to-face interviews of restaurateurs in the Midwestern United States and found no significant difference in the cost of using local ingredients, though there were higher costs for delivery and transportation. Inwood et al. (2008) collected quantitative and qualitative data from interviews with Ohio restaurants and found distribution problems and a lack of convenience to be limiting factors for the use of local products.

Starr et al. (2003) used telephone surveys of Colorado farmers and food service buyers and found price was not a major factor in purchasing decisions, while quality was among the top priorities of intermediate buyers. Many were not aware that local farmers could provide a comparable or higher quality product and service. Another study used focus groups to investigate shoppers' beliefs and behaviors regarding local foods in Madison, Wisconsin (Zepeda and Leviten-Reid, 2004). A significant finding was that respondents were not concerned with local food labels, but were concerned with product qualities of local foods. The authors found that marketing strategies catering to consumer concerns were needed for local food promotions.

Brain et al. (2015) studied the Utah Farm-Chef-Fork Program, connecting producers and restaurants through workshops, farm and restaurant tours, and other local-sourcing events via pre- and post-assessments, and found that 71% of purchasers indicated they would increase the percentage of ingredients sourced locally as a result of the program's workshops. Market activities such as contacting a local farm for the first time, knowing the best time of day to make a new contact, knowing what area farms sell locally, and understanding needs of local farmers were a central focus of the study. Post-assessment revealed participants' confidence in these marketing activities increased significantly from confidence scores on the pretest.

Smith II et al. (2013) conducted an online survey in the Northeastern United States to identify factors influencing hospitals' decisions to adopt "farm-to-hospital" programs (FTH). The survey, sent to a random sample of 160 hospital food and nutrition service directors, identified agriculture and county characteristics of areas in which hospitals are located and how they may affect a hospital's propensity to adopt FTH. The authors found that the Healthy Food in Healthcare Pledge, number of hospital meals prepared daily, percent of farms participating in Community Supported Agriculture, and a hospital's county classification had the greatest impacts on the decision to adopt FTH. O'Hara and

Benson (2017) used probit and OLS to explore how local food purchases by schools are influenced by local agricultural conditions using data from the 2015 Farm to School Census. Results implied that the value of local direct-to-consumer agriculture, number of students, and relative prosperity of the school district had positive impacts on the probability of a School Food Authority making local food purchases. Ralston et al. (2017) studied school districts using the 2013 Farm to School Census, school district data, and state and county attributes from USDA's Economic Research Service's Food Environment Atlas. Districts with enrollment above 5,000, in counties with high farmers market density, higher per capita income, higher level of college attendance, and those in states with more policies supporting farm-to-school programs were more likely to serve local foods. Moldovan (2016) surveyed Missouri buyers, including restaurants, grocery stores, distributors, government and academic institutions, and other intermediate buyers, with data split into institutional and intermediated. Results showed institutions were 22% less likely to purchase local products than intermediate buyers.

Surveying this literature, common themes emerge. First, not knowing where and what local producers have available was a common reason for intermediate buyers not purchasing local food (Food Processing Center (FPC), 2003; Curtis and Cowee, 2009; Gregoire et al. 2005; Starr et al. 2003). Second, most research has been done in the Midwest, leaving an information void on intermediate markets in the Northeast. Size, location, farm-to-institution policies, and various sociodemographic characteristics all play significant roles in intermediate establishments' willingness and abilities to source locally (O'Hara and Benson, 2017; Smith et al., 2013; and Ralston et al., 2017).

Pilot Study

To investigate the role that restaurants play in distributing local food, a pilot study was conducted in the Seacoast Region of New Hampshire, where the local food movement has been gaining strength. According to the 2012 Census of Agriculture data, 51.4% of New Hampshire is woodland, 24.9% cropland, and 8.9% pastureland (Vilsack and Clark, 2014). Due to the state's topography, expansion of farms may be difficult at best, and recent research does indeed indicate that land availability is a major constraint to expanding local agriculture (Werner et al., 2019). However, little research has been conducted to examine this possibility and linkages between the local and regional food systems. The main goal of the pilot study was to highlight perceptions and barriers between producers and restaurants in Seacoast New Hampshire.

A series of interviews was conducted with local food distribution outlets, including Farm Fresh Connection, Unity Food Hub, Three Rivers Alliance, and Farm to Restaurant

Connection. These provided insights on the supply side of the market and how the food network typically operates in New England. An interesting takeaway was that local food distributors felt they could compete with national suppliers in terms of price, quality, and quantity. Interview questions were shaped by these findings and previous surveys by FPC (2003), Ortiz (2010), and Starr et al. (2003). The definition of local was left to respondents for this portion of the research. A list of restaurants along New Hampshire's seacoast was used to select interview subjects. Selected subjects were asked if an owner or kitchen manager would participate in a 20- to 30-minute interview**.** Survey answers were recorded manually.

In total, 16 restaurants along the Seacoast participated, self-identifying as nine casual/family, one fine dining, three pub fare, and two seafood. The top three reasons for making local food purchases were 1) support for the local economy and farmers, 2) freshness, and 3) locally sourced menu options were desired by patrons. Additionally, eight interviewees cited quality as their top concern when making purchases and three considered price their top concern. Among independently owned restaurants, availability was cited by seven restaurants as the main obstacle to sourcing local food products, whereas franchises were more concerned with consistency across restaurant locations. Other concerns included customer service, seasonality, lack of farmers markets in the area, communication, and price increases during the offseason.

Of interest was that 15 of 16 restaurateurs perceived local food as a “profitable” asset to their business despite obstacles encountered in the purchasing process. In regard to contacting suppliers, 25% of interviewees were actively seeking new local suppliers, 37% relied on “word of mouth,” 13% waited for farmers to approach them, 13% went to farmer's markets, and 12% were not seeking new suppliers. Eight of the restaurants estimated that 35% or less of their budget was spent on local food sources while the other half estimated at least 50% of their budget was spent on local suppliers.

One product that a number of restaurants would like to purchase locally more often was meat, particularly red meat, which can be sourced year-round. The main obstacle to sourcing local beef, however, was cost. Lastly, 14 restaurants stated that their menus featured “seasonal” items which offer greater flexibility when doing business with local farmers.

Methods

Objectives

Following Smith II et al. (2013), O'Hara and Benson (2017), Moldovan (2016), FPC (2003), Curtis and Cowee (2009), and questions inspired by the pilot study, a logit model was specified to examine the propensity of New Hampshire restaurants to purchase locally grown food. The model includes explanatory variables such as buyer classification, supplier attributes, perceptions of food-related attributes, buyer autonomy, and other restaurant demographics.

Ordered and binary logit models were estimated. The dependent variable for the binary model equaled one if the respondent's percentage of monthly local food purchases is $\geq$ 41%, and zero when the respondent's percentage of monthly local food purchases is $<$ 41%. The threshold parameter (41%) was based on previous research by FPC (2003). This screening prevents establishments which purchase small percentages of local food from being classified as local buyers, so that the model identifies characteristics of only major purchasers.

Survey Design

There are 3,063 eating and drinking establishments in New Hampshire (New Hampshire Lodging and Restaurant Association (NHLRA), 2017). In order to gather data, an online survey was issued to these establishments via Qualtrics survey software. The statewide survey contained 25 questions pertaining to food service establishment demographics, purchasing power, perceptions of local food, obstacles related to sourcing local food, and marketing local menu options. Survey invitations were sent via email through the NHLRA to its members. This yielded only 10 responses, so an additional 1,145 email addresses were extracted from New Hampshire's Licensing Verification Site Facility Search to conduct another survey launch. One caveat is that the website only includes restaurants with active liquor licenses. Data were collected from October 2017 until March 2018. STATA statistical software was used to obtain descriptive statistics and estimate regression models.

Conceptual Model

A binary choice of the *i*th individual is represented by a random variable y_i that takes on a value of 1 if local sourcing occurs and 0 otherwise. P_i is the probability that y_i takes on the value 1, and $1 - P_i$ is the probability that y_i is 0. This can be written as

(1)

$$F(y_i) = P_i^{y_i}(1 - P_i)^{1-y_i} \qquad y_i = 0{,}1$$

and

$$y_i = \begin{cases} 1 & \text{with probability } p \\ 0 & \text{with probability } 1 - p \end{cases}$$

In this case, *y*=1 when the respondent's percentage of monthly local food purchases is ≥ 41% of total food purchases and *y*=0 otherwise a logistic regression model is outlined below. For *k* explanatory variables and *i* =1,…, T individuals, the logistic model is

(2)

$$\log\left[\frac{p_i}{1 - p_i}\right] = \alpha + \beta_1 x_{i1} + \beta_2 x_{i2} + \cdots + \beta_k x_{ik}$$

where p_i is the probability that y_i takes on the value 1, and then $1 - p_i$ is the probability that that y_i is 0. Solving the logit equation for p_i

(3)

$$p_i = \exp\frac{(\alpha + \beta_1 x_{i1} + \beta_2 x_{i2} + \cdots + \beta_k x_{ik})}{(1 + \exp(\alpha + \beta_1 x_{i1} + \beta_2 x_{i2} + \beta_k x_{ik})}$$

Using the property $\log(e^x)$= x, we further simplify the last equation

(4)

$$p_i = 1\,/(1 + \exp(\alpha + \beta_1 x_{i1} + \beta_2 x_{i2} + \beta_k x_{ik})$$

The marginal effect of an increase in a regressor x_i on the probability of selecting y_i is

(5)

$$\frac{\partial P_{ij}}{\partial x_{ri}} = \beta p_i(1 - p_i)$$

If the explanatory variable is discrete, $\partial p_i / \partial x_{ij}$ does not exist and the discrete explanatory variable is obtained by evaluating P_i at alternative values of x_{ij} taking on values of 1 and 0. The marginal effect of a discrete variable is expressed as

(6)
$$\frac{\partial p_i}{\partial x_{ij}} = P(x_{ij} = 1) - P(x_{ij} = 0)$$

Ordered Logit Theory

The conceptual theory for an ordered logistic model differs slightly. Ordered outcomes are modeled to arise sequentially as a latent variable, y^*, crosses progressively higher thresholds (Cameron and Trivedi, 2009). For this model, y^* is an unobserved measure of local sourcing levels. For individual *i,* we specify

(7)
$$y^* = x_i'\beta + u_i$$

where a normalization is that the regressors x do not include the intercept. For very low local sourcing y^*, local sourcing is 0-20%; for $y^* > \alpha_1$, local sourcing increases to 21-40%; for $y^* > \alpha_2$, local sourcing increases to 41-60%; for $y^* > \alpha_3$, local sourcing increases further to 61-80%; for $y^* > \alpha_4$, local sourcing increases to 81-100%.

For an *m*-alternative ordered model, we define

(8)
$$y_i = j \text{ if } \alpha_j - y_i^* \leq \alpha_j, \qquad j = 1, \ldots, m$$

where $\alpha_0 = -\infty$ and $\alpha_m = \infty$. Then

(9)
$$\begin{aligned} \Pr(y_i = j) &= \Pr(\alpha_{j-1} < y_i^* \leq \alpha_j) \\ &= \Pr\left(\alpha_{j-1} < x_i'\beta + u_i \leq \alpha_j\right) \\ &= \Pr\left(\alpha_{j-1} - x_i'\beta < u_i \leq \alpha_j - x_i'\beta\right) \\ &= F(\alpha_j - x_i'\beta) - F(\alpha_{j-1} - x_i'\beta) \end{aligned}$$

where *F* is the cumulative distribution function of u_i. The regression parameters, β

and $m-1$ threshold parameters $\alpha_1, \ldots \alpha_{m-1}$, are obtained by maximizing the log-likelihood with $p_{ij} = \Pr(y_i = j)$ as previously defined (Cameron and Trivedi, 2010).

For the ordered logit model, *u* is logistically distributed with $F(z) = \frac{e^z}{1+e^z}$. The sign of the regression parameters, β, can be interpreted as the predicted probability of a respondent operating in each local sourcing level, and cumulative probabilities can be predicted as well. The model assumes the outcome variable is a latent variable (Liu, 2010). It is expressed as

(10)

$$\ln(\mathrm{Y}j') = \mathrm{logit}\,[\pi(\mathrm{x})] = \ln\left(\frac{\pi_j(x)}{1-\pi_j(x)}\right) = \alpha_j + \left(-\beta_1 X_1 - \beta_2 X_2 - \cdots - \beta_p X_p\right)$$

where $\pi_j(x) = \mathrm{Y} \leq \mathrm{j} \middle| \mathrm{x}_1, \mathrm{x}_2, \ldots\ \mathrm{x}_\mathrm{p})$, the probability of being at or below category j, given a set of predictors (Liu, 2010). For the model, α_j are cut points, and $\beta_1, \beta_2 \ldots\ \beta_p$ are logit coefficients.

Variable Definitions

Based on previous literature, the pilot study, and theory, our model takes the form

(11)

$$\begin{aligned}\text{BUY\_LOCAL (0, 1)} = {} & \beta_0 + \beta_1 BUS\_TYPE + \beta_2 MEALS750 + \beta_3 MEALS1250 + \\ & \beta_4 MEALS1750 + \beta_5 MODERATE\_AUTONOMY + \\ & \beta_6 COMEPLETE\_AUTONOMY + \beta_7 STORE\_LOCATIONS + \\ & \beta_8 SUPPLIER\_ATTRIBUTES + \beta_9 PRODUCTION + \\ & \beta_{10} PURCHASING\_VOLUME + \beta_{11} AUTO\_LENGTH + \\ & \beta_{12} FOOD\_ATTRIBUTES + \beta_{13} CHALLENGES + \beta_{14} IMPACTS + \in\end{aligned}$$

Respondents from each establishment were asked if they had purchased locally produced food products within the past calendar year ("local" = grown or raised in New England). Respondents were then asked what percentage of their food purchases were locally sourced, on a scale of 0-20%, 21-40%, 41-60%, 61-80%, and 81-100%. Responses were transformed into the model's binary dependent variable.

Of 14 explanatory variables in the model, one is continuous, eight are discrete, and five are composite variables based on factor analysis (Table 1). For *Food Attributes*, respondents were asked to rank the importance of 11 different food characteristics over a range of 1-5 (1 being Not Important; 5 being Very Important), making the overall range of the variable 4-20. Of the 11 attributes, four were selected based on buyers' reasons for making local food purchases: 1) product's brand 2) product's quality, 3) personally know who raised or grew product, and 4) product is nutritious and healthy. *Production* includes questions on farming methods. Respondents were asked to rank the importance of 1) knowing how a product was grown, 2) if the product was New England-grown, and 3) ability to process and package products according to buyer needs. The range on each question was 1-5 (1 being Not Important; 5 being Very Important), making the overall range of the composite variable 3-15.

The third composite variable, *Supplier Attributes*, is based on supplier perceptions. Respondents ranked the importance of the following characteristics when making purchasing decisions: 1) guaranteed consistent delivery, 2) ability to provide promotional samples, 3) ability to develop a long-term business relationship, and 4) product knowledge, making the overall range of the composite variable 4-20. The composite variables *Supplier Attributes* and *Production* are based on work by Curtis and Cowee (2009). *Challenges* and *Impacts* controlled for perceptions of local sourcing obstacles and broader impacts of local food production. The range on each question was 1-5 (1 = Strongly Disagree; 5 = Strongly Agree). Respondents were asked if they agreed or disagreed that 1) inconsistent quality, 2) price, 3) lack of availability, and 4) inconsistent deliveries impeded their ability to source locally, making the overall range of the composite variable 4-20 for *Challenges*. For *Impacts*, respondents were asked if they agreed or disagreed that local food production 1) reduces the carbon footprint, 2) helps sustain the environment, and 3) helps support the local economy, for a maximum composite score of 15.

This study tests if restaurants serving less than 1,750 meals/week are more likely to buy local. Curtis and Cowee (2009) classified restaurants serving over 1,750 meals/week as "large" which were found to negatively impact a restaurant's likelihood of purchasing locally. It is hypothesized that restaurants serving less than 1,750 meals/week (small-midsized) will not require the consistent and large volumes local distributors may have difficulty supplying and will, therefore, be more likely to source more from local suppliers.

Table 1. Variable Definitions.

Variable	Definition	Coefficent
Bus Type:	Indicator variable representing the type of ownership of the establishment; Chain or franchise (=1), Independent (=2), Corporate (=3), and Other (=4)	+ (chain), -independent, - (corporate)
Meals (750):	Average number of meals served per week for each establishment; =0 if the establishment serves ≥750 meals per week and =1 if the establishment serves <750 meals per week	+
Meals (1250):	Average number of meals served per week for each establishment; =0 if the establishment serves ≥1250 meals per week and =1 if the establishment serves <1250 meals per week	+
Meals (1750):	Average number of meals served per week for each establishment; =0 if the establishment serves ≥1750 meals per week and =1 if the establishment serves <1750 meals per week	+
Store Locations:	Continuous variable representing the number of store locations the establishment owns and operates.	
Moderate Autonomy	Dummy variable representing the level of autonomy; =1 if mostly autonomous and =0 all else	
Complete Autonomy	A dummy variable representing the level of autonomy; =1 if completely autonomous and =0 all else	-
Supplier Attributes	Composite variable comprised of questions based on the buyer's perception of important supplier related attributes, including 1) Guaranteed consistent delivery, 2) Ability to provide promotional samples, 3) Ability to develop a long-term business relationship, and 4) Product knowledge. The range on each question is 1-5 (1 being Not Important; 5 being Very Important), making the overall range of the composite variable 4-20.	+
Production	Composite variable comprised of questions based on the buyer's perception of important production related attributes, including 1) Knowing how a product was grown, 2) If the product was New England grown or raised, and 3) Ability to process and package products according to their needs. The range on each question is 1-5 (1 being Not Important; 5 being Very Important), making the overall range of the composite variable 3-15.	+
Purchasing Volume	Represents total annual purchasing volume, in dollars, of fresh fruits and vegetables for the establishment ranging on a scale from less than $5,000 to Greater than $500,000	-
Autonomy Length	Represents the number of years the respondent has had their indicated level of autonomy. Less than 2 years (=1), 2 to 5 years (=2), 5 to 7 years (=3), 8 to 10 years (=4), and Greater than 10 years (=5).	+
Food Attributes	Composite variable comprised of questions based on the buyer's perception of food-related attributes, including 1) Product's brand 2) Product's Quality, 3) Personally know who raised or grew product, and 4) Product is Nutritious and healthy. Range on each question is 1-5 (1 Not Important; 5 Very Important), making the overall range of the composite variable 4-20.	-
Challenges	Composite variable comprised of questions based on the buyer's perception of local sourcing related challenges, including 1) Inconsistent quality, 2) Price, 3) Lack of availability, 4) Inconsistent delivery. The range on each question is 1-5 (1 Strongly Disagree; 5 being Strongly Agree), making the overall range of the composite variable 4-20.	+
Impacts	Composite variable comprised of questions based on the buyer's perception of broader local sourcing impacts, including 1) Reducing the carbon footprint, 2) Help sustain the environment, and 3) Help support the local economy. The range on each question is 1-5 (1 Strongly Disagree; 5 being Strongly Agree), making the overall range of the composite variable 3-15.	+

Table 1 shows predicted signs by variable. Following Curtis and Cowee (2009) and Starr et al. (2003), variables such as *Bus Type, Store Locations, Autonomy,* and *Autonomy Length* are predicted to have statistically significant and positive impacts on the likelihood of a food service establishment purchasing local food products. Independently owned restaurants may not have to abide by product uniformity and, thus, may be more likely to purchase food from local suppliers, whereas franchises or corporations may not have that luxury. Establishments with greater autonomy are predicted to source a higher percentage of local food products owing to greater input on purchasing decisions. *Food*

Attributes and *Production* are predicted to have positive yet marginal effects. Specifically, if respondents indicate a mean score ≥ 8, they may be more apt to source locally as they value attributes and production methods associated with local food and sourcing. *Supplier Attributes* is hypothesized to have a negative sign as local food suppliers may not have long-standing relationships with buyers and the consistent supply that restaurants require.

Descriptive Results

A sample of 145 food service establishments completed the survey; 109 were usable for analysis. Of respondents, 81% were independent, 3.6% were part of a chain or franchise, and 7.2% were corporate (6.3% other). Of the 109, 20.1% were buying ≥ 41% of total monthly purchases from local sources. The most frequent source of food purchased by restaurants was from a national food supplier, but nearly one-third of respondents indicated they made purchases directly from a farmer or regional foodservice distributor (Table 2). When asked where they would *prefer* to make the majority of food purchases, almost half of respondents indicated they would like to purchase directly from a farmer. For the purpose of this study, "local" was defined as raised or grown in New England, but respondents were also asked how they personally define “local." Of those who answered, 26.6% considered local as being grown or produced within New England, 25.6% within 50 miles, 19.2% within New Hampshire, and 17.4% within 100 miles.

Table 2. Purchases Made from Various Food Suppliers.

Supplier Type	Frequency	Percent
National food service distributor	54	49.5
Direct from a farmer	40	36.6
Regional food service distributor	40	36.6
Local manufacturer or processor	26	23.8
Direct from a farmer's co-op	14	12.8
Farmer’s market	13	11.9
Food hub	10	9.1
Other	7	6.4

Note: Buyers could select all that apply.

Respondents were most interested in purchasing locally produced vegetables (73%), fresh-cut produce (50%), local cheese (49%), and local beef (48%); and least interested in grains, wine, and yogurt. All buyers cited taste as important or very important, also noting quality (98%), cost (74%), and product marketability (67%) as important. A majority of respondents (97%) cited consistent supply and quality as important or very important. Buyers were least concerned with kitchen/staff training and promotional samples. Approximately 74% of buyers had promoted their use of locally sourced products. The top form of advertisement was word of mouth (87% cited as very or extremely effective); 0% cited newspaper advertisement as effective for promoting local food use.

Buyers cited seasonal availability of produce as the top challenge to purchasing local food products (Table 3); 96% agreed or strongly agreed local sourcing helps keep local farmers in business, and 93% felt it supports the local economy. Lastly, buyers were asked how they would like to be notified about availability of local food products, with a plurality (47%) preferring online newsletters, and less interest in social media and in-person visits (16% each).

Table 3. Challenges to Sourcing Local Food Products.

Challenge Type	Frequency	Percent
Seasonal availability of vegetables	83	76.1
Seasonal availability of fruits	82	75.2
Lack of availability	79	72.4
Price	67	61.4
Inconsistent delivery times	45	41.2
Undeveloped relationship with farmers	40	36.6
Inconsistent quality	35	32.1
Lack of farmers' markets	27	24.7
Lack of commitment by farmers	26	23.8
Lack of food safety certification	21	19.2
Lack of interest by farmers	15	13.7
Additional food preparation required	12	11
Packaging issues	9	8.2
Negative relationship with farmers	4	3.6
Other	3	2.7
Low quality	0	0

Qualitative Results

Respondents were asked open response questions on strategies to increase local sourcing, why they continue to source locally, or why they have not sourced locally. Top reasons for sourcing local food products include: 1) higher quality, 2) supporting local businesses, and 3) supporting local farmers; also cited were freshness, customer preferences, sustainable practices, and knowing who and where the food comes from. Those not purchasing local cited availability and cost as barriers (Figure 1). Providing better networking and distribution systems were the top solutions suggested to connect farmers with food service establishments (Figure 2).

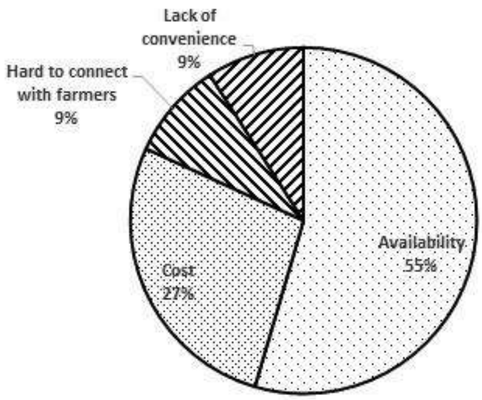

Figure 1. Reasons for Not Buying Locally.

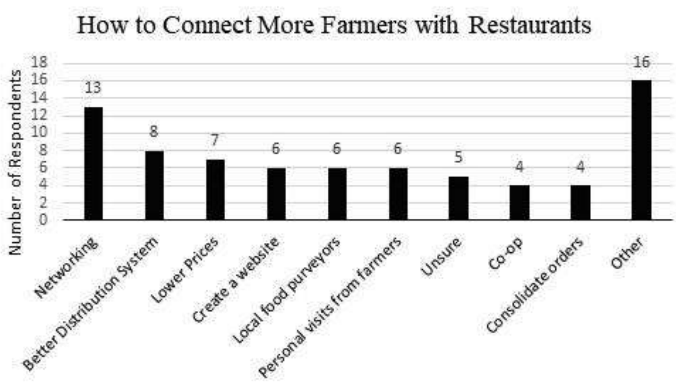

Figure 2. Proposed Solutions for Increasing Local Sourcing.

Logit Model Results

Parameter estimates from the logistic model were used to calculate probability of a buyer's willingness to purchase at least 41% of their food from local sources. The χ^2 results imply that the model is statistically significant as a whole. The Hosmer-Lemeshow χ^2 shows no evidence of poor fit, implying a correctly specified model. Estimated coefficients and marginal effects were obtained using STATA (Table 4). Of 109 respondents, 20% were buying local (≥ 41%). Coefficients for meals (< 750), *Autonomy Length,* Level (*Moderately Autonomous*), and the composite variable for *Production* were statistically significant at the 5% level. The estimated coefficient for *Impacts* was positive and statistically significant at the 10% level. Length of autonomy and number of meals served per week (<750) had negative marginal effects.

Table 4. Broader Impacts Associated with Local Food Production and Purchasing.

Broader Impacts	Frequency	Percent
They help keep local farmers in business	105	96.3
They help support the local economy	101	92.6
They help local farmers expand their operations	90	82.5
Locally produced food products taste better	79	70.4
They are safe to eat	75	68.8
They reduce the carbon footprint	79	72.4
They help sustain the environment	76	69.7
There is a growing preference for local menu options among customers	74	67.8
Locally sourced menu options attract a higher number of customers	66	60.5
Other	3	2.7

Buyers serving less than 750 meals/week were 19% less likely to buy local than those serving more than 750 meals/week. Buyers with an autonomy length of 5-7 years were 27% less likely to buy local than those with autonomy under two years. Buyers with an autonomy length of 8-10 years were 30.5% less likely, and buyers with autonomy greater than 10 years were 29% less likely to buy local than buyers with autonomy less than two years. Marginal effects implied buyers who were mostly autonomous (12% of total) were 38% more likely to purchase locally than those with minimal autonomy. An additional one-unit increase in *Production* increases the probability of buying local by 4.4%. When there is no perceived value in local production techniques, buyers are only 4.4% more likely to make local food purchases, but at a score of 15, are 52.8% more likely to purchase locally. An additional one-unit increase in *Impacts* increases probability of buying local 4.7%. When there are no perceived broader impacts of local production, buyers are only 4.7% more likely to make local purchases. If a buyer thinks local food had a positive impact on the environment and the local economy for a maximum composite score of 15, they are 56.4% more likely to buy local.

Odds Ratio

The odds ratio in logistic regression is interpreted as the effect of a one-unit change in X in the predicted odds ratio (other variables held constant) (Table 5). The odds ratio of .102 for *Meals (<750)* implies the odds of buying local for a restaurant serving less than 750 meals per week are 89.7% lower than the odds for a restaurant serving more than 750 meals. The odds ratio of 1.59 for *Production* implies a 59% increase in the odds of buying local for a one-unit increase in the composite variable score. For *Impacts*, there is a 63% increase in the odds of buying local for every one-unit increase in the composite variable score. For restaurants making purchasing decisions 5-7 years, odds of buying local are 46% lower than the odds for restaurants making purchasing decisions less than two years. Level of autonomy appears to play a positive role in the odds of buying local. Results imply that odds of buying local for mostly autonomous restaurants are 24 times higher than restaurants with minimal autonomy.

Attributes by Restaurant Size and Length of Autonomy

Overall, 30 restaurants served less than 1,750 meals/week, 28 served less than 1,250 meals/week, and 51 served less than 750 meals/week. Similar trends for the level of autonomy across the board were displayed, but restaurants serving less than 750 meals/week were the majority of completely autonomous establishments. The majority of restaurants serving less than 750 meals/week have been making purchasing decisions more than 10 years. For composite variable scores, no differences were found by restaurant size. Average composite scores for the 5 variables remained consistent across categories. Each variable’s mean scores were within one point of each other, implying no major differences in business practices or perceptions by size of establishment. Similar trends held across length of autonomy: years making purchasing decisions do not change perceptions or business practices. Results show 17 restaurants making purchasing decisions less than two years, 17 for 2-4 years, 11 for 5-7 years, 11 for 8-10 years, and 54 over 10 years. In each group, the majority were independent restaurants. The majority of restaurants making purchasing decisions more than 10 years mainly had complete autonomy over purchasing. No differences were found among mean composite variable scores by length of autonomy. Results imply no strong correlation between restaurant size or autonomy length with establishment attributes or perceptions of local food.

Table 5. Estimated Coefficients and Marginal Effects Accompanied with p-Values of Independent Variables on Willingness to Purchase Local Food Products for Binary Logit Model.

Variable	Coefficient	P-Value	Marginal Effect	P-Value	Odds Ratio
Meals (≥750)	-2.278	0.021	-0.19	.003***	0.102
Meals (≥1250)	-0.624	0.714	-0.061	0.719	0.545
Meals (≥1750)	-1.42	0.405	0.126	0.349	4.13
Moderate Autonomy	3.185	0.067	0.381	.033**	24.17
Complete Autonomy	0.754	0.513	0.069	0.482	2.12
Store Locations	-0.168	0.517	-0.016	0.514	0.845
Supplier Attributes	0.014	0.929	0.001	0.929	1.01
Production	0.463	0.064	0.044	.046**	1.59
Volume	0.217	0.229	0.021	0.217	1.24
Autonomy Length					
2 (2 To 4 Yrs)					
3 (5 To 7 Yrs)	-0.607	0.582	-0.076	0.58	0.544
4 (8 To 10 Yrs)	-2.437	0.101	-0.268	.045**	0.087
5 (>10 Yrs)	-2.952	0.099	-0.305	.025**	0.052
	-2.695	0.017	-0.288	.006***	0.067
Food Attributes	-0.011	0.949	-0.001	0.949	0.988
Impacts	0.488	0.067	0.047	.055*	1.62
Challenges	-0.036	0.819	-0.003	0.819	0.964
Business Type					
2	-1.478	0.371	-0.163	0.462	0.227
3	0.302	0.884	0.039	0.884	1.35
4	0.711	0.728	0.092	0.722	2.03
Constant	-10.624	0.014	---	---	---

*** $\chi2$Chi-square significant at p<.01

** $\chi2$Chi-square significant at p<.05

* $\chi2$Chi- square significant at p<.10

$\chi2$ Chi Squared: 39.80***

Prob > $\chi2$: 0.0035

McFadden Pseudo R2: 0.3771

N = 106 (due to missing values in remaining 3 surveys)

Hosmer-Lemeshow $\chi2(8)$: 11.74

Prob > $\chi2$: 0.1632

Table 6. Ordered Logit Results.

Variable		Coefficient	Standard Error	P-Value	Odds Ratio
Meals (≥750)		-0.049	0.49	0.92	0.951
Meals (≥1250)		-0.374	1.07	0.727	0.687
Meals (≥1750)		0.358	1.111	0.747	1.431
Moderate Autonomy		0.61	0.776	0.432	1.84
Store Locations		-0.119	0.127	0.349	0.887
Supplier Attributes		-0.064	0.093	0.487	0.937
Production		0.589	0.136	.000***	1.8
Volume		0.16	0.109	0.141	1.174
Autonomy Length					
	2	0.214	0.783	0.784	1.239
	3	-1.378	0.874	0.115	0.252
	4	-0.428	0.91	0.638	0.651
	5	-0.273	0.635	0.667	0.76
Food Attributes		-0.068	0.084	0.419	0.933
Impacts		0.079	0.099	0.426	1.082
Challenges		-0.001	0.084	0.99	0.998
Business Type					
	2	-1.682	1.45	0.246	0.185
	3	-1.57	1.639	0.338	0.208
	4	-1.851	1.672	0.268	0.157
Cut 1		3.088	2.431		
Cut 2		4.161	2.444		
Cut 3		5.9	2.478		
Cut 4		7.423	2.531		

** Chi-squared significant at p<.05

* Chi-squared significant at p<.10

N=106 (due to missing values in 3 surveys)

Ordered Logit Results

Table 6 lists the model's estimated coefficients and odds ratios. A one-unit increase in *Production* leads to a .589 increase in log odds of a higher level of local sourcing. For a one-unit increase in *Production*, odds of the highest level of local sourcing vs. lower levels are 1.8 times greater. Due to the proportional odds assumption, the same increase is found between all levels of local sourcing. Threshold parameters (cut points) indicate where the latent variable is cut to make the five groups found in the data (i.e. constants are set to zero and cut points estimated for separating the five levels of local sourcing. With five possible values for Y, threshold parameter values are: $Y_i = 1$ if Y_i^* is ≤ 3.088; $Y_i = 2$ if $3.088 \leq Y_i^* \leq 4.161$; $Y_i = 3$ if $4.161 \leq Y_i^* \leq 5.900$; $Y_i = 4$ if $5.900 \leq Y_i^* \leq 7.423$; $Y_i = 5$ if $Y_i^* \geq 7.423$. According to results, threshold parameters do not differ statistically so they should be collapsed into fewer categories.

The probability of sourcing 0-20% from local sources increases by 15% per one-unit increase in the composite score of *Production* (Table 7), with diminishing effects for higher values of *Production*. For *Autonomy Length*, probability of 0-20% local sourcing is 33% more likely for restaurants that have been making purchasing decisions 5-7 years than restaurants with less than two years of purchasing decisions; the probability of 41-60% local sourcing decreases by 16.9% for restaurants that have been making purchasing decisions for 5-7 years than restaurants with less than two years of purchasing. Results suggest small-midsized restaurants are less likely to purchase local. A closer look at the data, however, revealed that 74% of buyers serving less than 750 meals/week sourced at least 11% of food products from local sources. The probability of 0-20% local sourcing is 32% higher for independent restaurants, but 19% lower for probability of 41-60% local sourcing. Buyers identifying as *mostly autonomous* were 38% more likely to buy local than those with minimal autonomy. This suggests those looking for new buyers might focus on restaurants with more purchasing flexibility, such as independent restaurants. Independent restaurants are more likely to increase local purchases up to 40%. Results imply respondents making purchasing decisions more than two years are less likely to purchase locally, perhaps due to supplier agreements or aversion to change. Restaurants making purchasing decisions less than five years are more likely to purchase locally up to 20%. Beyond 20%, propensity of crossing to higher thresholds becomes negative. For farmers or suppliers, it may be in their interests to contact newly established and independent restaurants to promote higher levels of local sourcing.

Impacts and *Production* tell an interesting story. A buyer who values local food's broader impacts is 56.4% more likely to buy local; if they value local production methods, they are 52.8% more likely. The impact of *Production* diminishes with higher levels of local sourcing. Moreover, results imply room for market expansion through advertising, especially increasing intermediate purchases of local foods between 0 - 20%. Overall, buyers are more likely to purchase local if they feel they are socially or economically benefiting their community.

Table 7. Marginal Effects for Statistically Significant Variables at Each Sourcing Level.

	ME for 0-20%	P Value	ME for 21-40%	P Value	ME for 41-60%	P Value	ME for 61-80%	P Value	ME for 81-100%	P Value
Production	**0.146**	**.000*****	0.023	0.153	**0.084**	**.001*****	**0.028**	**.007*****	**0.009**	**.066***
Auto Length-3 (5 to 7 years)	**0.328**	**.084***	-0.093	0.981	**-0.169**	**.100***	-0.049	0.186	-0.015	0.787
Bus Type-2 (Independent)	**0.322**	**.068***	0.074	0.6	**-0.186**	**.002****	-0.148	0.427	-0.016	0.787
Bus Type-4 (Other)	0.364	0.172	0.066	0.656	**-0.21**	**.085***	-0.155	0.414	-0.064	0.539

Discussion of Results and Solutions

When buyers were asked where they would *prefer* to purchase their food, 44% said directly from farmers. Farmer cooperatives or regional distributors were preferred second (14%). Indirect buyers would rather purchase from farmers despite opportunity costs, possibly because they can pass on additional costs to customers. Local sourcing in restaurants may be effective in meeting demand for local foods and for reducing purchasing restraints for direct consumers. In fact, 68% of buyers agreed or strongly agreed on expanding preferences for local menu options.

Selling points for local sourcing included quality and supporting local businesses and local farmers. Challenges included price and seasonal availability of produce. A frequently cited solution by buyers was to set up better networking environments to help connect with farmers. Introducing a program similar to Utah's Farm-Chef-Fork in New Hampshire may facilitate a better-connected food network. Research has found that holding workshops is effective in providing information to strengthen farmer-restaurant relationships. Restaurants found it difficult to deal with multiple purchase and delivery sources—they can't "keep their refrigerator open 7 days a week for multiple deliveries." Many felt erratic deliveries hurt local purchasing (Inwood et al., 2008; FPC, 2003); consolidating deliveries could lower costs and affect ability to purchase locally. While many cited availability and distribution as obstacles, there was little interest in buying from food hubs (1.8%) or regional distributors (13.7%). There are few hubs in the region which may be why there is a lack of interest.

Conclusion

We investigated New Hampshire restaurants' potential to increase intermediate purchases of locally grown food. Using survey data, we estimated binary and ordered logistic models to study major factors influencing purchasing decisions. The model expanded on previous literature using a threshold parameter to define major local buyers in the market and investigate sourcing levels. Results revealed a negative propensity to purchase local for restaurants serving less than 750 meals/week. Owners and chefs making purchasing decisions longer than two years are less likely to buy local. *Impacts* and *Production* had significant and positive effects on buying local. *Impacts* may be capturing moral obligations to purchase locally; the coefficient on *Production* may be capturing similar awareness. Emphasizing knowing where their food comes from may increase intermediate purchases of locally grown food. There is little interest in purchasing from food hubs, but considerable interest in purchasing from farms. Respondents noted purchasing from multiple suppliers costs time and impedes ability to source locally. Lack of knowledge of local suppliers may explain the information gap between restaurants and local producers.

The survey response rate in the study was problematic; a longer data collection period/repeated sampling may help. Some addresses were inactive; specific contacts were unavailable, so it was hard to conclude who was reached. Other problems may stem from self-selection bias. Clearly, larger sample sizes across regions will be needed to draw broader generalizations, and a longitudinal investigation would help with investigating seasonal challenges in local purchasing in future studies. Further research is needed to explore effects of workshops with distributors and food hubs. Information distribution on local food availability may increase use of intermediate channels, thus lowering costs of buying.

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Journal of Agribusiness 38, 1 (Spring 2020)

Estimating the Economic Impacts of the COVID-19 Pandemic on the State of Georgia Economy: A Quick-Response Method

John Salazar, John C. Bergstrom, and Dikshit Poudel

The primary objective of this research was to conduct a quick-response estimation of the total economic impacts of the COVID-19 pandemic on the leisure and hospitality industry in the State of Georgia utilizing state job loss data and an input-output model. The advantage of using job loss data is that they are frequently reported (e.g., weekly, monthly) and are readily available from federal and state labor statistical sources allowing for a quick, industry-specific snapshot of the economic impacts of the COVID-19 pandemic. In the State of Georgia, approximately 187,500 jobs were lost in March and April of 2020 in the accommodation and food services sectors, which are part of the broader leisure and hospitality industry. These job losses were associated with estimated decreases in total output in the state in March and April about $1.4 billion, $2.3 billion, and $4.3 billion, respectively.

Key words: COVID-19 Pandemic, Economic Impacts, Job Losses, Leisure and Hospitality Industry, State of Georgia

The State of Georgia's tourism industry generated a record-breaking $66.2 billion in business sales impact with more than $3.4 billion in tax revenue in 2018 from travel and tourism sectors (Georgia Department of Economic Development, Georgia Tourism Division, 2019). At the heart of the travel and tourism industry is the accommodations and foodservices sector. According to the U.S. Bureau of Labor Statistics (BLS), the accommodation and foodservices sector is comprised of establishments that provide customers with lodging or prepare meals, snacks, and beverages for immediate consumption. The sector includes both accommodation and foodservices establishments because the two activities are often combined at the same establishment (BLS, 2020a). Accommodations employ 56,000 individuals while foodservices provide over 500,000 statewide jobs. The sector is heavily reliant on consumer demand and is at the core of the leisure and hospitality super sector, which also includes businesses categorized into arts,

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entertainment, and recreation (BLS, 2020b). Unfortunately, the COVID-19 pandemic has greatly impacted the accommodations and foodservices sector, and many industry analysts and leaders assert that future hotel and restaurant revenues will not return to pre-COVID-19 until late 2021 or, in some cases, 2023 (Krishnan et al., 2020; Hotel News Now, 2020). Because of the pandemic's profound impact on the Georgia accommodations and foodservices sector, the primary objective of this research was to conduct a quick-response estimation of the total economic impacts of the COVID-19 pandemic event utilizing readily-available state job loss data to develop an input-output (I-O) model with IMpact Analysis for PLANning (IMPLAN).

Background

The 2020 COVID-19 pandemic has severely impacted the U.S. economy. According to the International Monetary Fund (IMF) World Economic Outlook (2020) the United States' real gross domestic product (GDP) for 2020 is projected to contract 8% when compared to 2019 (IMF, 2020). For 2020, the United States is projected to have the fourth largest year-over-year percent decline when compared to other advanced economies. As a result of the coronavirus pandemic and its control measures, the international tourism industry—one of the huge industries to be hardest hit—is about to face a 60% to 80% decline in the economy (Organisation for Economic Co-operation and Development (OECD), 2020). While the final effects of the pandemic remain to be seen, its impact on U.S. employment has been significant. As a result of business shutdowns and operation curtailments, the unemployment rate in United States went up to 14.7% in April which was the highest level since the Great Depression (Long and Dam, 2020). The Congressional Research Service (CRS) reports that over the 18-week period from mid-March to mid-July 2020, 52.7 million Americans filed for unemployment insurance (CRS, 2020). In that same report, CRS cites the BLS indicating that 20 million Americans lost their jobs in April while report in the World Economic Forum claims the travel and tourism sector threatened 16.8 million jobs in United States in July (Richter, 2020). In July 2020, the BLS State Employment and Unemployment Summary reported that 49 states and the District of Columbia had jobless rate increases from a year earlier, while one state had no change (BLS, 2020c). Regarding Georgia, the unemployment claims were higher among any other states (i.e. a whopping 4,933 percent between March 16 and May 4), according to a Wallet Hub study (Shearer, 2020).

While all industries have been affected by COVID-19, a specific cluster of industry sectors have been especially hard hit. According to 24/7 Wall St., the following 18 industries are being devastated by the pandemic: gambling, airlines, hotels, movie theaters, live sports, cruises, shipping, film production, automakers, oil and gas, retail, tech, conventions, food service, theme parks, gyms, construction, and transportation (Suneson, 2020). The BLS April 2020 Monthly Labor Review identified the following six North American Industry Classification System (NAICS)-coded sectors as the most exposed sectors to COVID-19 shutdowns: Restaurants and Bars, Travel and Transportation, Entertainment (e.g., casinos and amusement parks), Personal Services (e.g., dentists, daycare providers, barbers), other sensitive Retail (e.g., department stores and car dealers), and sensitive Manufacturing (e.g., aircraft and car manufacturing) (BLS, 2020d). At the center of both lists are the industries that are heavily reliant on service consumption.

According to Pew Research, nearly one-in-four U.S. workers (38.1 million out of 157.5 million) are employed in sectors most likely to be impacted by the COVID-19 pandemic (i.e., restaurants, hotels, childcare services, retail trade, and transportation services) (Koschhar and Barroso, 2020). Retail trade and foodservices and drinking places are the most vulnerable sectors and employ nearly 26 million Americans. These positions are inextricably linked to consumer behavior and confidence. Of the hardest hit sectors, the American Hotel and Lodging Association (AHLA) reports that the leisure and hospitality industry has been the most impacted. According to AHLA, the leisure and hospitality industry lost as many jobs as construction, government, manufacturing, retail, education, and health services combined (AHLA, 2020a). At the core of the leisure and hospitality industry is the accommodation and foodservices sector.

The IBIS World's Industry Factsheet reported that the accommodation and foodservices sector is at risk for a sustained drop in demand because of the decline of inbound international travel and cancelled events. The closure of many bars and restaurants due to government stay-at-home orders also has exacerbated the decreased demand for services (IBISWorld, 2020). Gossling, Scott, and Hall (2020) reported that these sectors account for over 20% of all vulnerable positions. The stay-at-home orders have also exacerbated the sector's decline for both accommodation and foodservices. AHLA identifies that drop as "staggering" and "historic." The association reports that eight in 10 hotel rooms are empty and that 2020 is projected to be the worst year on record for hotel occupancy (AHLA, 2020b). According to the most recent Smith Travel Research (STR) profit and loss data release, U.S. hotel gross operating profit per available room is down 105.4% in June 2020 (Ortiz, 2020; STR, 2020a).

AHLA also states that 70% of hotel employees have been laid off or furloughed and that nearly 3.9 million total hotel-supported jobs have been lost since the pandemic began (AHLA, 2020b). It is reported that more than 2.5 million Georgians have filed unemployment since mid-March 2020 at the beginning of the pandemic when businesses were shuttered and travel restrictions were implemented (Williams, 2020). As of July 2020, STR (2020b) reported that the Hotel Employment Index was 50% of pre-COVID-19 staffing levels, providing evidence that more than 4 million industry workers remain out of work and, according to STR, managers are skeptical about much variation from that level through the end of calendar 2020. Labor at hotel companies throughout the entire chain scale have been severely impacted by the pandemic. From leading hotel corporations to independent operators, furloughs and layoffs have been the prevailing response to COVID-19 pandemic (Ross, 2020).

According to the National Restaurant Association (NRA), eating and drinking places are the primary component of the U.S. restaurant and foodservice industry which, prior to the coronavirus outbreak, generated approximately 75% of total restaurant and foodservice sales. In total, between March and June, eating and drinking places saw sales levels down more than $116 billion from expected levels. NRA's total shortfall for all combined foodservices operations (i.e., non-restaurant foodservice operations in the lodging, arts/entertainment/recreation, education, healthcare and retail sectors) is estimated to exceed $145 billion for March through June 2020 (NRA, 2020a).

Similar to the accommodation sector, the pandemic impacts both restaurant corporations and independent operators. The impacts are a result of declining consumer traffic, reduced in-house dining revenues due to social distancing management practices, and the outright closure of in-house dining. However, independent restaurateurs face higher hurdles because they lack the capital required to weather the financial challenges of being closed for multiple months. According to a survey by the James Beard Foundation and the Independent Restaurant Coalition, 80% of operators are not certain their business will survive the pandemic. Forbes reports that the entire restaurant industry can lose as much as $240 billion by the end of 2020 (Kelso, 2020). The loss of revenues has led to several states losing more than 60% of their restaurant jobs, and the NRA reports that 3.6 million full-service restaurant jobs were lost between February and April (Fantozzi, 2020; NRA, 2020b). AHLA projects the closure of more than 8,000 hotels in September if business travel remains at the same low levels and if funding runs out from the Paycheck Protection Program (Falcon, Nexstar, and Wiernicki, 2020). An updated report on August 31 from AHLA stated that the devastating unemployment rate of 38% in the accommodation sector and 65% of hotels are below 50% occupancy rates because of all-time low consumer travel (AHLA, 2020d). With the worst case analysis, U.S. hotel revenue per available room is predicted to be down by 20% by 2023 (Krishnan, Mann, Seitzman, and Wittkamp, 2020).

Georgia's Accommodation and Foodservice Sector

According to the Georgia Hotels and Lodging Association (GHLA), the lodging and foodservice industries comprise the largest sector of small businesses in Georgia and are significant contributors to the state's economy. According to GHLA, Georgia has over 1,845 lodging properties that contain more than 168,000 rooms. Almost 10% of all jobs in the state are directly or indirectly related to the lodging industry that provides $3.7 billion in direct sales. The accommodations sector employs over 56,000 people and provides over $2.5 billion in total employee wages (GHLA, 2020).

Consequently, COVID-19 has devastated the Georgia hotel industry. STR's most recent reports shows that both Georgia and Atlanta. (the state's largest metropolitan statistical area) have suffered double-digit losses in both occupancy and room revenue. The 2020 STR June Monthly Review shows that, when compared to 2019, Georgia occupancy year to date (YTD) is down over 30% and room revenue is down 45% (STR Monthly Review, 2020). The 2020 STR Second Quarter Report also shows that Atlanta (Georgia's largest hotel market) is down almost 50% in occupancy and over 71% in room revenue compared to 2019 (STR, 2020b). According to the AHLA's most recent COVID-19 report, Georgia has lost 38,500 direct hotel-related jobs. Among the biggest, the Atlanta Marriott Marquis, Ritz Carlton on Lake Oconee and a hotel in Savannah laid off nearly 800, 440, and 244 employees, respectively (Williams, 2020).

Though the Georgia accommodations sector is impactful to the state's economy, the state's foodservices sector is significantly even larger. According to the Georgia Restaurant Association (GRA), the state is home to almost 19,000 eating and drinking places that have total sales in excess of $24.9 billion. Restaurant and foodservice jobs made up 15% of Georgia's employment prior to the pandemic and restaurants provide more than 500,000 statewide jobs (GRA, 2020a).

In May, it was reported that Georgia restaurants lost approximately $2.5 billion in sales since March 17 (McIntyre, 2020). As reported by Williams (2020), Oxford Economics claims the expected loss due to COVID-19 in tax revenue from the hotel industry in Georgia's state and local governments is over $335 million. The Cuebiq Visit Index (CVI), which measures store traffic according to U.S. NAICS codes, for March through May shows a 55% decline in the casual dining sector and a 29% decline in quick service restaurants (QSR) when compared to 2019 for the state of Georgia. Open Table (2020) reservations data during the same period indicates over an 80% decline in reservation dining for Georgia restaurants. Georgia Restaurant Association (GRA) Chief Executive Officer Karen Bremer stated that the COVID-19 crisis has been much worse for the group's members than past economic downturns and that some restaurants have closed for good (Miller, 2020). According to a NRA survey of Georgia restaurants, 84% of the operators indicated they have laid off or furloughed employees since March. The average reduction per restaurant was 80% of the total staff (GRA, 2020b). Because of the severity of the pandemic's impact on Georgia's accommodations and foodservices sector, our research objective was to measure the economic impacts of the COVID-19 pandemic on the state of Georgia's economy utilizing job loss data reported by the Georgia Department of Labor.

Methodology

The economic impacts of job losses in the leisure and hospitality industry attributable to the COVID-19 virus were estimated using the IMPLAN model. IMPLAN is a computer-based, input–output economic modelling system designed specifically to conduct economic impact analysis in use since 1979. IMPLAN is a widely applied and accepted tool for measuring the total economic impacts of tourism and other industries.

The IMPLAN model estimates the direct, indirect, and induced effects of hospitality- and tourism-related expenditures such as overnight hotel stays. The direct effects represent the initial spending by hotel guests in the local or state economy. The initial spending by hotel guests stimulates secondary spending in the economy. For example, when guests stay at a hotel, the hotel increases purchases of inputs needed to provide guest services—for example, food and beverages needed to provide room meal service. Food and beverage suppliers, in turn, need to purchase more inputs to provide more of their products to hotels. The "ripple effect" expenditures made by all business sectors in order to meet hotel guests' demands for goods and services are the indirect effects of hotel guest spending.

The additional economic activity stimulated by the direct and indirect effects hotel guest spending results in increased income in the local economy (for example, increased profit to business, increased wages, and more compensation to employees). As household incomes grow, households spend more money on goods and services, stimulating additional economic activity. This additional economic activity and its impacts represent the induced effects of hotel guest spending.

Ideally, the economic impacts of the COVID-19 pandemic on the leisure and hospitality industry would be measured by entering reductions in final demand for hotel guest services into IMPLAN. However, data on final demand changes (e.g., changes in final demand for hotel stays) were not readily available. Entering changes in jobs lost in the hospitality industry into IMPLAN is an alternative approach for estimating the direct, indirect, and induced effects of the COVID-19 virus on the Georgia's economy. The main advantage of this approach is that jobs and employment data are frequently reported (e.g., weekly, monthly) and are readily available from federal and state labor statistics sources such as the U.S. Department of Labor and the Georgia Department of Labor, which allows for a quick snapshot of the economic impacts of a rapidly changing event such as the COVID-19 pandemic.

The Georgia Department of Labor reports that approximately 187,500 jobs were lost in March and April in the accommodation and foodservices sector, which is part of the broader leisure and hospitality sector. For our model, we assumed that almost all of these job losses were due to COVID-19 travel restrictions and consumer concerns about being infected with the virus. For input into IMPLAN, the 187,500 job losses were disaggregated into sub-sectors as shown in Table 1. In Table 1, referred to as a Bridge Table, the "share" (percentage) of the total accommodations and foodservices sector, which is composed of a particular sub-sector (e.g., Industry Code 507, Hotels and Motels), comes from the Industry Detail data provided in the IMPLAN software/data sets.

Table 1. Bridge Table for Disaggregating March and April 2020 Employment Losses in the Accommodations and Food Services Sector into Industry Sub-Sectors for Input into IMPLAN.

Code	Industry Categories for Food & Accommodations	Share	State Total Unemployment Reported
507	Hotels and motels, including casino hotels	7.94%	-14883.03
508	Other accommodations	2.38%	-4471.39
509	Full-service restaurants	34.82%	-65296.35
510	Limited-service restaurants	38.67%	-72511.38
511	All other food and drinking places	16.18%	-30337.84
	Total	**100.00%**	**(187,500.00)**

The next step in estimating the economic impacts of employment losses was to enter the sub-sector employment losses shown in the fourth column of Table 1 as "event" changes in the corresponding sub-sectors in IMPLAN. The IMPLAN model then estimated the changes in labor income, value addition, and output in each sub-sector associated with the reduction in employment. Because IMPLAN automatically generates impacts from an "event" change on an annual basis, it was then necessary to divide the IMPLAN impact results by 12 to convert the annual impact estimates to a monthly basis. The two-month (March and April) impacts were then calculated by multiplying the monthly impact estimates by two.

Results

The estimated economic impacts on the State of Georgia economy in March and April associated with employment reductions in the accommodations and foodservices sector in these months are shown in Table 2. The total decrease in labor income in March and April was estimated at $1.4 billion. The total decrease in value addition in March and April was estimated at $2.3 billion. The total decrease in output in March and April was estimated at $4.3 billion.

Table 2. Economic Impacts on the State of Georgia Economy of Employment Reductions in the Accommodation and Food Services Sector in March and April 2020.

Impact Type (2 months)	Labor Income 2 months	Value Added 2 months	Output of 2 months
1 - Direct	(770,461,052.55)	(1,164,902,413.37)	(2,202,848,029.36)
2 - Indirect	(362,759,482.24)	(589,188,280.35)	(1,130,594,561.19)
3 - Induced	(308,622,517.68)	(575,406,915.88)	(989,152,501.54)
Total	(1,441,843,052.47)	(2,329,497,609.59)	(4,322,595,092.09)

The estimated changes in output by sub-sector in the State of Georgia in March and April associated with employment reductions in the accommodations and foodservices sector in these months are shown in Table 3. The total decrease in output during March and April in the hotel and motel sub-sector was estimated at $343 million. The total decrease in output during March and April in the “other accommodations” sub-sector was estimated at $103 million. The total decrease in output during March and April in the full-service restaurant sub-sector was estimated at $1.5 billion. The total decrease in output during March and April in the limited-service sub-sector was estimated at $1.7 billion. The total decrease in output during March and April in the “all other food and drinking places” sub-sector was estimated at $160 million.

Table 3. Changes in Output in the State of Georgia Economy by Sub-Sector Associated with Employment Reductions in the Accommodations and Food Services Sector, March and April 2020.

Impact Type (2 months)	Hotels and motels, including casino hotels	Other accommodations	Full-service restaurants	Limited-service restaurants	All other food and drinking places
Direct	$ (174,853,575.53)	$ (52,532,257.32)	$ (767,135,714.50)	$ (851,901,619.61)	$ (356,424,862.42)
Indirect	$ (89,742,233.17)	$ (26,961,771.13)	$ (393,726,419.14)	$ (437,231,858.47)	$ (182,932,279.28)
Induced	$ (78,515,108.32)	$ (23,588,741.96)	$ (344,469,614.29)	$ (382,532,343.07)	$ (160,046,693.90)
Total	$ (343,110,917.02)	$ (103,082,770.41)	$(1,505,331,747.92)	$ (1,671,665,821.14)	$ (699,403,835.60)

Conclusions

The $4-billion-plus total impact of the pandemic on Georgia for March and April is quite significant to the state's economy. Consequently, the 187,500 reported job losses had a broader effect that far exceeded their direct impact. The foodservices sub-sector carried almost 90% of the sector's job losses, as well as almost 90% of the total economic impact during March and April for the entire accommodation and foodservices sector.

Utilizing the Georgia Department of Labor job loss reports to estimate the total economic impact of the accommodation and foodservice sector is a quick-response examination of the pandemic's impact on state's economy. IMPLAN is often used to produce total impacts based on spending or final revenue demand for tourism. Given the limited real-time data resources depicting final demand for accommodations and foodservice, using this method to examine the pandemic's total impact is appropriate and allows for quick-response estimation of the economic impacts of a rapidly changing event such as the COVID-19 pandemic. In the future, we plan to estimate the economic impacts of the COVID-19 pandemic on the leisure and hospitality industry in Georgia using final demand (e.g., hotel room revenue) loss data.

A limitation of this study is that it utilizes IMPLAN's nationally aggregated I-O assumptions (such as employee productivity) whereas the national production functions embedded in the model can over- or underestimate the pandemic's total impact. A second limitation to the model is that it did not include any inputs related to the federal programs that were implemented, such as the Payroll Protection Program and the Pandemic Unemployment Assistance portion of the CARES Act which were intended to help business keep their workers on payrolls as well as keep nonworking employees paid.

Because the hotels and other accommodations and restaurants and other food services are located throughout the state, all regions in Georgia, both urban and rural, are being affected by reduced economic activity in these business sectors due to the COVID-19 pandemic. Future studies using the job loss methodology reported in this paper can provide a quick-response snapshot of the extent of business losses caused by a rapidly changing exogenous event such as a pandemic in specific regions of Georgia and in other states. Such information can help industry and government leaders make more informed and effective decisions needed to quickly adjust to unexpected, dynamic events such as a global pandemic or other exogenous events that affect economic activity (e.g., natural disasters).

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