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Engaging Consumers about the Nuances of Agricultural Technologies

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While most consumers are detached from the food system, there is a renewed interest in agricultural production practices. Consumer interest in production practices has led food companies to source differentiated commodities and display labels on packaging that communicate various production practices associated with a product. A food system that seeks to satisfy the desires of diverse consumer segments has changed the landscape for every actor in the food value chain, from input supplier to point of sale, and the way in which we must discuss commodities historically used as classic examples of homogeneous goods.

Some discussion around agricultural production practices is characterized by misinformation and even disinformation. This presents an opportunity to educate consumers about the nuances of agricultural production decisions through extension efforts. To this end, the Genetic Literacy Project launched a series called *GMO: Beyond the Science* in an effort to decrease information failures associated with genetically engineered (GE) food. The series, which was funded by the Center for Food Integrity, hoped to stimulate public discussion on genetic engineering through nuanced coverage of regulation, food security, sustainability, and consumer confusion.

A more nuanced discussion around issues like genetic engineering is necessary because simply providing information about safety from scientific organizations is not sufficient to win public trust. This deficit model assumes that consumer reluctance to accept GE persists because of a lack of information about safety. However, as recently pointed out by a National Academies of Sciences, Engineering, and Medicine (2017) report, "People rarely make decisions based only on scientific information…" Evidence confirms this point. While more than 280 scientific and technical institutions support the safety of GE food (Norero, 2017), beliefs about its safety of in the United States are fairly uniformly divided between safe, unsafe, and not sure (McFadden and Lusk 2015, 2016). Moreover, Funk and Rainie (2015) found that only 37% of U.S. consumers

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believe GE food to be safe to eat, compared to 88% of scientist members of the American Association for the Advancement of Science.

My contribution to *GMO: Beyond the Science* addressed the complex views of consumers regarding GE foods (McFadden, 2017). My research has indicated that the public has a widely distorted perception of agricultural production and what genetic engineering entails. It is possible these misperceptions can help explain why some consumers remain so reluctant to accept GE foods.

Some of the highlights from my contribution were:

- Consumers have misconceptions about genetics and planting GE varieties. Survey results showed that 34% of respondents thought that GE tomatoes contained altered genes and that non-GE tomatoes did not, and 32% thought fresh vegetables did not contain DNA at all. In addition, respondents thought that more than 50% of wheat acreage was planted to GE varieties, when in fact there is no GE wheat acreage (McFadden and Lusk, 2016).
- There are many reasons for developing GE foods, and consumers do not uniformly desire these reasons. Keeping crop production in the United States and lower food prices were significantly more desirable than saving farmers time or breeding herbicide-tolerant crops (Lusk, McFadden, and Rickard, 2015).
- Simple opinion polls are an unreliable signal for informing public policy about GE food. While 84% of consumers prefer mandatory labels for GE food, 80% also prefer labels for food containing DNA (McFadden and Lusk, 2016).
- Providing information from scientific organizations about the safety of GE food can backfire. Respondents who had believed GE food to be unsafe prior to receiving information were equally likely to think GE food was *less* safe or to think GE food was safer after receiving information (McFadden and Lusk, 2015).

We hoped that *GMO: Beyond the Science* would be informative to industry while at the same time pushing consumers to think critically about the false dichotomy often applied to discussions about the safety and value of GE foods. My contribution has been read 11,213 times on the Genetic Literacy Project website. The summary posted by Genetic Literacy Project on Facebook has reached 27,118 people; been clicked on 895 times; and received 688 reactions, comments, and shares.

Current and future consumer involvement in the food system presents an opportunity for consumer extension. Consumers have the purchasing power to shape production practices, and more education is needed so consumers can better understand the tradeoffs between various production practices. However, it is becoming increasingly apparent that education alone is not sufficient. Extension efforts should focus on innovative ways to engage consumers rather than simply providing information.

Acknowledgments

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Local Food Resource Mapping Project Update

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Project Overview

This is an update on a USDA-funded, multi-state research project that began in 2015 and is led by the Northeast Regional Center for Rural Development at Penn State University. Partners include other Regional Rural Development Centers, the USDA Agricultural Marketing Service, and Land Grant Extension personnel in Alaska, Arizona, Arkansas, Kentucky, Mississippi, and North Carolina. The aims of this project include assessing web-enabled state food system directories in pilot states, identifying and understanding the diverse set of stakeholders and their needs in local food systems, and facilitating the growth of business opportunities in the states by identifying information gaps in the local food system.

Preliminary Findings

Between July 2016 and June 2017, 27 focus groups (1–12 per state) were conducted in all 6 states and surveys were conducted in 4 states (Table 1). Both surveys and focus groups engaged a variety of stakeholders, including producers, farmers' market managers, restaurant and food service buyers, grocers, distributors, extension, agricultural support agencies, non-profits, college and university educators, and home consumers. The project identified several themes unique to specific states, including challenges to production, marketing, distribution, and purchasing of food. One example of variation across states is the perception of farmers' markets in terms of market opportunities for producers, which ranged from minimal to significant. While farmers'

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markets may be the only viable market for many small farmers in certain states, in other states, participants noted downward trends in attendance and sales over the past several years. Particularly noteworthy were several common themes identified across states, including challenges for farmers in accessing capital and training, access to wholesale markets, and food safety regulations as a barrier to entry in wholesale markets. Themes for buyer challenges across project states included lack of diversity of products available, cost, lack of consistency of product, and unawareness of how to find producers.

Table 1. Focus Groups and Surveys by State

State	Focus Groups	Focus Group Participants			Survey Respondents
		Total	% Min.	% Fem.	
Alaska	2	9	83	83	--[a]
Arizona	1	15	25	20	60
Arkansas	5	206	7	58	120
Kentucky	2	29	6	45	--[b]
Mississippi	12	134	34	49	81
North Carolina	5	60	2	43	154

Notes: [a]Not administered due to lack of broadband.
[b]Not administered due to respondent fatigue; covered in FG instead.

This project has several applied aims for the research output. At the state level, land grant partners are using survey and focus group data to reassess and develop programming to fill education and training gaps and better promote existing programs. At the federal level, the project is working with the USDA Agricultural Marketing Service to inform online curriculum and technical assistance resources, which may be used by producers, food systems practitioners, and future federal grant applicants and awardees.

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Exploring Supplier-Manufacturer Relationships in the Specialty Food Sector

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Abstract

We use results from a survey of specialty food manufacturers to examine how supplier–manufacturer relationships vary in the specialty food sector. While diverse mechanisms govern relationships between manufacturers and suppliers, relational contracts (longstanding, informal commitments) are the most common governance structure in our sample overall, particularly for

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medium-sized manufacturers. Vertical integration with the principal supplier is most common for smaller manufacturers, who also are most likely to use open market purchases. The largest manufacturers are significantly more likely to use formal contracts. Nearly half of manufacturers in our sample, regardless of their size, purchase directly from farms.

Keywords: small and medium-sized farms, supplier-manufacturer relationships, specialty food industry, specialty food manufacturers, value-added products

Introduction

As Sexton (2013) notes in his 2012 AAEA presidential address on modern agricultural markets, food products are often highly differentiated, and relationships among primary producers, distributors, manufacturers, and retailers are often governed by arrangements that foster vertical coordination. In this paper, we use results from a survey of specialty food manufacturers (SFMs) to more closely examine the nature of ingredient supplier–manufacturer relationships in the specialty food sector. This work is part of "Beyond Fresh and Direct," a USDA/NIFA-funded project focused on the following research question: As markets for direct to consumer sales of fresh products become saturated, are there opportunities for small and medium-sized farms to sell ingredients to SFMs or to produce specialty foods themselves?

The Specialty Food Association defines specialty foods as "foods and beverages that exemplify quality and innovation, including artisanal, natural, and local products that are often made by small manufacturers, artisans, and entrepreneurs from the U.S. and abroad." This sector is growing rapidly; in 2015, its combined U.S. retail and food service sales reached $120.5 billion, up 21.2% from 2013 (Tanner and Purcell, 2016). Sexton (2013) notes that modern agricultural markets have "a growing emphasis on product differentiation and increasingly broad dimensions of product quality" (p. 217); these trends are the hallmarks of the specialty food industry. Thus, the specialty food sector serves as an excellent vantage point for understanding modern agricultural markets.

Literature Review

Sexton (2013) argues that modern agricultural markets differ significantly from the ideal of perfect competition and yet do not perform in a manner consistent with predictions based on analyses of oligopoly/oligopsony power. These markets are highly concentrated in the processing and retail segments of the supply chain, yet processors and retailers do not exercise significant market power. In addition, the need for assured supplies of differentiated farm inputs encourages repeat purchases from suppliers. Although Sexton does not use the term "relational contracts," the stylized facts he identifies for the operational strategies of food manufacturers and retailers suggest that relational contracts (MacNeal, 1974, 1978; Klein and Leffler, 1981; Levin, 2003; MacLeod, 2007) are likely to play a significant role in modern agricultural markets. The key features of a relational contract are: i) buyers and sellers trade repeatedly yet generally do not have a formal contract; ii) they trade at a fixed price or price premium with specific quality and quantity requirements that may be adjusted over time by mutual agreement; and iii) the

relationship ends if either the buyer or seller reneges (MacLeod, 2007). These features imply that in many cases we should expect to see stable manufacturer–supplier relationships, with ingredients trading at prices above commodity prices and with terms of trade enforced by informal mechanisms rather than formal contracts.

Based on results from MacLeod's (2007) formal model, we hypothesize that relational contracts will be most likely when ingredient requirements are idiosyncratic. For ingredients purchased directly from farms, relational contracts may be more likely for medium-sized manufacturers because their size is better matched with that of typical farms. In contrast, as price becomes more important and as volumes increase, formal contracts may be more efficient. We use data from a survey of SFMs to investigate these hypotheses about the choice of manufacturer–supplier governance mechanisms in modern agricultural markets.

Methods

We conducted a survey of SFMs during 2015. The target population was 940 specialty food businesses in California, Minnesota, Oregon, Washington, and Wisconsin, identified through directories, web searches, and government lists. We limited the list to firms selling products in four broad categories: dairy; grain and baked goods; processed meats; and processed fruit, vegetables, nuts, and herbs. We received 266 responses, with 240 of them useable for analysis.

The first section of our survey instrument included questions on foods produced, modes of distribution, annual sales, years selling products produced with the key ingredient, types of suppliers, and SFMs' criteria for choosing suppliers for their key ingredient. The second section focused on the nature of the firm's relationship with its principal ingredient supplier. It included questions on the type of supplier, the mechanism governing the relationship with the principal supplier, and the duration of that relationship. A more complete compilation of survey results and a copy of the survey instrument are presented in King et al. (2017).

Results

In our sample, the most common key ingredient category was fruit/vegetables/nuts/herbs (48%), followed by milk (24%), grain (19%) and meat (9%). We divided the SFMs into three size categories: i) small, with annual sales less than $500,000; ii) medium, with annual sales between $500,000 and $4,999,999; and iii) large, with annual sales of $5,000,000 or more. The majority of respondents were small (61%), followed by medium (22%) and large (17%). Table 1 shows principal supplier types for firms grouped by key ingredient. While a distributor is the most common principal supplier type overall, direct purchases from farms and procurement from a farm owned by the company are almost as common. The distributions of principal supplier types across ingredient categories are significantly different at the 0.01 level. When grain is the key ingredient, procurement is much more likely to be from a distributor or manufacturer, perhaps because grain has standardized grades and can be blended to meet specific quality standards. Approximately 70% of firms identifying milk as their key ingredient procure it directly from farms or farmer cooperatives. Firms with fruit/vegetable/nuts/herbs as their key ingredient are most likely to source from a distributor or purchase direct from a farm. Finally, firms that list

Table 1. Principal Supplier Type of Specialty Food Manufacturers, by Key Ingredient Category

	Key Ingredient				
Principal Supplier Type	**Milk**	**Grain/ Flour**	**Meat**	**Fruit/Vegetable/ Nuts/Herbs**	**Overall**
Distributor	9%	46%	29%	29%	27%
Direct purchase from farm(s)	32%	9%	24%	29%	25%
Farm owned by our company	26%	6%	33%	23%	22%
Manufacturer	14%	24%	9%	4%	11%
Farmer cooperative	12%	2%	0%	6%	6%
Other	4%	9%	5%	6%	6%
Co-packer	3%	4%	0%	3%	3%

Notes: The distributions of principal supplier types across firms grouped by key ingredient are significantly different from the overall distribution at the 0.01 level.

meat as their key ingredient are the most likely to have a farm owned by the firm as a principal supplier.

Table 2 shows principal supplier types for firms grouped by annual sales. The distributions of principal supplier types across sales categories are significantly different at the 0.01 level. The percentage of SFMs that identify a farm owned by their company as their principal supplier declines fairly steadily as annual sales increase. However, farms are principal suppliers (the sum of supplier types "farm owned by our company" and "direct purchases from farms") of about 46% across the three SFM sales categories. Firms in the two smallest sales categories often rely on a distributor as a principal supplier; they may be too small to buy significant quantities of ingredients from farms or farmer cooperatives.

Table 2. Principal Supplier Type of Specialty Food Manufacturers, by Sales Category

	Annual Sales			
Principal Supplier Type	**< $500,000**	**$500,000– $4,999,999**	**≥ $5,000,000**	**Overall**
Distributor	31%	25%	15%	27%
Direct purchase from farm(s)	18%	31%	41%	25%
Farm owned by our company	28%	17%	5%	22%
Manufacturer	10%	15%	8%	11%
Farmer cooperative	2%	10%	18%	6%
Other	9%	0%	5%	6%
Co-packer	2.9%	1.9%	7.7%	3%

Notes: The distributions of principal supplier types across firms grouped by annual sales revenue are significantly different from the overall distribution at the 0.01 level.

We consider SFMs that identify a farm they own as their principal supplier to be vertically integrated. We asked firms that were not vertically integrated to characterize their relationship with their principal supplier. SFMs in the highest sales category are most likely to have formal

Table 3. Relationship of Specialty Food Manufacturers with Principal Supplier, by Sales Category

Relationship with Principal Supplier	Annual Sales			Overall
	< $500,000	$500,000–$4,999,999	≥ $5,000,000	
Relational contract	26%	50%	26%	32%
Formal contract	11%	23%	66%	23%
Open market purchase	34%	10%	3%	23%
Vertical integration	28%	17%	5%	22%
Other	1%	0%	0%	0%

Notes: The distributions of principal supplier relationships across firms grouped by annual sales revenue are significantly different from the overall distribution at the 0.01 level.

contracts and are much less likely than smaller firms to be vertically integrated (Table 3). Relational contracts are the most common form of relationship for the midsize SFMs. The smallest SFMs are most likely to make open market purchases. The distributions of principal supplier relationships across annual sales categories are significantly different at the 0.01 level.

The duration of a firm's relationship with its principal supplier is also important for understanding the relationships SFMs have with their suppliers. SFMs' responses indicated that 72% of firms that were not vertically integrated had been sourcing their key ingredient from their current key ingredient supplier for as long as they had been selling products made with the key ingredient. Once trusting relationships are formed, they tend to last.

We also asked respondents to rate the importance of thirteen factors considered in choosing suppliers for their key ingredient. There were several interesting differences in responses for firms grouped by their relationship with their principal supplier; Table 4 presents percentages of SFMs rating a subset of these factors as "very important." Quality and food safety practices are the most important factors across all relationship types. However, price is significantly less likely to be rated "very important" by firms that are vertically integrated and by firms that have relational contracts with their principal supplier. Conversely, "stories" about ingredients that can be used in marketing are considerably more important for SFMs that are vertically integrated or have relational contracts with their principal supplier.

Conclusions

In this paper we examine relationships between SFMs and their ingredient suppliers. We assert that these relationships often take the form of relational contracts characterized by repeated transactions governed by informal enforcement mechanisms. We find that SFMs use a variety of mechanisms to govern their relationships with suppliers. These range from vertical integration to open market purchases, but relational contracts are the most common governance form for firms in our sample.

Medium-sized SFMs are more likely to use relational contracts. As SFMs' sales increase, they are significantly more likely to use formal contracts. Price is also more important for firms using

Table 4. Very Important Factors in Choosing a Supplier for Firms Categorized by Relationship with Principal Supplier

	Relationship with Principal Supplier				
Very Important Factors in Choosing Suppliers	**Vertical Integration**	**Formal Contract**	**Relational Contract**	**Open Market**	**Overall**
Quality	86%	93%	93%	80%	87%
Food safety practices	73%	81%	71%	75%	75%
Year-round availability	53%	74%	62%	71%	65%
Price[a]	49%	76%	53%	73%	62%
Local or regional sources	69%	63%	58%	49%	59%
Convenience of logistics	43%	41%	39%	40%	41%
Non-GMO certification	37%	30%	33%	25%	31%
"Stories" about ingredients[a]	53%	22%	32%	13%	30%
Organic certification	22%	25%	22%	18%	22%
Gluten-free certification	10%	22%	14%	20%	17%

Notes: [a]Importance of this factor differs significantly across relationship categories at the 0.01 level.

formal contracts and for firms making open market purchases. Finally, many of the SFMs in our sample are vertically integrated; this is most likely for smaller firms and for firms that use stories about ingredients in marketing their finished products.

This study points to the need for more analytical and empirical research on supply chain relationships in modern agricultural markets. Analytical work should focus on integrating models of relational contracts, such as those presented by Levin (2003) and MacLeod (2007), into the model of modern agricultural markets proposed by Sexton (2013). Empirical work should focus on investigation of supply chain relationships in other sectors within the food system to determine whether relational contracts are common in other settings and on the design and implementation of more sophisticated empirical strategies that make it possible to identify causal factors underlying the choice of supplier-manufacturer relationships.

Finally, though not the focus of this paper, our survey results show that there are significant opportunities for farms to directly supply ingredients to SFMs. More than 45% of firms in our sample identify a farm—either owned by or distinct from the SFM itself—as the principal supplier for their key ingredient. Thus, it is important for farms interested in becoming ingredient suppliers to SFMs to understand how such relationships can be established and nurtured.

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Is Local Produce Really More Expensive? A Comparison of Direct Market and Conventional Grocery Produce Pricing

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Abstract

As fresh produce growers look to expand their markets to include lower-income consumers, they must overcome consumer perceptions that direct markets, such as farmers' markets, are expensive and elitist. The absence of pricing data makes comparisons very difficult, which perpetuates misconceptions. This study uses fresh produce pricing data collected at farmers' markets and grocery stores in northern Utah in Summer 2016 to illustrate actual pricing differences across outlets. Results show that, on average, farmers' markets are more expensive, but location and produce item greatly influence price, especially for organics. Locally owned grocery stores were less expensive than national brands.

Keywords: direct markets, fresh produce, grocery outlet, local, price comparisons

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Introduction

While consumer demand for fresh produce at direct-to-consumer marketing channels such as farmers' markets and community supported agriculture (CSA) programs has increased greatly over the last two decades, growth in direct markets has slowed since 2012. Thus, produce growers focusing on direct markets are now seeking new customers and additional market outlets, including winter farmers' markets, agritourism opportunities, and value-added foods. (Debnath, Curtis, and Slocum, 2015). Increasing the customer base at direct markets to include more price-sensitive and lower-income families, such as those on federal assistance programs, could greatly enhance the ability of direct markets to provide a sustainable source of revenue for producers. However, there is a common misconception that produce at direct markets is more expensive than in grocery stores, when, in fact, this is often not the case (Estabrook, 2011).

Although the consumption of fruits and vegetables has been shown to have significant health benefits, the typical U.S. diet does not meet the recommended intake of fruits and vegetables. This is especially true for the low-income population (Quandt et al., 2013). If consumption patterns are to change, it is important that consumers, especially those on federal nutrition assistance program, recognize that healthy food is not necessarily more expensive (Carlson and Frazão, 2012).

This study seeks to illustrate actual pricing differences between farmers' markets and grocery stores by comparing fresh produce pricing as well as comparing organic and conventionally grown produce pricing in northern Utah. Accurate cross-outlet fresh produce pricing information will dispel potential myths regarding prices at direct markets and those of organic foods as well. Increased direct market produce purchases may positively affect consumer health as well as the financial security of fresh produce growers.

Background and Previous Literature

U.S. residents do not consume the recommended amounts of fresh produce, and intake has declined in recent years (Lorson, Melgar-Quinonez, and Taylor, 2009; Slining, Mathias, and Popkin, 2013). This trend is concerning, as diets high in fruits and vegetables are naturally high in nutrients and low in energy, resulting in a reduced risk for obesity and related chronic diseases. Several studies have found that a diet high in fruits and vegetables is associated with lower risk for central obesity (Bradlee et al., 2010), and one dietary intervention for obesity showed that increasing fruit and vegetable intake was more effective than decreasing fat and sugar (Epstein et al., 2001).

In an effort to increase consumption of fruits and vegetables among the lower income population, the U. S. Department of Agriculture (USDA) has made funds available for Supplemental Nutrition Assistance Program (SNAP) participants to shop at farmers' markets. This program has seen significant improvement over the years. There has been an 829% increase in SNAP-authorized farmers' markets (753 markets in 2008 to 6,996 in 2016) and a 638.5% increase in redemptions ($2,740,236 in 2008 to $20,235,869 in 2016) (USDA, 2017). In Utah, there are currently 31 SNAP-authorized farmers' markets, a 675% increase since 2008, and

SNAP redemption at farmers' markets increased from $5,667 in 2008 to $75,428 in 2016 (Food and Nutrition Service, 2016; USDA, 2017).

Previous literature has primarily examined the cost differences between healthy and unhealthy foods (Carlson and Frazão, 2012; Polis, 2013), and a few state-based studies have examined costs differences between farmers' markets and grocery stores (de Figueiredo, 2010; Estabrook, 2011; Pesch and Keeler, 2015). In general, the state-based studies have found that farmers' market pricing is generally lower than grocery stores for comparable products, especially when a particular item is in season (Claro, 2011; Pesch and Keeler, 2015). The lack of national comparison studies is primarily due to the absence of pricing data for goods sold through direct markets. The USDA Agricultural Marketing Service (AMS) provides pricing data on fresh produce and even organic produce at retail and wholesale markets nationally and regionally but not for fresh produce sold through direct markets, with the exception of selected farmers' market and auction data for six U.S. states, primarily in the Southeast. Hence, there is very little public information for consumers or producers regarding direct market outlet pricing. The lack of data makes comparisons for consumers very difficult, and, consequently, consumers fall back on previous habits (Pollak, 1976), such as shopping only at selected stores and making decisions based upon biased perceptions (Kahneman, 2011). This study provides important insights into the true differences in fresh produce prices across outlets and locations in Utah.

Methods

Data collection was completed from June to October 2016 at four different farmers' markets across northern Utah and seven local and national grocery stores in the vicinity of the farmers' markets. Prices for 33 different fresh produce items were collected over the 2016 season; of those, 28 items were used in this analysis. Produce item price and average weight were collected. When the weight of an item was not available, the national average was used. The sample includes 938 farmers' market and 4,600 grocery store fresh produce price observations.

Prices were normalized to a dollar amount per pound ($/lb) for each produce item, which was then applied to the national average weight of each produce item. This allows for the comparison across markets for a "basket of produce."[1] The price comparisons were completed using a simple difference in means analysis on individual produce items, as well as for a "basket of produce." Statistically significant differences are reported at the 90%, 95%, and 99% levels. Comparisons were made between grocery store and farmers' market pricing and also by production type (organic vs. conventional), as well as between farmers' market locations and local versus national grocery chains. The analysis was conducted at the regional level using the average price over the entire season. Later, a hedonic price model will be used to assess which components of the fresh produce item including type of production (conventional vs. organic), market type (farmers' market vs. grocery, locally owned vs. national chain), and market location (city, rural, urban) are the most valued by consumers.

[1] Common basket of 14 produce items often purchased in the United States. See Table 2 for a listing.

Results

Table 1 provides a per pound comparison of 28 fresh produce items at farmers' markets and grocery stores for both conventional and organic produce. The price differences for conventional produce range from -173% to 57%, with a negative percentage indicating the farmers' market is more expensive. The most expensive item at a farmers' market relative to a grocery store is romaine lettuce. On average, a pound of romaine will cost an additional $1.65 at the farmers' market. Conversely, a pound of zucchini at the farmers' market is, on average, $0.83 less expensive than at the grocery stores.

Table 1. Grocery Store vs. Farmers' Market Comparison by Produce Item

	Conventional			Organic		
Item	Grocery Store ($/lb.)	Farmers' Market ($/lb.)	Difference	Grocery Store ($/lb.)	Farmers' Market ($/lb.)	Difference
Beets	$1.21	$1.12	8%	$1.55	$2.51	-63%***
Broccoli	$1.46	$2.30	-58%***	$2.06	N/A	N/A
Cabbage, Green	$0.81	$1.03	-27%	$1.61	$2.00	-24%
Cabbage, Red	$0.99	$1.00	-1%	$1.51	$1.50	1%
Cantaloupe	$0.52	$0.80	-52%***	$0.85	N/A	N/A
Carrots	$0.80	$1.74	-117%***	$1.26	$2.14	-70%***
Cucumbers, Normal	$1.22	$0.93	24%***	$2.45	$1.64	33%
Garlic	$3.47	$7.18	-107%***	$3.79	$5.44	-43%
Green Beans	$2.17	$2.76	-27%***	$4.27	$3.01	30%***
Bell Peppers, Green	$1.60	$1.25	22%***	$3.02	$2.33	23%
Mixed Greens	$3.95	$5.27	-33%***	$6.38	$6.00	6%
Onions, Red	$1.41	$2.15	-52%***	$2.09	$3.03	-45%**
Onions, White	$1.12	$1.12	0%	$1.51	$1.67	-10%
Onions, Yellow	$0.77	$1.09	-42%***	$1.31	$1.90	-46%*
Potatoes, Gold	$1.09	$1.22	-12%***	$1.13	$2.03	-81%
Potatoes, Red	$0.92	$1.41	-53%***	$1.18	$2.24	-90%*
Potatoes, Russet	$0.69	$0.99	-43%***	$1.36	$2.50	-84%
Potatoes, Sweet	$1.66	$1.00	40%*	$1.90	N/A	N/A
Raspberries	$8.66	$7.53	13%**	$11.39	N/A	N/A
Romaine Lettuce	$0.95	$2.60	-173%**	$1.51	$2.79	-85%***
Spinach	$1.74	$4.17	-140%***	$3.93	$4.55	-16%
Strawberries	$2.63	$5.57	-112%***	$3.69	$9.33	-153%***
Sweet Corn	$0.42	$0.36	15%***	$0.53	$0.44	16%***
Tomatoes, Cherry	$4.71	$3.59	24%***	$4.89	$8.35	-71%***
Tomatoes, Roma	$1.09	$1.37	-26%***	$1.52	$2.50	-65%***
Tomatoes, Slicing/Vine	$1.66	$1.42	15%*	$2.47	$2.50	-1%
Watermelon	$0.43	$0.41	5%	$0.31	N/A	N/A
Zucchini	$1.45	$0.62	57%***	$3.07	$3.26	-6%

Notes: Single, double and triple asterisks (*, **, ***) indicate 10%, 5%, and 1% significance.

Of the 23 conventional produce items with statistically significant price differences, eight were less expensive at the farmers' market. There were fewer statistically significant price differences for organic produce. Generally, organics are less expensive at the grocery store, but this may be due in part to the lack of organic produce at the Utah farmers' markets. On average, 1 lb of organic strawberries cost $9.33 at the farmers' market and $3.69 at a grocery store ($5.64 premium at the farmer's market). One pound of organic sweet corn is statistically less expensive at the farmers' markets, but the cost savings is minimal, at $0.09 per pound.

Table 2 and Figure 1 compare an organic and a conventional "basket of produce" at farmers' markets and grocery stores. Prices are based on the average weight of the produce item. The conventional farmers' market basket is priced at $35.93, and the grocery store basket is priced at $30.53. The farmers' market basket is 17% more expensive relative to the grocery store basket. The most significant price difference is for a bundle of spinach, which is priced at $1.30 at a grocery store and $3.13 at a farmers' market (140% increase in price).

Table 2. Grocery Store vs. Farmers' Market Comparison – Conventional Basket of Produce

	Basket Items	Average Weight	Grocery Store Price	Farmers' Market Price	Difference
1 head	Broccoli	0.5 lb	$0.73	$1.15	-58%
1 head	Cabbage, Green	2 lb	$1.62	$2.07	-27%
2 each	Cucumbers, Normal	0.62 lb	$1.52	$1.15	24%
2 each	Bell Peppers, Green	0.5 lb	$1.60	$1.25	22%
1 bag	Mixed Greens	5 oz	$1.24	$1.65	-33%
2 each	Onions, White	12 oz	$1.68	$1.68	0%
5 lb	Potatoes, Gold	5 lb	$5.44	$6.08	-12%
2 lb	Potatoes, Red	2 lb	$1.85	$2.83	-53%
1 bunch	Spinach	12 oz	$1.30	$3.13	-140%
1 carton	Strawberries	1 lb	$2.63	$5.57	-112%
1 pint	Tomatoes, Cherry	10.5 oz	$3.09	$2.36	24%
1 lb	Tomatoes, Slicing/Vine	1 lb	$1.62	$1.42	12%
1 each	Watermelon	13 lb	$5.58	$5.31	5%
1 each	Zucchini	7 oz	$0.63	$0.27	57%
	Total Price		**$30.53**	**$35.93**	**-17.66%**

Notes: Significance level: 95%

The price comparison of an organic "basket of produce" (Figure 1) shows that the total price of the basket at a grocery store was $40.21, whereas the same basket was priced at $51.05 at a farmer's market (27% more expensive). A carton of organic strawberries has the biggest price difference: farmers' market organic strawberries are, on average, $5.64 more expensive than organic strawberries bought at a grocery store. Organic gold potatoes also had a significant price difference. In contrast, there are few organic produce items that are on average less expensive at farmers' markets, including cucumbers, green bell peppers, and mixed greens. The supply of

Figure 1. Farmers' Markets vs. Grocery Store Comparison – Basket of Fresh Produce

Figure 2. National vs. Local Grocery Comparison – Basket of Fresh Produce

organic produce in the northern Utah farmers' markets is fairly sparse, so most of the organic produce data came from the Salt Lake City Downtown Farmers' Market, which was the most expensive.

Table 3 shows the average prices for a conventional basket of produce across the different farmers' markets. Several produce items were unavailable in some of the markets, so a total basket price comparison is not possible. However, looking at each produce item individually, the Kaysville farmers' market is generally the least expensive market, and the Salt Lake City farmers' market is on average more expensive for 9 out of 14 produce items.

Table 4 shows the price comparison of the eight grocery stores where data collection took place. The data were averaged for the two Walmart locations and also for the Smith's Grocery locations. Rancho Market, a locally owned store, has the lowest prices for produce overall, and was the least expensive for seven out of the 12 produce items. However, some of the produce items were unavailable, as it is shown in the table. Although Lee's Marketplace, another local store, did not have the lowest price for any individual item, it was the second least expensive grocery store. The price differences between local and national grocery stores were not statically significant for organic or conventional produce (Figure 2).

Conclusions

We find that farmers' markets are in general more expensive than grocery stores in northern Utah. However, for specific produce items, farmers' markets can be just as competitive or even less expensive than grocery stores. Prices for organic produce tend to be higher at farmers' markets. It's important to point out that the farmers' market prices in our sample varied greatly by location, and the farmers' market basket at two of the four market locations was less expensive than at seven of the eight grocery stores. Hence, location can make a large difference

Table 3. Farmers' Market Comparison – Conventional Basket of Produce

	Basket Items	Average Weight	Kaysville	Logan	Ogden	SLC
1 head	Broccoli	0.5 lb	$0.33	$1.33	N/A	$0.50
1 head	Cabbage, Green	2 lb	N/A	$2.09	N/A	$2.00
2 each	Cucumbers, Normal	0.62 lb	$0.95	$1.03	$1.44	$1.26
2 each	Bell Peppers, Green	0.5 lb	$0.87	$1.47	$1.44	$1.08
1 bag	Mixed Greens	5 oz	N/A	$1.29	$4.00	$1.80
2 each	Onions, White	12 oz	$1.18	$1.37	$2.91	$0.99
5 lb	Potatoes, Gold	5 lb	$5.63	$6.44	N/A	$5.67
2 lb	Potatoes, Red	2 lb	$2.01	$2.67	$3.00	$3.76
1 bunch	Spinach	12 oz	N/A	$2.99	N/A	$3.75
1 carton	Strawberries	1 lb	N/A	$4.95	$5.25	$9.33
1 pint	Tomatoes, Cherry	10.5 oz	$1.79	$2.81	$2.10	$2.84
1 lb	Tomatoes, Slicing/Vine	1 lb	$1.16	$1.34	$1.36	$1.77
1 each	Watermelon	13 lb	$3.54	$5.51	$5.69	$5.59
1 each	Zucchini	7 oz	$0.20	$0.27	$0.26	$0.33
	Total Price		**$17.65**	**$35.55**	**$27.46**	**$40.67**

Table 4. Grocery Store Comparison – Conventional Basket of Produce

	Basket Items	Avg. Weight	Harmon's	Lee's Mktplace	Smith's Grocery	Target	Walmart	Rancho Market
1 head	Broccoli	0.5 lb	$0.79	$0.68	$0.63	$1.02	$0.86	$0.63
1 head	Cabbage, Green	2 lb	$1.45	$1.53	$1.19	$1.77	$2.60	$1.35
2 each	Cucumbers, Normal	0.62 lb	$1.53	$1.62	$1.54	$2.03	$1.40	$1.18
2 each	Bell Peppers, Green	0.5 lb	$1.97	$1.51	$1.61	$1.80	$1.39	$1.52
1 bag	Mixed Greens	5 oz	$1.41	$1.40	$1.25	$0.97	$0.74	N/A
2 each	Onions, White	12 oz	$1.38	$1.50	$1.88	$1.80	$1.59	$0.75
5 lb	Potatoes, Gold	5 lb	$4.85	$4.23	$4.95	$4.95	$3.72	$4.95
2 lb	Potatoes, Red	2 lb	$1.80	$1.62	$2.15	$2.02	$1.49	$1.67
1 bunch	Spinach	12 oz	$1.10	$1.72	$1.36	$1.47	$1.40	$1.07
1 carton	Strawberries	1 lb	$3.89	$2.55	$2.79	$2.63	$2.31	$1.39
1 pint	Tomatoes, Cherry	10.5 oz	$3.25	$3.40	$3.19	$3.22	$3.09	N/A
1 lb	Tomatoes, Slicing/Vine	1 lb	$1.61	$1.46	$1.63	$2.58	$1.87	$1.01
1 each	Watermelon	13 lb	$4.49	$5.09	$6.59	$4.99	$6.45	$3.41
1 each	Zucchini	7 oz	$0.57	$0.67	$0.56	$0.69	$0.88	$0.44
	Total Price		**$30.09**	**$28.98**	**$31.31**	**$31.94**	**$29.79**	**$19.37**

Notes: Harmon's, Lee's Marketplace, and Rancho Market are local stores.

in pricing. Finally, fresh produce at local grocery stores is less expansive that at national chains, but the price differences are not statically significant. Hence, large chains such as Walmart are not necessarily less expensive, as is commonly thought. Fresh produce can be found at local grocery stores and at some farmers' markets for competitive prices.

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Factors Affecting Frequency of Fast Food Consumption

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Abstract

Progress in science, technology, and industry has changed human lifestyle and especially food consumption habits. For many families, especially in large urban centers, fast food consumption has become routine. To determine factors affecting the frequency of fast food consumption, this study surveyed 396 families using Poisson and negative binomial regression models. The main reasons that households consume fast food are a shortage of time and for entertainment. Policy makers could use social marketing tools to control the growing trend of fast food consumption.

Keywords: consumption, fast food, health, marketing tools, nutrition

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Introduction

All societies, especially in urban areas, face changes in transportation, communication, nutrition, and health that affect lifestyle and eating habits. Since the 1950s—when fast food entered markets—hamburgers, pizza, french fries, and other foods that can be prepared and served quickly at relatively low prices have become more and more popular (Song, 2016).

Fast food consumption has the potential to be harmful to human health. Afolabi, et al. (2013) showed that fast foods are concentrated sources of energy, low in fiber and high in dietary cholesterol, and could significantly contribute to dietary cholesterol intake, with implications for cardiovascular health. In addition, the amount of salt in fast food increases the risk of heart attacks, and consumption of fast food and high-calorie condiments such as carbonated beverages and sugary sauces double the effects of such foods.

A report by the World Health Organization (WHO)'s International Agency for Research on Cancer (WHO, 2015) indicated that there was enough evidence to consider processed meats to be group 1 carcinogens because of a causal link with colon cancer. The IARC's experts concluded that each 50 g (1.8 oz) portion of processed meat eaten daily increased the risk of colorectal cancer by 18%.

The labels people attach to fast food are always "high in calories," "low in nutritional value," "obesity," and "additives" (Song, 2016). Despite widespread knowledge about the harmful effects of fast food on human health, the demand for fast food restaurants is still growing.

Many studies have investigated factors that affect people's tendency to consume fast food (Park, 2004; Sahagun and Vasquez-Parraga, 2014, Song, 2016). Given the important role of fast food consumption on obesity, cardiovascular problems, and other related diseases, this study attempts to investigate the main factors affecting the frequency of fast food consumption by households in a month in the city of Mashhad in Iran.

Literature Review

Even though some consumers are aware of the consequences of consuming fast food, fast food consumption is increasing around the world (Xue et al., 2016). Hearst et al. (2013) showed that frequent consumption of fast food menu items high in fat, sugar, and sodium contribute to poor dietary quality, increasing individuals' risk for diet-related chronic diseases. Consumption of fast food has been associated with food safety problems in some developing countries (Omari and Frempong, 2016). Socioeconomic and demographic variables such as age, education, income, hours spent at work, and the number of household members have significant effects on the probability of consuming fast food (Fanning, Marsh, and Stiegert, 2002). Fast food is relatively cheap, less time consuming, and tasty, and these advantages incentivize consumers to increase consumption.

Austin et al. (2005) showed that fast food sales increased 900% between 1975 and the mid-2000s: from $16 billion to $153 billion. Advertising and branding are powerful tools that affect food choices (Christian and Gereffi, 2010); children are often targeted by fast food marketing

messages. Lee and Lien (2015) concluded that fast food advertising and other marketing tools positively influence fast food consumption and that fast food advertisers make profits at the expense of children's health.

Social marketing—the application of marketing principles, tools, and techniques to influence socially desirable behaviors in a target audience—is one potential solution for controlling the growing consumption of fast food (Lee and Kotler, 2015). Carins and Rundle-Thiele (2014) showed that social marketing can promote healthy eating and the effectiveness of social marketing on healthy eating could be enhanced.

Few studies have addressed consumers' preferences for fast food consumption in developing countries such as Iran. This research analyzes factors affecting the frequency of fast-food consumption of products like hamburger and sausage in Mashhad, the capital of Iran's Khorasan Razavi province. Mashhad is the second largest city in Iran, with a population of around 3.2 million in 2016. We hypothesize that socioeconomic and marketing factors contribute to the frequency of fast food consumption. This study investigates the consumption frequency of fast food among Mashhadi households over the course of a month using Poisson and negative binomial regression models and considers the effects of marketing tools on consumption frequency.

Methodology

This research investigates the factors affecting frequency of monthly fast food consumption among Mashhadi households. Hence, the dependent variable is a count variable showing the number of times each household purchases and consumes fast food. The use of linear regression models for count outcomes can result in inefficient, inconsistent, and biased estimates (Long and Freese, 2001), but there are models that deal explicitly with properties of count outcomes such as the Poisson regression model. With this model, a Poisson distribution determines the probability of a count, and the mean of the distribution is a function of the explanatory variables. The conditional mean of the outcome is equal to the conditional variance. If conditional variance exceeds the conditional mean, then the negative binomial regression (NBR) model is used (Long, 1997). This method can be used when the objective is the description of a count variable with some explanatory variables.

After some assumptions and calculations, the NBR model can be estimated by maximum likelihood (ML) method. The likelihood equation is

$$(1) \qquad L(\beta \mid y, X) = \prod_{i=1}^{N} \Pr(y_i \mid x_i) = \prod_{i=1}^{N} \frac{\Gamma(y_i + \alpha^{-1})}{y_i!\Gamma(\alpha^{-1})} \cdot \left(\frac{\alpha^{-1}}{\alpha^{-1} + \mu_i}\right)^{\alpha^{-1}} \left(\frac{\mu_i}{\alpha^{-1} + \mu_i}\right)^{y_i},$$

where $\mu = \exp(x\beta)$, $\upsilon_i = \alpha^{-1}$ for $\alpha > 0$, and υ_i is the mean of the gamma (Γ) distribution for δ_i. After taking logs, the log-likelihood equation can be maximized using numerical methods (Long, 1997). The NBR model is one of a class of models constructed by mixing the Poisson distribution with a second distribution (Γ), while other distributions and mixtures can also be

used. Finally, we use factor change to interpret the results of the Poisson regression model (PRM) or the NBR model.

The data used in this study were collected through field study in 2016. The sample size was determined and stratified random sampling was used to sample 13 regions of Mashhad, based on the classification of urban areas by the Municipality of Mashhad.

Results

The dependent variable is the frequency of fast food consumption by households in a month. The explanatory variables and their description are listed in Table 1.

Table 1. Model Variables and Descriptions

Variable	Description
Gender of household head	Women =0, men=1
Education level	Years education of household head
Income	Household's monthly income
Composition awareness	Awareness about composition, nutritional value, production methods, and ingredients of fast food (aware=1, not aware=0)
Spouse occupation	Employed =1, not employed=0
Other meat consumption	Amount of other meat consumption in a month
Availability	Effect of availability on consumption (low=0, high=1)
Quality	Effects of quality on consumption (low=0, high=1)
Age	Age of respondent
Advertising	Effects of advertising (low=0, high=1)
Informative label	Effect of label on consumption (low=0, high=1)
Price	Effect of price on consumption (low=0, high=1)

Table 2 presents the main reasons and priorities that households gave for consuming fast food products (sausages, salami, and hamburgers). Entertainment was listed as the main reason (first and second priority) for 52% of respondents. Shortage of time was listed as the main reason by 50% of respondents. Hence, the most common cause of fast food consumption—such as sausages and hamburgers—by Mashhadi households are entertainment and shortage of time.

The results of Poisson regression and NBR models are shown in Table 3. Comparing the goodness-of-fit measures, the NBR model performs better than the Poisson model. Considering that the variance of consumption frequency is larger than its average, the NBR model is selected and hence, only the coefficients of the NBR model are interpreted.

Table 2. Main Reason for Fast Food Consumption by Households

Main Reason	Priority	1	2	3	4	Other
Shortage of time	Frequency	147	52	34	39	124
	Percentage	37%	13%	9%	10%	31%
Taste and flavor	Frequency	77	78	65	46	130
	Percentage	19%	20%	16%	12%	33%
Habit	Frequency	6	45	60	59	226
	Percentage	1.5%	11.3%	15.1%	15%	57%
Child penchant	Frequency	30	36	50	47	233
	Percentage	8%	9%	12.6%	11.9%	59%
Entertainment	Frequency	131	75	55	25	110
	Percentage	33%	19%	14%	6%	28%

Table 3. Main Factors Affecting Fast Food Consumption Frequency

	Poisson Regression Model			NBR Model		
Variable	Coefficient	Standard Error	Z stat.	Coefficient	Standard Error	Z stat.
Constant	1.083**	0.54	2	0.984*	0.595	1.65
Gender	0.053	0.104	0.51	0.066	0.1	0.66
Education	-0.041*	0.024	-1.7	-0.052***	0.021	-2.47
Income	-0.151**	0.073	-2.07	-0.141*	0.077	-1.82
Spouse occupation	0.233**	0.119	1.95	0.264**	0.119	2.2
Other meat	-0.191***	0.076	-2.5	-0.21***	0.082	-2.6
Age	-0.019	0.034	-0.58	-0.016	0.034	-0.48
Composition awareness	-0.0065**	0.003	-2.15	-0.006**	0.003	-2.03
Quality index	0.0004	0.003	0.12	0.0001	0.037	0.05
Availability	0.075	0.051	1.49	0.084*	0.050	1.68
Advertising	0.045*	0.026	1.73	0.043*	0.024	1.79
Label	-0.12	0.17	-0.7	-0.14	0.18	-0.77
Price	-0.053	0.046	-1.16	-0.048	0.046	-1.05
Alpha stat.				0.5757***	0.06	9.4
Pierson stat	-1,351.8***					
Deviance stat	1,318.3***					
-2log likelihood	2,435.8			2,002.76		
McFadden R^2	0.031			0.011		
Cragg–Uhler R^2	0.18			0.054		
AIC	6.24			5.15		
BIC	157.8			-569.9		

Notes: Single, double, and triple asterisks (*, **, ***) indicate significance at the 10%, 5%, and 1% level, respectively

According to Table 3, the education level of household head, income, spouse occupation, other meat consumption, awareness about composition of fast food, availability of fast food, and advertising have significant effects on the amount of fast food consumed by households. The results show that for a unit change in income, the expected count of fast food consumption decreases by a factor of exp (-0.141), or 0.87 units, holding other variables constant.

Higher education levels, other meat consumption, awareness about the composition of fast food, and income all have a negative and significant effect on the frequency of fast food consumption, while spouse occupation and availability of fast foods have a positive effect on the frequency of fast food consumption. Finally, by advertising fast food, the expected frequency of fast food consumption increases by 4% compared to the case where there is no advertising, holding other variables constant. Moreover, the results in Table 3 show that variables such as price do not have any significant effect on the frequency of fast food consumption by a household. Fast food is available in the market at a wide variety of price and quality points, but price and quality do not seem to influence consumption frequency.

Conclusions

Given changes in food consumption behaviors, there is a considerable need to identify the determinants of fast food consumption. This research analyzed factors affecting the frequency of fast food consumption among households in Mashhad, Iran. The top reasons for consuming fast food by households in a month in Mashhad were entertainment and lack of time to prepare food at home. The results of estimating negative binomial regression (NBR) model show education, income, spouse occupation, other meat consumption, awareness about composition of fast food, availability of fast food restaurants, and advertising variables have significant effect on the consumption frequency of fast food by households.

Consumer awareness about the composition of fast food has a negative effect on the frequency of consumption. Therefore, it is recommended that fast food suppliers be proactive and provide healthier fast food as a strategic response to consumers' concerns in order to increase sales and profits. Quality assurance provisions through social media could increase population awareness and demand for healthy foods. Policy makers could use social marketing tools to create incentives for households to eat more healthy products. It is also recommended that traditional Iranian foods, which have high nutritional values and are quick to prepare, to be added to the menus of fast food restaurants.

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Crop Rotation Systems for High-Value, Cool-Season Vegetables in the Southern United States

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Abstract

Demand for organic food has increased tremendously over the last decade in the United States. In the Southeast, high demand for organic food has sparked interest in organic production techniques among conventional vegetable growers and put increasing demand on existing organic growers. However, little information is available on profitable organic vegetable crops suitable for the region. This study analyzes crop rotation systems for high-value, cool-season vegetables to develop production and economic models to help growers increase profit and reduce risk.

Keywords: demand, organic food, vegetables, crop rotation, southern region, U.S.

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Introduction

The organic market sector is among the fastest growing food sectors in the United States (Dettmann and Dimitri, 2007). From 1997 to 2012, organic retail sales increased from $3.7 to $28 billion, increasing to a record high of over $43 billion in 2015. The total value of farm-level organic sales reached $5.5 billion in 2014, up 72% since 2008 (Greene, 2013; Young, 2015). In addition, the market share of organic sales for different food categories has remained very stable over the last decade. In term of sales, vegetables and dairy remain the two top-selling organic food categories, followed by packaged foods and beverages (Dettmann and Dimitri, 2007; Greene, 2013; Gelski, 2015)

Interest in organic and locally produced food in the Southeast United States has increased demand for regionally grown organic produce. Increased demand has sparked an interest among conventional vegetable growers about organic production techniques and put increasing demand on existing organic growers.

The challenge in this region is to increase organic production in the face of higher incidence of disease, insect, and weed pressures typically experienced due to long growing seasons under hot, humid conditions. Almost all organic vegetables in the Southeast are produced on small farms. As a consequence, production and economic models that encompass profitability of entire rotations are not available. Crop rotations are needed to help growers increase profits and reduce risk, but relatively little research-based information is available on optimal production systems in the Southeast. Providing production and economic information on well-planned crop rotations, crop budgets, and profitability to small and medium-sized growers interested in organic production will make agriculture more sustainable and profitable. This information will also be a useful tool for conventional growers interested in transitioning to organic production (Fonsah et al., 2007b; Ahmadiani et al., 2016).

Continuous monoculture cropping does not contribute to soil fertility and productivity but rather encourages pests and diseases and increases environmental degradation. Adopting a crop rotation system—which has major agronomic, environmental, and economic benefits compared to monoculture cropping (Fonsah et al., 2010; Christensen et al., 2012)—is one solution to these issues (Dogan et al., 2008; Christensen et al., 2012; Kinyau et al., 2013).

Crop rotation increases soil fertility and productivity; reduces diseases, pests, and weeds; and increases farmer profitability (van Bniggen and Termorskuizen, 2003; Fonsah et al., 2007b; Neves et al., 2007; Dogan et al., 2008; Nielsen et al., 2011; Ahmadiani et al., 2016). Studies on factors related to the use of crop rotations and cover crops have shown beneficial effects on diminishing disease severity (percentage of host tissue infected) and incidence (number of plants infected) (van Bniggen and Termorskuizen, 2003).

A well-planned and appropriate crop rotation can improve soil physical properties by increasing organic matter and soil fertility and controlling soil erosion (Gianello and Bremner, 1986; Thomas, 1996; Lu, Teasdale, and Huang, 2003; Halloran, Griffin, and Honeycutt, 2005). Crop rotation may also help farmers reduce income variability and the likelihood of economic loss (Baldwin, 2006). Rotations can also help farmers protect the value of their assets. According to

Hennessy (2006), a rotation can be used to better manage labor supply through the year in regions with a small labor market.

This study evaluates crop rotation systems for high-value, cool-season vegetables and develops an economic methodology and framework to determine the rotation with the highest return at the lowest risk in the Southeast United States (Fonsah et al., 2007a; Fonsah et al., 2008; Flanders et al., 2009).

Materials and Methods

The research was conducted on certified organic land at the Horticulture Farm in Watkinsville, Georgia, over 3 years (September 2010–September 2013). The Durham Horticulture Farm is a University research and education center located on the Piedmont soils of Georgia. The land has been in organic production since 2010. The experiments were designed in a randomized complete block, with three replications for each rotation. Plot size was 2 m × 15 m.

The experiment consisted of two main rotations each of which had three treatments or sub-rotations of high-value, cool-season crops (A_1, A_2, and A_3 for rotation A, and B_1, B_2 and B_3 for rotation B). Different treatments or sub-rotations indicate the sequence of crops in each rotation. These rotations were discussed and modified based on experience and inputs from the organic grower advisory team. The goal was to improve soil quality through cover crop biomass addition, to rotate and use cover crop families to break pest cycles, and to use crops to supply nitrogen and suppress weeds.

In rotation A, strawberry was planted in September, grown through the winter, and harvested in May. Following the strawberry harvest, bush beans were planted as a summer crop. This was followed in late summer/early fall by oats/Austrian winter pea, then followed in late winter with potatoes, harvested in May. After potatoes, sunhemp was planted as a summer cover crop, followed by onions planted in September and harvested in April and May, followed in early fall by southern pea.

The second rotation, rotation B began with broccoli transplanted in September and harvested in November/December. Broccoli was followed by lettuce in January and sudax/iron clay pea mix in April to over summer. This was followed by carrots sown in September/October and harvested in January/February and followed by sugar snap peas. Sunhemp was planted in May to over summer at which time onions were planted in September and harvested the following April/May. Onions were followed by millet to over summer. Table 1 summarizes the different sub-rotations and crop sequences.

An enterprise budget was developed for each crop to perform the economic analysis. The budget included crop total variable costs (costs related to plants or seed, fertilizer, labor, plastic, machinery, interest on capital, irrigation, harvest, and marketing), total fixed costs (costs associated with machinery, irrigation, land, and overhead management), total gross revenue or return, and crop net return (Fonsah and Hudgins, 2007; Fonsah and Torrence, 2008). Total costs are the sum of total variable costs and fixed costs. Total gross revenue represents total sales from each crop. Mean gross revenue represents average sales or average gross revenue.

Table 1. Crop Rotations for High-Value, Cool-Season Vegetables in the Southeast United States, 2011–2013

Rotation A Treatments		
A_1	**A_2**	**A_3**
Strawberry	Oats/Austrian winter pea	Onion
Bush bean	Potato	Southern pea
Oats/Austrian winter pea	Sunhemp	Strawberry
Potato	Onion	Bush bean
Sunhemp	Southern pea	Oats/Austrian winter pea
Onion	Strawberry	Potato
Southern pea	Bush bean	Sunhemp

Rotation B Treatments		
B_1	**B_2**	**B_3**
Broccoli	Carrot	Onion
Lettuce	Sugar snap pea	Millet
Sudax	Onion	Broccoli
Carrot	Millet	Lettuce
Sugar snap pea	Broccoli	Sudax
Onion	Lettuce	Sugar snap pea
Millet	Sudax	Sunhemp

Results

Table 2 shows that it costs more over 3 years to produce lettuce, onion, and strawberry than the other crops under study.

Table 2. Total Costs per Acre for High-Value, Cool-Season Vegetable Crop Rotations in the Southeast United States, 2011–2013

Crop	Year 1 (2011)	Year 2 (2012)	Year 3 (2013)
Broccoli	$4,759	$5,343	$7,014
Carrot	$4,957	$5,297	$5,526
Lettuce	$7,497	$11,182	$10,452
Onion Rotation A	$8,523	$10,108	$10,700
Onion Rotation B	$8,508	$9,455	$10,539
Potato	$6,015	$6,036	$6,609
Strawberry	$10,028	$9,429	$11,417
Bush beans	$2,173	$4,340	$5,453
Southern peas	$1,966	$3,379	N/A

Notes: 1 acre = 0.405 hectares**.**

In terms of total gross revenue, onions have the highest mean gross return, followed by lettuce and strawberry, over the 3 years under study (Table 3).

Table 3. Gross Revenue per Acre for High-Value, Cool-Season Vegetable Crop Rotations in the Southeast United States, 2011–2013

Crop	Year 1 (2011)	Year 2 (2012)	Year 3 (2013)	Mean Gross Revenue	Coefficient of Variation
Broccoli	$2,762	$6,205	$10,248	$6,405	0.585012
Carrot	$4,756	$5,596	$6,130	$5,494	0.126075
Lettuce	$12,064	$22,971	$22,418	$19,151	0.320806
Onion Rotation A	$9,760	$28,514	$23,347	$23,874	0.184333
Onion Rotation B	$19,664	$28,343	$23,779	$23,929	0.181432
Potato	$6,655	$7,844	$10,116	$8,205	0.214322
Strawberry	$21,023	$12,970	$11,265	$15,086	0.345472
Bush beans	$0	$4,238	$7,111	$3,783	0.945394
Southern peas	$0	$4,323	N/A		

Notes: 1 acre = 0.405 hectares**.**

Though Table 3 indicates that average revenues for onions are higher than those for lettuce, Table 4 shows that there was an increase in crop net returns or net revenue—the difference between gross revenue and total costs—from year 1 to year 3 for all crops except strawberry, which had a decreasing trend. Onions had the highest net return, followed by lettuce and strawberry.

Table 4: Net Returns per Acre for High-Value, Cool-Season Vegetable Crop Rotations in the Southeast United States, 2011–2013

Crop	Year 1 (2011)	Year 2 (2012)	Year 3 (2013)	Mean Net Returns	Coefficient of Variation
Broccoli	($1,997)	$862	$3,234	$699.67	3.743605
Carrot	($201)	$300	$604	$234.33	1.734698
Lettuce	$4,567	$11,790	$11,967	$9,441.33	0.447206
Onion Rotation A	$11,237	$18,406	$12,646	$14,096.33	0.269445
Onion Rotation B	$11,156	$18,887	$13,240	$14,427.67	0.277245
Potato	$640	$1,807	$3,508	$1,985.00	0.726580
Strawberry	$10,995	$3,541	($152)	$4,794.67	1.184287
Bush beans	($2,173)	($101)	$1,658		
Southern peas	($1,966)	$944	N/A		

Notes: 1 acre = 0.405 hectares. Numbers in parentheses represent a negative return or a loss.

In rotation A, treatment A_1 had the highest net return, followed by A_2 and A_3 (Table 5). In rotation B, treatment B_2 produced the highest net return, followed by B_3 and B_1.

Table: 5: Net Returns per Acre for High-Value, Cool-Season Vegetable Crop Rotations in the Southeast United States, 2011–2013

Rotation	Net Return
A_1	$21,063
A_2	$17,339
A_3	$14,317
B_1	$11,765
B_2	$30,957
B_3	$20,168

	Rotation A			Rotation B		
	A_1	A_2	A_3	B_1	B_2	B_3
	Strawberry	Oats/Aust. W Pea	Onion	Broccoli	Carrot	Onion
	Bush bean	Potato	Cowpea	Lettuce	Sun Hemp	Millet
	Oats/ Aust. W Peas	Sun Hemp	Strawberry	Su/C. pea	Onion	Broccoli
	Potato	Onion	Bush bean	Carrot	Millet	Lettuce
	Sun hemp	Cowpea	Oats/Aust W Peas	Sunhemp	Broccoli	Su/C. pea
	Onion	Strawberry	Potato	Onion	Lettuce	Carrot
		Bush bean				
Net return	$21,063	$17,339	$14,317	$11,765	$30,957	$20,168

Notes: 1 acre = 0.405 hectares**.**

Conclusion and Discussion

This study analyzed the profitability and economic viability of organic crop rotations for high-value, cool-season vegetables in order to identify high-profit, low-risk crops and rotations. Economic analysis of data collected over a 3-year experimental crop rotation shows that lettuce, onion, and strawberry cost more to produce, but onion has the highest net returns over those 3 years, followed by lettuce and strawberry. However, the means test comparison indicated no difference in net returns between lettuce and onion, implying that a farmer would be indifferent between planting onion and lettuce.

This study can serve as a source of information on organic vegetable crop production in the Southeast United States. Researchers and farmers interested in organic production can learn how to develop and set up a profitable organic vegetable crop production system. The information can help small- and medium-sized growers move from monoculture cropping systems to crop rotation systems, increase profits, reduce risks, and respond effectively to increasing demand for organic food.

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Price Discovery and Integration in U.S. Pecan Markets

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Abstract

The United States is a major supplier in the world pecan market. Using grower-level pecan price data from the 2005–2016 seasons, we estimate pecan market integration patterns among Texas, Oklahoma, Georgia, and Louisiana using causality structures identified through cutting-edge machine-learning methods. Current pecan price received by growers in Texas is a direct cause of those in Oklahoma, Georgia, and Louisiana. Past-period grower-level pecan price in Georgia either directly or indirectly influences the current price in other states. These findings are useful for businesses and the government in order to price and promote marketing of pecan.

Keywords: directed acyclic graphs, machine learning, market integration, pecan markets, price discovery

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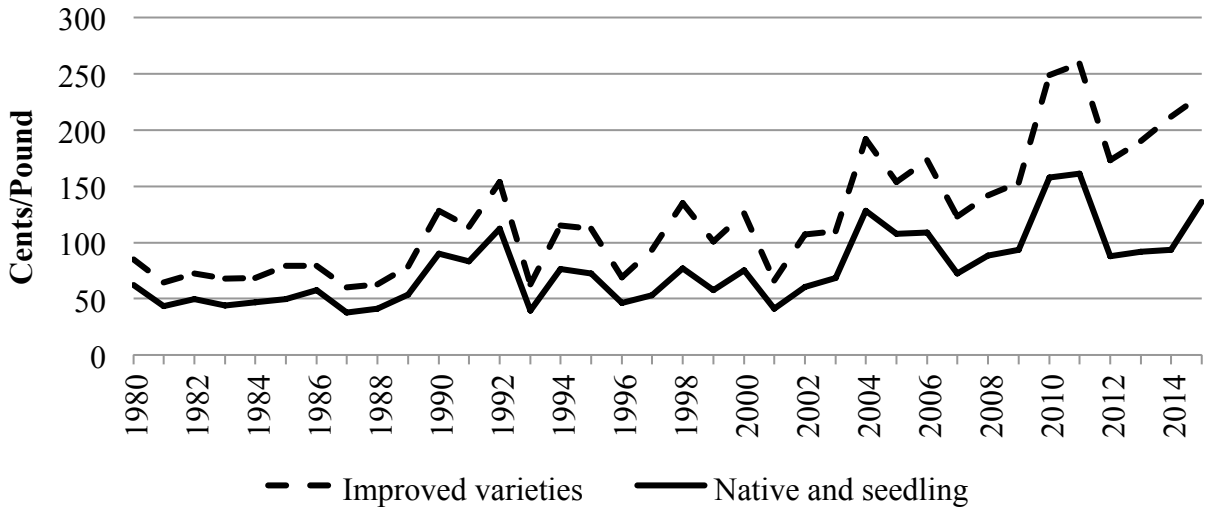
Introduction

The United States is a major worldwide supplier of tree nut products, particularly pecan and almond (International Nut and Dried Fruit Council, 2015; California Almond Board, 2016). The United States supplies about 55% of the world's pecan, while Mexico comes in second at about 38% of market share. However, pecan has lost its share in the U.S. tree nut market, while almond has taken the most of the potential growth since the 2010/11 season. The U.S. pecan market was valued at $560 million in the 2015/16 season (U.S. Department of Agriculture, 2017). Some research with regard to several players in the pecan supply chain is beginning to emerge. Ibrahim and Florkowski (2007) studied sheller-level pecan prices, while Dharmasena and Capps (2017) focused on consumer-level pecan prices. Figure 1 shows season-average pecan prices when growers sell their pecans to shellers/processors. While there is an increasing trend, it fluctuates seasonally due to the alternate bearing character of pecan (Shafer, 1996). In early 2016, the U.S. Department of Agriculture (USDA) approved a federal marketing order, which supports better marketing conditions for fruit, vegetable, dairy, and specialty crop producers and handlers (USDA, 2016). Research on pecan prices was emphasized to help shape current and future U.S. pecan marketing programs.

Figure 1. In-Shell Pecan U.S. Season-Average Grower Price, 1980–2016



Notes: Estimates discontinued in 1996 for Missouri and Tennessee. Estimates since 2005 include Missouri.

Oklahoma, Texas, and Georgia produce approximately 90% of the pecan production of native varieties, while Georgia, New Mexico, Texas, and Arizona account for about 95% of total production of improved varieties. Given the nature and the location of pecan production in the United States, it is likely that the pecan price in one state affects or is affected by pecan price in another state. Major pecan markets in Texas, Oklahoma, Georgia, and Louisiana might be integrated in some form, affecting price-discovery patterns. Understanding pecan price integration patterns will be imperative for upstream players in the pecan supply chain (such as growers, shellers, and wholesalers) as they attempt to discover pecan price each season.

Using biweekly data from 2005–2016, we investigate pecan price integration patterns among Texas, Oklahoma, Georgia, and Louisiana using causality structures identified through cutting-edge machine-learning methods. We find that pecan price at the grower level in Texas contemporaneously determines pecan price in Oklahoma, Louisiana, and Georgia, making Texas pecan price a common cause. In the current time, Oklahoma, Louisiana, and Georgia only receive price signals, making them strictly endogenous in the price-discovery process. Georgia's past-period price is a common cause for Georgia, Texas, and Louisiana's current-period prices, making Georgia's past-period price strictly exogenous. Also, Louisiana's past-period price affects Louisiana and Oklahoma's current-period prices.

Literature Review

Wood (2001) found that pecan's alternate-bearing characteristic caused significant marketing problems in the U.S. pecan industry and that pecan prices have a much stronger relationship with supply at the national level than at the state level. In addition to the supply side, he found both the prices of substitutable nuts and competition among shellers/processors to influence pecan price.

Shafer (1996) found that expected pecan production in the current season and carry-in stocks from the previous year mainly determine pecan price in each season. He found that relatively high pecan prices in 1990–1995 were caused by lower production and stocks in those years. In addition, he noted a growing trend in international trade in pecan as well as a significant impact on U.S. pecan market prices from pecan import volumes. Ibrahim and Florkowski (2005) analyzed the relationship between pecan price and pecan cold storage inventory by applying seasonal cointegration methods to deal with pecan price seasonality. Ibrahim and Florkowski (2007) found that the price of shelled pecan and its inventories are nonstationary and have long-run relationships.

Dharmasena and Capps (2017) concentrated on the demand side of tree nut products, including pecan. They estimated the own-price elasticity of demand (0.98) and market penetration (7%) for pecan. They concluded that income, age, region, and presence of children are significant drivers of pecan consumption at the U.S. household level. In addition, Moore et al. (2009) analyzed the effectiveness of state-level pecan promotion programs and found that they had a statistically significant impact on increased sales for improved varieties but not for native varieties. Palma and Chavez (2015) studied the potential implications of federal marketing orders on pecan price and concluded that average pecan price at the grower level would increase by $0.063 for improved varieties and $0.036 for native varieties.

Very few studies in the extant literature have examined the movement of U.S. pecan prices. To the best of our knowledge, this article is the first to look at grower-level market integration patterns in the U.S. pecan market. This article investigates the relationships between grower-level pecan prices in four major pecan markets (Georgia, Texas, Louisiana, and Oklahoma) in the southern United States.

Data and Methods

Average grower-level pecan prices in Georgia, Texas, Louisiana, and Oklahoma are obtained from the U.S. Department of Agriculture Agricultural Marketing Service (USDA-AMS). Since grower-level pecan prices are recorded by season, the data usually range from October to February for each year, which is when most pecan growers harvest their crop and sell to shellers/ processors. For example, pecan prices from October 2005 to January 2006 are categorized as the 2005 season.

Summary statistics of grower level pecan prices from seasons 2005–2016 are presented in Table 1. A few missing data points in the USDA-AMS report for the 2011, 2012, and 2013 seasons for Texas and Oklahoma were generated by estimating an autoregressive model with one lag. SIMETAR© statistical software (Richardson, 2008) was used to estimate these models. In addition, pecan price is recorded as non-shelled basis until the 2014 season, after which it changed to shelled basis beginning in the 2015 season. Converting non-shelled pecan price to shelled requires knowing the nut-yield percentage—the ratio of shelled to unshelled pecan weight—which determines the weight of actual nut once the shell is removed. There are over 10 varieties of improved pecans, each with a different nut yield. The conversion from non-shelled to shelled price is a linear transformation, which does not affect the correlation among the price variables. Therefore, non-shelled prices are not adjusted for shelled prices in this study. We also use biweekly average per pound price of all varieties of pecan (including improved, natives, blends, and mix budded, which are recorded in shelled basis in dollars per pound). According to Table 1, pecan prices in all four states are comparable: Georgia and Texas have higher prices per pound ($1.49/lb and $1.47/lb) compared to Louisiana and Oklahoma ($0.96/lb and $0.98/lb).

Table 1. Grower-Level Pecan Prices by State ($/lb)

	Georgia	Louisiana	Oklahoma	Texas
Mean	1.49	0.96	0.98	1.47
Standard Deviation	0.55	0.34	0.35	0.48
Minimum	0.55	0.41	0.45	0.57
Maximum	3.47	1.66	2.55	3.11

This study estimates integration patterns among grower-level pecan prices in Texas, Oklahoma, Georgia, and Louisiana using causality structures identified through cutting-edge machine-learning algorithms applied to the underlying variance–covariance matrix (or the underlying correlation matrix) of price variables. Causality structures among price variables are developed using Directed Acyclic Graphs (DAGs), as explained in Pearl (2009). Table 2 presents Pearson correlation matrix that show correlation between current and previous-year pecan prices. Current pecan prices in every state are positively correlated with previous pecan prices in the same and other states. Even though we intuitively assume that previous price affects current price, the correlation matrix itself does not provide clear evidence for causal structures among these prices.

Dharmasena, Bessler, and Capps (2016) used a machine-learning algorithm called Greedy Equivalence Search (GES) to select appropriate predictors to conduct regression analysis as applied to variables determining food insecurity in the United States. GES is a part of TETRAD

Table 2. Correlation Matrix of Pecan Prices

	GA(*t*)	LA(*t*)	OK(*t*)	TX(*t*)	GA(*t* - 1)	LA(*t* - 1)	OK(*t* - 1)	TX(*t* - 1)
GA(*t*)	1.00							
LA(*t*)	0.45	1.00						
OK(*t*)	0.32	0.48	1.00					
TX(*t*)	0.41	0.40	0.32	1.00				
GA(*t* - 1)	0.51	0.60	0.33	0.48	1.00			
LA(*t* - 1)	0.35	0.82	0.52	0.24	0.45	1.00		
OK(*t* - 1)	0.27	0.43	0.72	0.17	0.32	0.49	1.00	
TX(*t* - 1)	0.29	0.45	0.39	0.65	0.41	0.39	0.31	1.00

Notes: GA(*t*), LA(*t*), OK(*t*), TX(*t*), GA(*t* - 1), LA(*t* - 1), OK(*t* - 1), and TX(*t* - 1) represent pecan price received by growers in time periods *t* and (*t* – 1) in Georgia (GA), Louisiana (LA), Oklahoma (OK), and Texas (TX), respectively.

statistical package (Glymour et al., 2014), which searches causal models using artificial intelligence and DAG (see Chickering, 2002, for details). The GES algorithm compares many possible types of directed acyclic graphs (DAG) to search for the optimum graph associated with price variables.

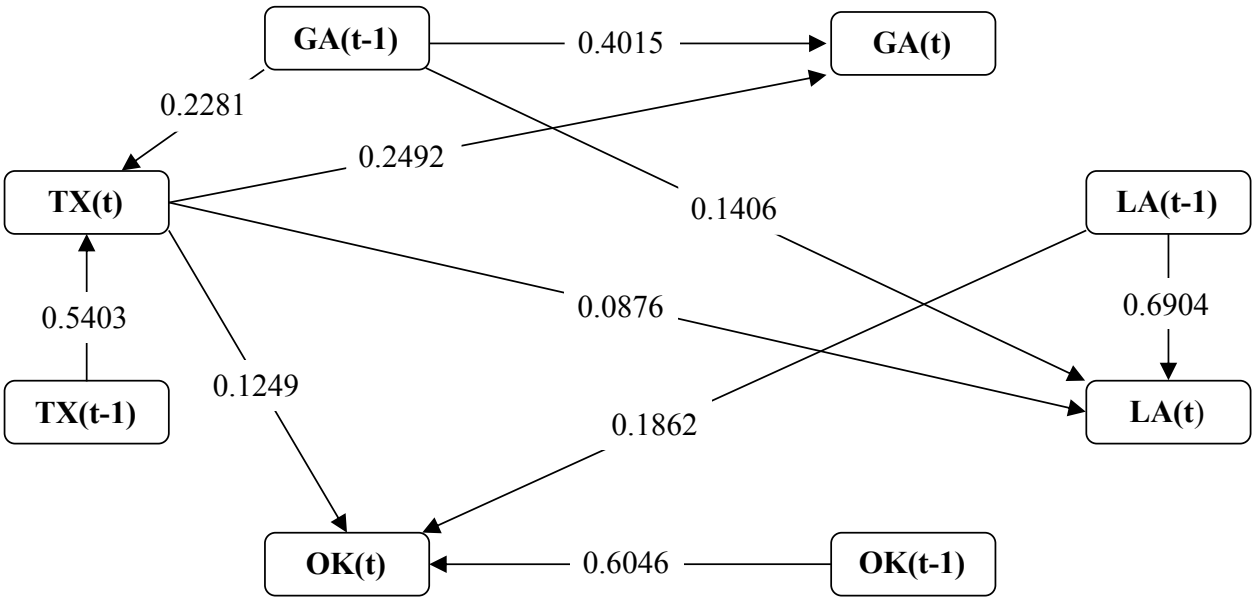
Empirical Results

Figure 2 shows the DAG associated with current and previous grower-level pecan prices in Texas, Georgia, Louisiana, and Oklahoma. Each edge with direction determines the predictor and predicted variables in the regression model. Each number on an edge is the estimated slope coefficient of the predictor variable when arrow-received variable (dependent variable) is regressed on every causing variable (independent variable). For example, the current Texas pecan price can be explained by Texas and Georgia's previous pecan prices. When TX(*t*) is regressed on TX(*t* - 1) and GA(*t* - 1), the slope coefficients for the two independent variables are 0.5403 and 0.2281, respectively. Table 3 shows slope coefficients and p-values for each estimated edge.

Texas's current pecan price is a common-cause variable for current prices in Georgia, Louisiana, and Oklahoma. Even though current Texas pecan price blocks the path, if included in the regression model, the previous Texas price also indirectly influences current pecan price in Georgia, Louisiana, and Oklahoma in a causal chain relationship. A higher current Texas pecan price drives pecan prices in Oklahoma, Georgia, and Louisiana to increase at the grower level. As shown in Table 3, the current pecan price in Georgia has the highest slope coefficient (0.2492) and Louisiana has the lowest (0.0876) with respect to Texas being a common cause variable.

Current-period pecan price in Georgia is affected by both current price in Texas and its own previous period price. Current Texas pecan price is the only current factor that directly affects Georgia's price. Considering the large amount of pecan production in Georgia, it is interesting

Figure 2. Directed Acyclic Graph (DAG) of Current and Past Pecan Prices



Notes: GA(*t*), LA(*t*), OK(*t*), TX(*t*), GA(*t* - 1), LA(*t* - 1), OK(*t* - 1), and TX(*t* - 1) represent pecan price received by growers in time periods *t* and (*t* – 1) in Georgia (GA), Louisiana (LA), Oklahoma (OK), and Texas (TX), respectively.

Table 3. Parameter Estimates for Each Edge

From	To	Slope Coefficient	p-value
GA(*t* - 1)	GA(*t*)	0.4015***	0.0001
GA(*t* - 1)	LA(*t*)	0.1406***	0.0005
GA(*t* - 1)	TX(*t*)	0.2281***	0.0014
LA(*t* - 1)	LA(*t*)	0.6904***	0.0000
LA(*t* - 1)	OK(*t*)	0.1862**	0.0185
OK(*t* - 1)	OK(*t*)	0.6046***	0.0000
TX(*t* - 1)	TX(*t*)	0.5403***	0.0000
TX(*t*)	GA(*t*)	0.2492**	0.0280
TX(*t*)	LA(*t*)	0.0876**	0.0355
TX(*t*)	OK(*t*)	0.1249**	0.0127

Notes: GA(*t*), LA(*t*), OK(*t*), TX(*t*), GA(*t* - 1), LA(*t* - 1), OK(*t* - 1), and TX(*t* - 1) represent pecan price received by growers in time periods *t* and (*t* – 1) in Georgia, Louisiana, Oklahoma, and Texas, respectively. Single, double, and triple asterisks (*, **, **) denote statistical significance at the 10%, 5%, and 1% levels, respectively.

that Georgia's price is not a common-cause variable for other states. However, the previous-period Georgia price has direct causal relations with its own current price as well as the current

price in Texas and Louisiana, making it a common cause. Past pecan price in Georgia also indirectly affects current pecan price in Oklahoma via Texas in a causal chain relationship.

Current pecan price in Louisiana is affected by its previous price, the previous pecan price in Georgia, and current pecan price in Texas. Current pecan price in Louisiana does not directly affect current prices of other states. Previous pecan price in Louisiana also affects current price in Louisiana and Oklahoma.

Current pecan price in Oklahoma is affected by current price in Texas and previous prices in Louisiana and Oklahoma. Oklahoma and Louisiana have the smallest pecan production among the states in this study; thus, we expect them not to be common-cause variables. Unlike that of Louisiana, previous pecan price in Oklahoma only affects its current price.

Conclusions

To summarize, among the four southern states considered in this study, Texas pecan price is weakly exogenous, meaning there are arrows coming into current Texas price (from past-period Texas and Georgia prices) as well as arrows going out (to current Oklahoma, Louisiana, and Georgia prices). Texas is the price leader in the current pecan market at the grower level since it directly causes current-period pecan prices in the other three states considered. However, past pecan price in Texas only affects its current price.

Current pecan price in Georgia does not affect any other states directly or indirectly, making Georgia strictly endogenous with regard to grower-level pecan price. However, past pecan price in Georgia is a common cause for current pecan price in Georgia, Texas, and Louisiana, making past-period pecan price in the largest pecan-growing state strictly exogenous. Past pecan prices in Georgia and Louisiana also affect the current pecan price in Oklahoma in a direct and indirect way, respectively. Thus, Georgia has the most influential past pecan prices affecting current price. In contemporaneous time, the Texas pecan price is the leader in determining grower-level pecan price. However, in lagged time, Georgia pecan price leads grower-level pecan price in Texas, Oklahoma and Louisiana.

Even though New Mexico produces approximately 30% of improved pecan, this study does not include the state due to the absence of consistent data. If those data had been available, it would have been possible to develop more refined graphical causal structures showing price information from New Mexico.

This study shows direct and indirect causal relationships among pecan prices from four southern U.S. states estimated using machine-learning algorithms and directed acyclic graphs. It establishes market integration patterns in the current and lagged-period pecan market with historical data from 2005 to 2016. These findings are expected to be useful to promote pecan marketing and design state-level pecan marketing programs.

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Forecasting Organic Wheat Prices: Do Conventional Prices Play a Role?

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Abstract

Organic wheat production is generally profitable in the West, but farmers considering organic conversion or maintaining current organic fields face uncertainty due to significant price variations over time. The ability to predict price movements in this market is complicated by the limited availability of pricing data as well as missing observations. This study evaluates three methods to impute missing price observations. Additionally, we investigate short- and long-run relationships between organic and conventional wheat prices to understand whether conventional prices can help to predict organic wheat prices. Results indicate that conventional wheat prices influence organic prices, but only in the short run.

Keywords: cointegration, market integration, missing observations, organic, pricing, wheat

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Introduction

Organic wheat prices have changed rapidly in the past few years, leading to an overall increase in excess of 140% between 2010 and 2017. Generally, current organic wheat prices allow organic wheat production to be profitable in the West. But farmers face uncertainties regarding the length of favorable market conditions, which affects their decision to begin or continue dryland organic wheat farming. Lags in conversion contribute to on-going supply deficiencies that cannot keep up with growing demand. The organic premium, the difference between organic and conventional wheat prices, is one factor that plays a role in the profitability of the organic wheat production (McBride et al., 2012) and thus affects its attractiveness to farmers.

In this study, we investigate both long- and short-run relationships between conventional and organic wheat prices, using the concepts of market integration and price transmission. These relationships are used to determine whether conventional wheat prices can be used to forecast organic wheat prices. By examining the long-run relationship between organic and conventional wheat prices, we also aim to gain understanding about how organic premiums develop over time. However, our analysis is complicated by the limited availability of historical organic pricing data as well as missing observations in available pricing data.

We have three objectives for this study. First, we aim to recover missing organic wheat pricing observations through three different methods used to impute missing values. Second, we will examine price transmissions between organic and conventional wheat markets in both the long run and the short run. We investigate the presence of a long-run relationship by testing whether these two markets are cointegrated. Third, we develop a model to forecast organic wheat prices. As no cointegration between organic and conventional wheat market was found, we estimate a structural vector autoregressive (SVAR) model. In addition to forecasting, this model will be used to identify any short-run relationships between organic and conventional wheat prices.

Background and Literature Review

If the same information is used to form expectations about supply and demand in two different markets, these markets and their prices become linked. The strength of the link between prices can be examined by investigating their long- and short-run relationships. If prices share a stable long-run equilibrium, then the markets are said to be cointegrated. In this case, if one of the prices deviates from this equilibrium due to a shock in the market, an adjustment will take place to re-establish the equilibrium relationship that allows prices to move together over time. In the absence of market cointegration, prices are likely to diverge over time. In the context of this study, cointegration between organic and conventional markets plays a role in keeping the organic premium stable over time. In addition, both prices may influence each other in the short run, regardless of whether the two markets are cointegrated.

Several studies have examined price transmissions and market integration between organic and conventional commodities, which are qualitatively differentiated but can potentially act as substitutes. Kleemann and Effenberger (2010) found that price transmission occurs from the conventional to organic pineapple market in the short run, even though the markets for conventional and organic pineapple are not integrated.

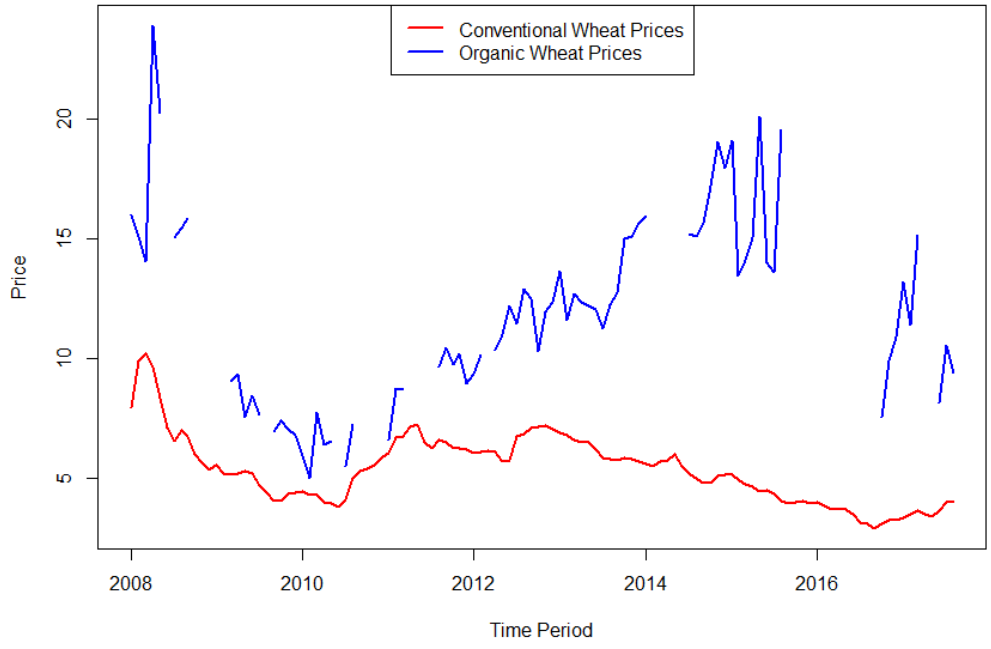
Singerman, Lence, and Kimble-Evans (2014) found no evidence of long- or short-run price relationships between organic and conventional corn and soybeans. Würriehausen, Ihle, and Lakner (2015) and Nemati and Saghaian (2016) found evidence of asymmetric price transmission and market integration between organic and conventional wheat and apples, respectively. Ankamah-Yeboah, Nielsen, and Nielsen (2017) found market integration between organic and conventional salmonids, at both the farm and retail levels. Conventional prices were found to influence organic prices clearly at the farm level only.

This study builds on the previous literature by investigating the dynamic short- and long-run relationships between organic and conventional wheat prices using standard vector autoregression methods. Examining such relationships will allow us to determine whether conventional wheat prices can be used to predict organic prices. We find that conventional wheat prices affect organic prices in the short run and thus can be used to predict recent organic prices. In the long run, however, these two markets are independent.

Data

The data used in this analysis are monthly farm-gate organic and conventional food-grade wheat prices between January 2008 and August 2017, obtained from the U.S. Department of Agriculture Agricultural Marketing Service (AMS) and Economic Research Service (ERS). Figure 1 plots observed organic and conventional wheat prices, with 116 observations for conventional wheat and 85 for organic. Values for the missing organic prices are imputed using i) spline interpolation, ii) an exponential moving average, and iii) an expectation maximization with bootstrapping (EMB) algorithm.

Figure 1. Observed Monthly Conventional and Organic Wheat Prices, January 2008–August 2017 (USD/bushel)



These three methods add robustness to our analysis, but the third method is most statistically sound and thus preferred. While the first two methods consider only observations proximate to missing values, the third uses the whole distribution of data in the imputation process and, additionally, accounts for the time series nature of the data. Figure 2 depicts observed organic prices as well as prices obtained using the three imputation methods. The organic wheat prices used in our analysis are the average of prices for soft red winter, hard red winter, and hard red spring wheat varieties. All prices were deflated using the seasonally adjusted consumer price index for cereals and bakery products and transformed into natural logarithms. Table 1 reports summary statistics for all price series used in this analysis.

Figure 2. Observed Monthly Organic Prices Compared to Complete Organic Prices Obtained Using Three Imputation Methods (USD/bushel)

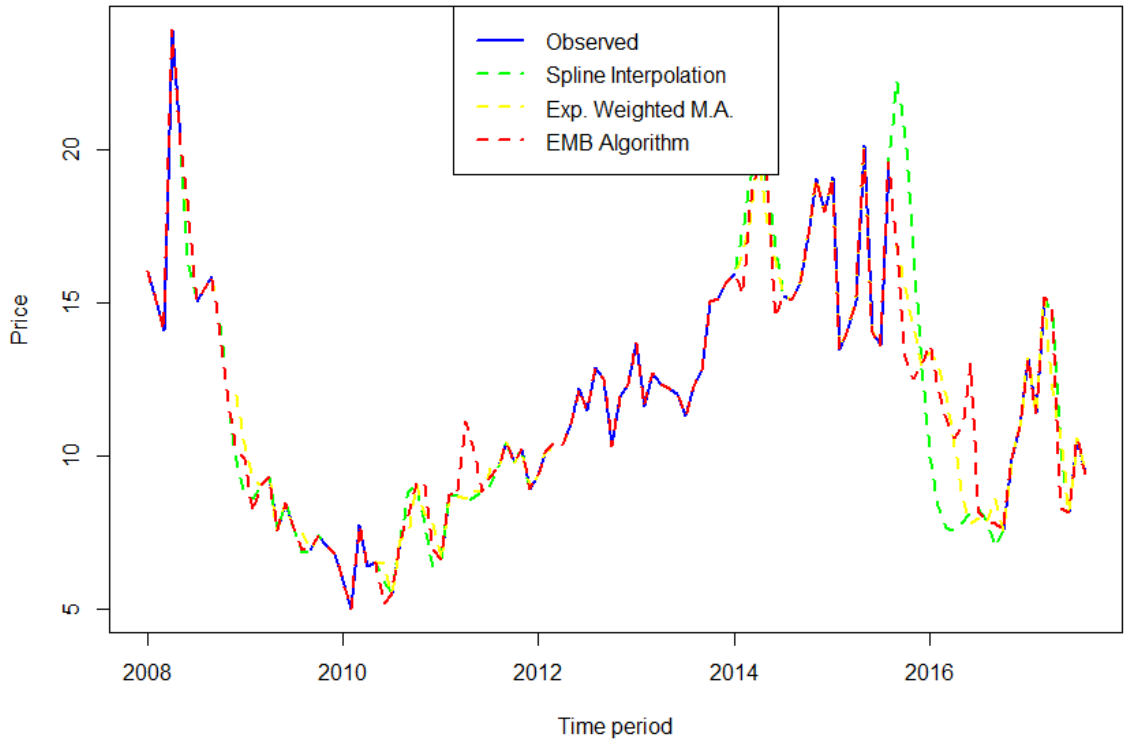


Table 1. Summary Statistics for Conventional and Organic Prices (USD/bushel)

	N	Mean	St. Dev.	Min.	Max.
Conventional price	116	5.38	1.44	2.93	10.19
Organic price – observed	85	11.96	3.96	5.02	23.91
Organic price – spline interpolation	116	11.80	4.18	5.02	23.91
Organic price – exponential moving avg.	116	11.85	3.85	5.02	23.91
Organic price – EMB algorithm	116	11.86	3.86	5.02	23.91

Methods

Markets are cointegrated when the corresponding price series follow a non-stationary process, a linear combination of prices results in a stationary process. Therefore, the first step is to apply unit root tests to individual price series to test for stationarity. We apply three tests, including Augmented Dickey-Fuller (ADF), Phillips-Perron (PP), and Kwiatkowski-Phillips-Schmidt-Shin (KPSS).

Next we test for the presence of cointegration on each pair of organic and conventional prices using the method developed by Johansen (1988). In general, given two non-stationary series, x and y, the series are said to be cointegrated if a unique β_1 exists that renders the difference $y - \beta_0 - \beta_1 x$ stationary. The Johansen cointegration test determines whether such β_1 exists. The cointegrating parameter, β_1, measures the long-run relationship. The Akaike information criterion (AIC) is used to determine the best number of lags to be used in the test.

Depending on whether we find evidence of cointegration, we then proceed to estimate either a structural vector error correction (SVEC) model or a structural vector autoregressive (SVAR) model to further examine dynamic relationships between prices. The bivariate SVEC model with k lags is specified as:

$$(1) \quad \begin{bmatrix}\Delta p_{1,t}\\ \Delta p_{2,t}\end{bmatrix} = \begin{bmatrix}\mu_1\\ \mu_2\end{bmatrix} + \begin{bmatrix}\alpha_1\\ \alpha_2\end{bmatrix}\left(p_{1,t-1} - \beta_0 - \beta_1 p_{2,t-1}\right) + A_0 \begin{bmatrix}\Delta p_{1,t}\\ \Delta p_{2,t}\end{bmatrix} + \sum_{i=1}^{k} A_i \begin{bmatrix}\Delta p_{1,t-i}\\ \Delta p_{2,t-i}\end{bmatrix} + \begin{bmatrix}\varepsilon_{1,t}\\ \varepsilon_{2,t}\end{bmatrix},$$

where $p_{1,t-1} - \beta_0 - \beta_1 p_{2,t-1}$ is the lagged error correction term and its coefficients α_1 and α_2 measure the percentage of deviation from equilibrium that is adjusted in the next period. A_0 is a 2 x 2 matrix with three coefficients restricted to 0 for identification purposes, and the remaining non-zero coefficient measures the contemporaneous effect between the two prices. A_i for $i = 1,2,\ldots,k$ is 2 x 2 matrix with the coefficients measuring short-run effects. The number of lags k is determined using the AIC, and $\varepsilon_{1,t}$ and $\varepsilon_{2,t}$ are *i.i.d.* error terms with 0 mean and constant variance. In addition, all log-transformed prices are in the first differences (Δ is the first-difference operator). If cointegration between organic and conventional wheat prices is not found, then a SVAR model is estimated similarly to equation (1) but with the error correction term removed.

Results

The unit root tests results reported in Table 2 show unambiguously that all log-transformed prices are non-stationary in level form and stationary in first differences. The results of the Johansen cointegration test reported in Table 3 show that there is no cointegration between the prices within each pair of organic and conventional wheat prices. That means that there is no stable long-run relationship between organic and conventional prices. As a result, we estimate a SVAR model. The best-fitting SVAR model is estimated on the pair of conventional and organic wheat prices obtained using the EMB algorithm. The AIC selected 2 lags as the best number of lags for the model. The results reported in Table 4 show that current organic prices are influenced by conventional prices in the current period and in the last two months. In addition, as expected, current organic prices are affected by both lags of organic prices.

Results also show that current conventional wheat prices are mainly influenced by conventional prices 1 month ago and weakly influenced by conventional prices 2 months ago and organic prices 1 month ago. The magnitude of the estimated coefficients is not interpretable in the usual way, as an impulse response function (IRF) analysis needs to be employed to assess the short-run dynamics more accurately. In our analysis, we also consider the possibility that the interactions between organic and conventional prices may change over time, meaning that the estimated coefficients would not be stable over the entire studied period. The test for the presence of structural breaks reveals that the stability condition of our estimates holds, meaning that no structural breaks occurred during the studied period. Thus our model, which assumes constant coefficient estimates over the entire studied period, is appropriate.

Table 2. Results of Unit Root Tests for Log Transformed Prices in Levels and First Differences

	Levels			**First Differences**		
	ADF	**PP**	**KPSS**	**ADF**	**PP**	**KPSS**
Drift only						
Conventional	-1.46	-	1.62***	-6.55***	-	0.10
Org – spline interp.	-2.20	-	0.70*	-7.31***	-	0.08
Org – exp. m. avg.	-1.67	-	0.77***	-7.38***	-	0.10
Org – EMB algorithm	-1.73	-	0.82***	-9.99***	-	0.08
Trend and drift						
Conventional	-1.76	-6.52	0.48***	-6.55***	-74.2***	0.10
Org – spline interp.	-2.35	-10.85	0.35***	-7.29***	-100.3***	0.07
Org – exp. m. avg.	-1.90	-9.99	0.37***	-7.35***	-136.9***	0.10
Org – EMB algorithm	-1.94	-12.15	0.37***	-9.97***	-109.9***	0.08

Notes: Single, double, and triple asterisks (*, **, ***) indicate significance at the 95%, 99%, and 99.9% confidence levels, respectively. H_0 for ADF and PP tests: Series are non-stationary. H_0 for KPSS test: Series are stationary.

Table 3. Results of Johansen Cointegration Tests for Each Pair of Log Transformed Prices

		Test	**Critical Values**		
	Rank	**Statistic**	**10%**	**5%**	**1%**
Conventional and organic	$r \leq 1$	5.32	7.52	9.24	12.97
(spline interpolation)	$r = 0$	17.47	17.85	19.96	24.6
Conventional and organic	$r \leq 1$	4.17	7.52	9.24	12.97
(exponential moving average)	$r = 0$	16.59	17.85	19.96	24.6
Conventional and organic	$r \leq 1$	2.74	7.52	9.24	12.97
(EMB algorithm)	$r = 0$	15.66	17.85	19.96	24.6

Notes: Single, double, and triple asterisks (*, **, ***) indicate significance at the 95%, 99%, and 99.9% confidence levels, respectively. H_0: There are r ($r = 0$ or $r \leq 1$) cointegrating relationships.

Table 4. Regression Results of the SVAR Model Using Organic Prices Obtained Using the EMB Algorithm

	$\Delta price_{conv}$		$\Delta price_{org}$	
	Coefficient	**Std. Error**	**Coefficient**	**Std. Error**
Conventional price, current period	-	-	0.871**	0.292
Conventional price, 1st lag	0.524***	0.097	0.108	0.331
Conventional price, 2nd lag	-0.178	0.092	0.880**	0.283
Organic price, 1st lag	-0.051	0.029	-0.261**	0.091
Organic price, 2nd lag	-0.005	0.030	-0.307***	0.090
Intercept	-0.536	0.461	0.773	1.410
Prob > F	0.000		0.000	
Adjusted R^2	0.189		0.219	

Notes: Single, double, and triple asterisks (*, **, ***) indicate significance at the 95%, 99%, and 99.9% confidence levels, respectively.

Conclusions

As organic wheat prices and, more specifically, their premium over conventional wheat prices play a role in the attractiveness and profitability of organic wheat farming, this study seeks to understand the relationships between organic and conventional wheat prices. We find that in the long run, organic and conventional prices behave independently of each other. But we find that conventional wheat prices do affect organic prices in the short run and thus can be used to predict recent organic wheat prices. We conclude that price transmission occurs between these two markets to some extent, but there are factors that cause prices to diverge over time. Shortages in the organic wheat market may contribute to the independent development of organic wheat prices.

Acknowledgments

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The Importance of Ethnic Food Stores in Identifying Food Deserts: A Case Study of Huntsville, Alabama

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Abstract

The paper examines the importance of including specialty and ethnic food stores in defining and identifying food deserts in a multi-ethnic suburban neighborhood. The paper uses an in-store food availability survey and GIS techniques to test the hypothesis that the availability of healthy and affordable food options will be considerably under-reported when not accounting for ethnic and specialty food stores in food desert analysis. Although a relatively large portion of the study area remains a food desert, ethnic and specialty food stores significantly offset the lack of supermarkets and grocery stores in providing healthy and affordable food options.

Keywords: ethnic food stores, food availability, food desert, West Huntsville neighborhood

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Introduction

The food desert literature has made much progress in assessing the existence of food deserts and have clearly documented that some areas can be considered food deserts (Bitler and Haider, 2009). However, local-area studies also point to numerous problems that exist with the data that have been used in large-scale studies (National Poverty Center, 2010). In particular, most food desert studies use mainstream supermarkets and grocery stores as proxies for healthy food suppliers, often ignoring small ethnic and other retail food stores (Sadler, Gilliland, and Arku, 2011; Behjat, Koc, and Ostry, 2013; Joassart-Marcelli, Rossiter, and Fernando, 2017). This paper builds on previous studies, particularly that have argued that a focus only on supermarkets and grocery stores is likely to underestimate the availability of healthy food options, some of which are also available at ethnic stores, specialty stores, and farmers' markets (Behjat, Koc, and Ostry, 2013; Joassart-Marcelli, Rossiter, and Fernando, 2017).

Defining Food Deserts

There have been many efforts to define food deserts and to define a methodology for identifying geographic areas that qualify (Sohi et al., 2014; Bonica and Story, 2016). Among the several definitions, the U.S. Department of Agriculture's (USDA) description is the most commonly used: Census tracts are identified as food deserts if i) the community is "low income," defined as "a) a poverty rate of 20% or greater, or b) a median family income at or below 80% of the area median family income;" and ii) the community is "low access," defined as a community with more than one-third of living at least 1 mile (for urban communities) or 10 miles (for rural communities) from a supermarket (U.S. Department of Agriculture, 2015). Based on this definition, West Huntsville, Alabama, and its surrounding communities are food deserts. By expanding the USDA definition to include ethnic food stores and specialty food stores,[1] this study re-examines whether the West Huntsville neighborhood is truly a food desert.

Data and Methods

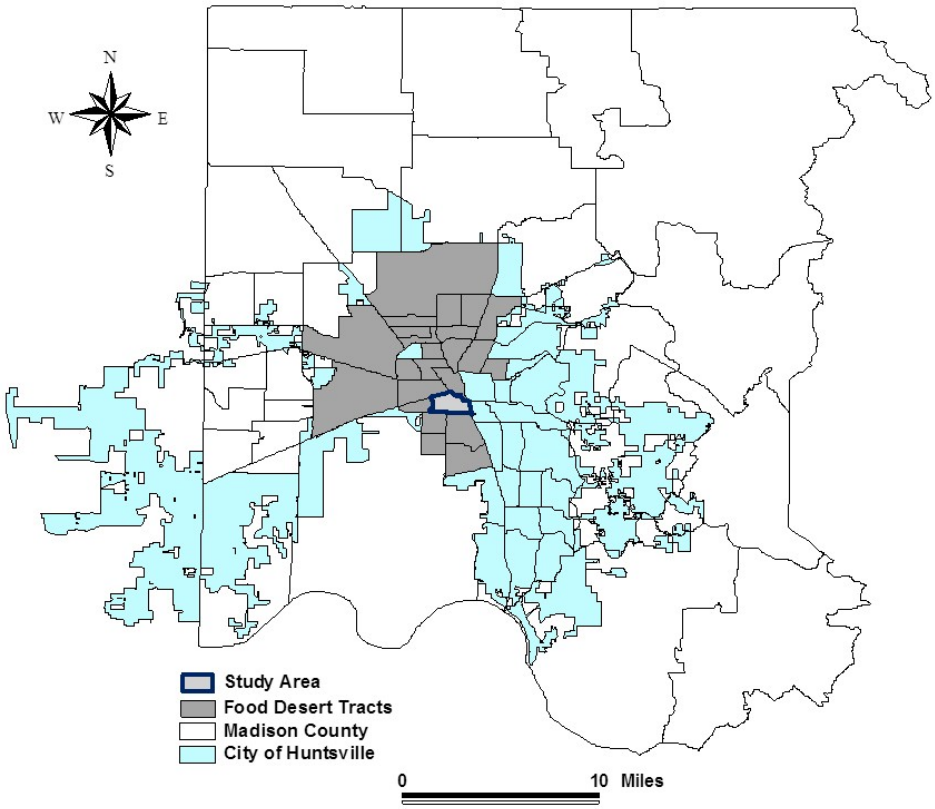
Study Area

West Huntsville is a suburban neighborhood (based on population density) located at latitude 34.715 and longitude -86.603 in Huntsville, Alabama (Figure 1). The 2015 population was estimated at 3,495, of which 26% of residents were 17 years of age or younger and 9% were 65 or older. The neighborhood stands out for having an average per capita income lower than 98.5% of the neighborhoods in the United States (NeighborhoodScout, 2017). With 71.5% of the children here below the federal poverty line, West Huntsville has a higher rate of childhood poverty than 98.3% of U.S. neighborhoods. Residents in West Huntsville most commonly identify their ethnicity or ancestry as African American (69.5%) and Mexican (9.2%). There are also a

[1] Specialty food stores are defined as food stores specializing in an item and include meat, seafood, and produce markets. Ethnic stores are any type of non-chain grocery store or supermarket selling food items that are distinctly cultural, often catering to specific segments of the immigrant population and whose signage is in a language other than English (Behjat, Koc, and Ostry, 2013).

number of people of Irish (7.3%), English (6.9%), Puerto Rican (2.3%), and Sub-Saharan African (1.9%) ancestry as well as other white American (2.9%). The greatest number of commuters in West Huntsville neighborhood spend under 15 minutes commuting one way to work (47.3% of working residents; and most residents (82.7%) drive alone in a private automobile to get to work.

Figure 1. Map of the Study Area: City of Huntsville, Alabama



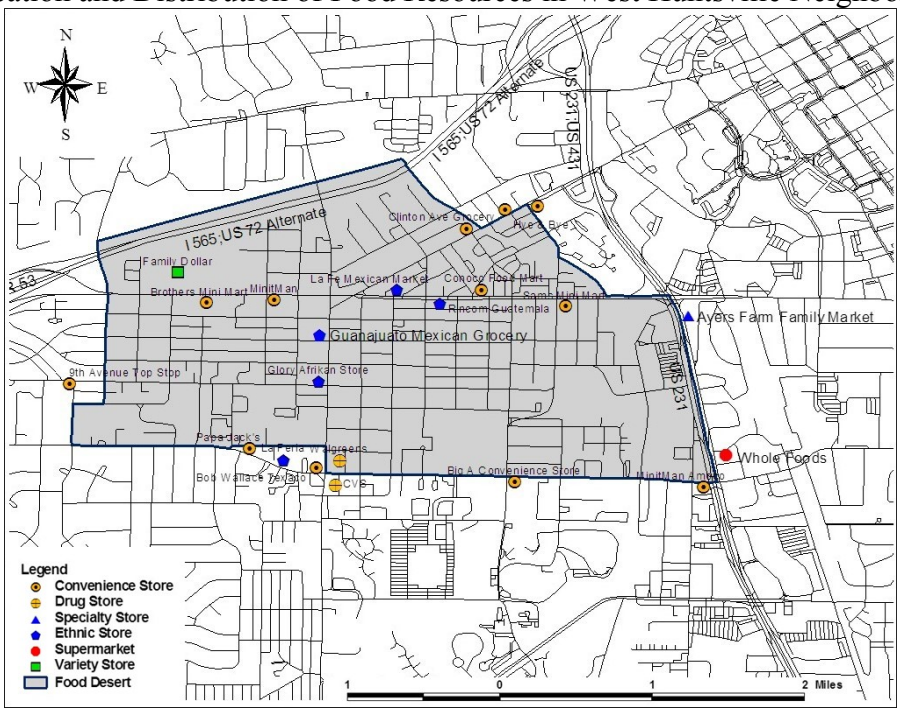
Source: Generated by author using information from City of Huntsville, GIS Division.

Food Store Data

Information on retail food resources (supermarkets, grocery stores, convenience stores, variant stores, drug stores, specialty and ethnic food stores, excluding prepared food such as restaurants) in the West Huntsville neighborhood was collected using a field questionnaire. Food resources outside the neighborhood but close to the study area boundary were also included to develop an accurate measure of food availability in the West Huntsville neighborhood. There are 22 food retailers located within or in close proximity to the West Huntsville neighborhood (Figure 2). Of these retailers, 55% were convenience stores,[2] 23% were ethnic food stores (23%), and specialty (4.3%) and supermarket (4.3%) located outside of the neighborhood boundary but in close

[2] Convenience stores are typically relatively small and specialize in packaged food and alcoholic beverages.

Figure 2. Location and Distribution of Food Resources in West Huntsville Neighborhood



Source: Generated by author using information from City of Huntsville, GIS Division

proximity to contribute to the food availability in the study area. Other stores identified included variety stores and drugstores, which represented 4.3% and 9%, respectively. The location of each food resource was geocoded into the city of Huntsville street file using ArcGIS 10.4 software.

To identify food stores that supply healthy and affordable food options, an in-store survey based on the *2015–2020 Dietary Guidelines* (U.S. Department of Health and Human Services and U.S. Department of Agriculture, 2015) was conducted. The survey data indicated that convenience stores, variety stores, and drug stores contribute to the local food environment but do not provide healthy food options. Among food store categories, only Guanajuato Mexican grocery (ethnic) and Ayers Farm Farmers Market (specialty) were found to supply healthy food options that meet the U.S. Department of Health and Human Services and U.S. Department of Agriculture dietary guidelines. Only three food stores (Whole Food, Guanajuato Mexican grocery, and Ayers Farm Famers Market) in the study area were found to supply healthy and affordable food options (Table 1). The analysis and discussion will focus on these three food stores.

Table 1. Type of Food Retailers in West Huntsville Neighborhood

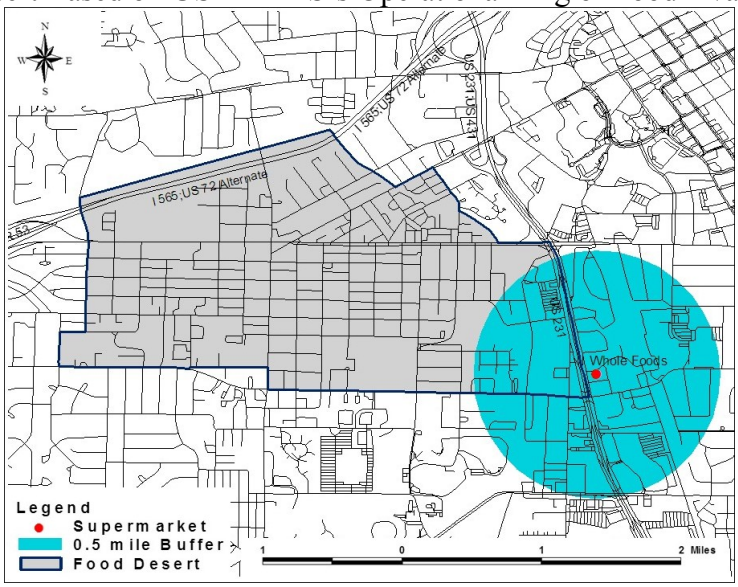
Type of Retail Store	Store Name	USDA Dietary Guidelines
Supermarket	Whole Foods	Completely
Specialty store	Ayers Farm Family Market	Completely
Ethnic store	Guanajuato Mexican store	Completely
Ethnic store	La Fe Mexican market	Partially
Ethnic store	Gloria Afrikan store	Partially
Ethnic store	La Feria	Partially

Ethnic store	Rincom Guatemala	Partially

Results

Figure 3 presents a food desert map based on the USDA's operational definition, which identifies a large portion of the West Huntsville neighborhood as a food desert. When the definition is expanded to include the contributions of ethnic and specialty food stores as suppliers of healthy and affordable food options, a relatively small portion of the West Huntsville neighborhood is identified as a food desert (Figure 4). The implication here is that focusing solely on supermarkets may underestimate food access in urban, low-income neighborhoods where small and specialty grocery stores are more prevalent.

Figure 3. Food Desert Based on USDA ERS's Operationalizing of Food Availability



Source: Generated by author using information from City of Huntsville, GIS Division.

Figure 4. Food Desert Based on the Current Study's Operationalizing of Food Availability

Source: Generated by author using information from City of Huntsville, GIS Division.

The findings of this study are consistent with the results of Martin et al. (2014), who indicated that classifying urban areas with few large supermarkets as food deserts may overlook the availability of healthy foods and low prices in small and medium-sized groceries common in inner cities. Similarly, in a study of ethnic markets in a low-income urban neighborhood in San Diego, Joassart-Marcelli, Rossiter, and Fernando (2017) offer evidence of the positive role that ethnic markets play in providing access to affordable, fresh, healthy, and culturally appropriate foods.

Conclusions

The objective of this study was to improve on methods used to determine food access and availability in low-income neighborhoods. The results support the hypothesis that food desert studies will considerably under-report the availability of healthy and affordable food options when not accounting for ethnic and specialty food stores. As others have noted, failure to include healthy food stores and culturally acceptable food choices in neighborhood studies of food deserts can significantly alter the results and hence mislead food planners and policy makers in decision making. However, although ethnic stores and specialty stores can be alternative sources of healthy food options, they may target specific segments of the local population. Further research is required to understand whether residents of other ethnicities face social and cultural barriers to using these options.

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Exploring Links between Health Perceptions and Financial Knowledge

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Abstract

Results from a random sample of 530 undergraduate students indicated that almost 50% of respondents ranked their health as being very good (30.2%) or excellent (19.6%) compared to 11.7% and 4.7%, respectively, who regarded their financial knowledge as being very good or excellent. Students who indicated that they were in excellent health were more likely to answer the financial quiz question on stock market risk correctly. Income and gender influenced the scores earned on the financial literacy quiz, but scores were invariant to age, academic classification, area of residence, household size, marital and work status, race, and health perceptions.

Keywords: financial knowledge, financial stress, health perceptions, National Financial Capability Survey, students

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Introduction

Since the 2008 global financial crisis, economists and others in the financial service industry have been shining a spotlight on Americans' low levels of financial literacy and their ramifications on the economy and consumers' health and well-being. In 2009, the Financial Industry Regulatory Authority Investor Education Foundation conducted the first National Financial Capability Survey to measure Americans' financial capabilities. Follow-up studies were conducted in 2012 and 2015. In all three studies, less than 50% of survey participants were able to correctly answer four or more of the five financial quiz questions.

Anderson, Baker, and Robinson (2017) incorporated questions from the National Financial Capability Survey along with questions from other sources to measure financial literacy among a sample of LinkedIn members. They found that, on average, financial literacy was low and that there were positive correlations among financial literacy, precautionary savings, and retirement planning for perceived but not actual scores earned on the financial quiz. Low-literacy respondents were less willing to accept financial advice. Kramer (2016) found a similar result on overconfidence and the seeking of financial advice among survey participants from the Netherlands. Respondents with higher confidence were less likely to seek advice than their corresponding counterpart.

Gubler and Pierce (2014) explored relationships between the decision to contribute to a 401(k) retirement plan and corrective actions to improve poor physical health. They found a high correlation between the two activities for those who contributed to the 401(k) plan compared to those who did not contribute. Other research findings suggested that health and financial literacy led to improvements in the health and well-being and better decision making in older adults (James et al., 2012), that conscientiousness and financial literacy were consistent predictors of asset accumulation among young adults (Letkiewicz and Fox, 2014), and that there were strong positive associations between financial literacy and net worth (van Rooij, Lusardi, and Alessie, 2012). O'Neill, Xiao, and Ensle (2016) used an online quiz to examine relationships between health and financial practices. They concluded that statistically significant relationships existed between health and financial behaviors with respect to time commitments and the avoidance of selected negative health practices. Race, income, and education levels also influenced these practices. O'Neill (2015) drew similar conclusions.

Consumer education programs focusing on health and personal financial management issues have been undertaken for several decades (O'Neill, Xiao, and Ensle, 2016). However, because of the 2008 financial crisis and Great Recession, rising healthcare costs, obesity rates, student loan debt, and financial stress, and the complexity of financial products, federal and state agencies and educational institutions are adopting a more holistic approach when addressing health and financial issues in order to improve the effectiveness of the educational programs being offered (Frentzel et al., 2010; Heckman, Lim, and Montalto, 2014).

As college costs and student debt load mount, more students are indicating that they are under financial stress, that the stress is causing anxiety, and that it is affecting their academic performance (Heckman, Lim, and Montalto, 2014). Coupled with financial stress is the high level of financial illiteracy prevalent among college students. Personal financial management

courses are often not taught in high schools or in colleges. Many college students lack the financial acumen to navigate the increasingly complex world of finance. Consequently, many do not understand how to budget, save, invest, or the importance of credit, among others. Because of the high level of financial illiteracy, concepts such as the time value of money are often not well understood, and as a result of which, many students often borrow more money than they will be able to comfortably repay from future earnings. Financial illiteracy and poor financial decisions can lead to future financial stress and health issues.

The two major health effects of financial stress are anxiety and depression, but financial stress can also cause or worsen a host of other health issues, including heart disease/attack, gastrointestinal problems, weight gain/loss, eating disorders, diabetes, insomnia, psoriasis, cancer, high blood pressure, and substance abuse (Cambridge Credit Counseling Corporation, 2017). Given the level of financial stress expressed by many college students, the negative health effects of financial stress, and the low level of financial literacy among young adults, our study explores whether there are links between health perceptions and financial knowledge in a selected group of college students.

Objectives

The study's specific objectives are to i) describe students' perceptions of their health status and levels of financial knowledge; ii) compare perceptions of health with performance on the National Financial Capability Survey quiz; iii) determine whether selected sociodemographic characteristics—age, academic classification, area of residence, household size, income levels, marital status, work status, gender, race, and health perceptions—influence performance on the financial literacy quiz. The study provides baseline data and enables us to help students to expand their knowledge about their health and finances.

Methods and Procedures

The study's data were compiled from a random sample of 530 undergraduate students in fall 2015. The survey's primary focus was to measure participants' level of knowledge on basic personal financial management concepts. The 48-item survey gathered information on self-assessments of financial literacy and health; budget, credit and credit cards, saving, and investing; financial experiences; and demographic characteristics—age, academic classification, major, area of residence, household size, marital and work status, race, family household income, and gender.

To address the stated objectives, we used a subset of the data on perceptions of health and financial knowledge, performance on the National Financial Capability Survey quiz, and sociodemographic characteristics. Data on health perceptions were compiled by asking respondents to rank whether they perceived their overall health as poor, fair, good, very good, or excellent. To measure perceptions on financial knowledge, respondents were given a similar five-point scale from which to rank their levels of financial knowledge as poor, fair, good, very good, or excellent. The financial literacy quiz questions dealt with interest rate computation (INTEREST), inflation (INFLATION), bond prices (BOND), mortgage payments (MORTGAGE), and stock market risk (RISK).

The data were analyzed using descriptive statistics, the Chi-square tests for independence, and linear regression. Equation (1) shows the linear regression model used in the study to determine whether relationships existed between the dependent variable, SCORE, and the selected demographic characteristics. The variables, their definitions, and summary statistics are given in Table 1.

$$(1) \quad SCORE = \beta_0 + \beta_1 AGE + \beta_2 CLASS + \beta_3 LIVE + \beta_4 HSIZE + \beta_5 INCOME + \beta_6 MSTATUS + \beta_7 WORK + \beta_8 GENDER + \beta_9 RACE + \beta_{10} HEALTH + \varepsilon,$$

where βs are unknown parameters to be estimated and ε is a random error term.

Table 1. Variables, Definitions, and Summary Statistics

Variables	Definitions	Summary Statistics
Independent		
AGE	Participants' age in years	19 (mean)
CLASS	Freshman = 1; otherwise = 0	49%
LIVE	Lives on campus = 1; lives off campus = 0	51%
HSIZE	Number of persons living at participants' permanent address	3 (median)
INCOME	Family's total household income: <$15,000=1; $15,000–$34,999 = 2; $35,000–$49,999=3; ≥$50,000=4	2 (median)
MSTATUS	Single, never married = 1; otherwise = 0	94%
WORK	Working = 1; otherwise = 0	47%
GENDER	Male =1; female = 0	39%
RACE	African-American = 1; otherwise = 0	90%
HEALTH	Poor =1; fair =2; good = 3; very good = 4; excellent = 5	3 (median)
Dependent		
SCORE	Percentage Earned on Financial Quiz	29.25%

Empirical Results and Discussion

From the results, 81.9% of the participants regard themselves as being in good (32.3%), very good (30%), or excellent health (19.6%). At the other end of the spectrum, 52.5% of the participants indicate that they possessed good (40.8%) to very good (11.7%) financial knowledge, while about 4.7% assess their knowledge as excellent. The average age of participants is 19 years. Most participants are freshmen (49%), living off campus (51%), single (94%), female (61%), and African-American (90%). Median household income is between $15,000 and $34, 999, and 53% do not have a job. The average score on the financial quiz is 29.25% (Table 1).

Table 2 shows cross-tabulations between participants' health perceptions and their performance on the National Financial Capability Survey. The results suggest that overall performance is low and not dissimilar from performance at the state and national levels. The results also indicate that there are no statistically significant differences between health perceptions and performance on the quiz except for the question on stock market risk. Participants who ranked their health as being very good or excellent performed better on that question than those who perceived their health as being poor, fair, or good. Although our sample is more homogeneous than in several of the articles reviewed, our results concur with studies that suggest that healthier individuals are more likely to invest in the stock market than those who are less healthy.

Table 2. Cross-Tabulations between Health Perceptions and Performance (%)

Responses	Poor	Fair	Good	Very Good	Excellent	Chi-Square	P-Value
Total	2.8	15.3	32.3	30.0	19.6		
Interest							
Incorrect	3.6	16.3	30.1	30.7	19.3		
Correct	1.8	13.8	35.3	29.0	20.1	3.277	0.513
Inflation							
Incorrect	2.8	15.2	31.2	30.7	20.1		
Correct	2.9	15.4	35.3	27.9	18.4	0.933	0.920
Bond							
Incorrect	2.7	15.3	30.6	31.1	20.2		
Correct	3.2	15.2	37.6	26.4	17.6	2.571	0.632
Mortgage	2.8	15.3	32.3	30.0	19.6		
Incorrect	3.4	15.2	32.9	31.7	16.9		
Correct	1.7	15.5	31.0	26.4	25.3	6.583	0.160
Risk							
Incorrect	3.1	15.2	35.7	29.5	16.4		
Correct	1.7	15.5	19.8	31.9	31.0	17.800***	0.001

Results from the multivariate analysis in Table 3 suggest that performance is statistically significantly influenced by income and gender but invariant to age, academic classification, area of residence, household size, marital status, work status, race, and health perceptions. Other things held constant, the average score on the quiz is about 23%. Participants from higher income households perform slightly better than those from lower income households. Male participants score about 9 percentage points higher on the quiz than female participants. These results also suggest that level of financial literacy is low and must be addressed to give students a better opportunity to effectively manage their finances.

Table 3. Linear Regression Results

Variables	Estimated Coefficients	Standard Error	t-Value	P-Value
Constant	23.234***	5.740	4.048	0.000
AGE	0.055	0.260	0.212	0.832
CLASS	-1.828	2.275	-0.804	0.422
LIVE	-2.972	2.182	-1.362	0.174
HSIZE	0.985	0.729	1.351	0.177
INCOME	1.665*	0.952	1.749	0.081
MSTATUS	1.100	3.686	0.299	0.765
WORK	-1.612	2.071	-0.778	0.437
GENDER	8.506***	2.176	3.909	0.000
RACE	-1.066	3.799	-0.281	0.779
HEALTH	0.570	1.016	0.560	0.575
F-Value	2.539***	0.005		

Notes: Single and triple asterisks (*, ***) imply statistical significance at the 10% and 1% level, respectively.

Summary and Conclusions

The study's main objectives were to document students' perceptions of their health and financial knowledge; their performance on the National Financial Capability Survey financial quiz, and whether there were any associations among performance, sociodemographic characteristics, and health perceptions. The results indicated no statistically significant relationships between health perceptions and performance on the quiz questions dealing with interest rate, inflation, bond prices, and mortgage payments. However, students who rated their health as being very good or excellent were more likely to correctly answer a question about whether a single company's stock was riskier than a stock mutual fund. Male participants and those from higher income households performed better on the financial literacy quiz.

Since the 2008 financial crisis and the passage of the Affordable Care Act in 2010, researchers are recognizing that many Americans do not have the tools to successfully navigate the financial and healthcare markets, even as they are being asked to make more health and financial decisions. Thus, more studies are combining the two issues to develop better ways to educate consumers in these two very important areas. Although our study was primarily about financial literacy, it provided us with a small window on these two important issues so we can help to educate students in these areas. Financial literacy is low throughout the country, while overweight and obesity rates and healthcare costs are skyrocketing. Given the rising federal budget deficit and healthcare costs, it is incumbent on all of us to learn about money and how to take better care of our health. Colleges and universities can play a greater role in getting the information to young adults and in so doing help them to become more informed citizens. We must strive for this goal so as not to impede future economic growth.

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Current Trends, U.S. Immigration Policies, and Marketing Strategies for Goat Meat

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Abstract

Demand for goat meat currently depends on foreign-born immigrants, but current U.S. immigration policies may have negative impacts on immigrant populations, which may affect the meat goat industry. Data from a consumer survey conducted in Georgia was used to determine the potential domestic market for value-added goat meat products among foreign- and native-born Americans. About 56% of participants who had never tasted goat meat expressed willingness to taste if the grocery stores gave out goat meat samples. Current goat meat consumers were more willing to pay for locally grown, grass fed, and organic goat meat.

Keywords: immigration policies, marketing strategies

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Introduction

Goat meat is one of the most widely consumed meats in the world, especially in developing countries. Although goats have been raised in the United States for centuries, they are mostly produced for milk and fiber. According to the U.S. Department of Agriculture (USDA, 2017a), there are 80% more meat goats (2,115,000) than all of the other types of goats in the United States. Even though goat inventory has increased in past years, demand still exceeded supply, a fact that was reflected in a sharp increase in imports and has made the United States the world's leading importer of goat meat since 1999 (Extension, 2015).

In 2017, imports of fresh, chilled, or frozen sheep or goat meat increased by 27%, from $523.55 million to $665.04 million, through the first 8 months when compared to the same period of 2016. Most of these imports came from Australia and New Zealand (World City, 2017). This import increase has been attributed to an influx of recent immigrants from non-European countries where goat meat is widely consumed: 87% of the U.S. foreign-born population comes from non-European countries (U.S. Census Bureau, 2010).

The Pew Research Center (2015) recognized a dramatic shift in immigrants' origins that occurred between 1960 and 2013. In 1960, 85% of immigrants were from Europe or Canada, but by 2013, 78% of immigrants were from South/East Asia, Mexico, and other Latin American countries. The goat industry is projected to grow as long as the U.S. ethnic population continues to increase (U.S. Department of Agriculture, 2005).

If changes in the U.S immigration policy limit the entry or presence of migrants from the countries where goat meat is widely consumed, meat goat producers and markets will have several questions: What is the future of the meat goat industry and goat meat market? What impact would immigration policies changes have? Will there be opportunities for domestic goat farmers if ethnic populations decrease?

This research provides meat goat producers with strategies to capture larger markets. Specific objectives were to examine consumers' views on domestic goat meat compared with imported goat meat and their willingness to buy locally produced meat and to examine favorability of locally produced, genetically modified (GM), organic, and grass-fed meat goats.

Methods and Analysis

This study uses data from a consumer survey of 593 Georgia residents conducted in 2012. Of these respondents, 92.6% were native born, and 85% had never tasted or eaten goat meat. Many of them had not been exposed to it. When asked whether they would be willing to buy goat meat if it were available in their local store, about 54% answered affirmatively. Hence, a larger goat meat market may be attained with strategies that would appeal to potential consumers.

This study examined i) whether consumers perceive domestic goat meat to be safer compared to imported goat meat; ii) consumers' preferences for locally grown and fresh goat meat; and iii) the consumers' perceptions of health aspects of goat meat. Additionally, the 86 respondents who

had tasted goat meat were asked about their preferences for types and varieties of processed goat meat products.

Domestic Goat Meat Is Safer than Imported Goat Meat

The U.S government ensures food safety at all levels with various USDA food safety and inspection programs. The U.S. Food and Drug Administration (FDA) requires producers to label all animal feed ingredients to prevent animal byproducts (such as meat and bone meal) from entering the ruminant food supply chain (USDA-ERS, 2017b). The safety of the supply chain is maintained by federal regulations that require livestock inspection before slaughter and meat inspection after slaughter (USDA-ERS, 2017b). However, the nearly 200 countries that export foods to the United States do not have the exact same pesticide, food additive, and veterinary drug approval systems as the United States, and many of these countries do not have any food safety or quality control programs (Wallace and Orja, 2010).

Therefore, the quality of imported goat meat to the United States can be questioned, and goat meat consumers in this study were asked whether they felt domestic goat meat was safer than imported. The study found that 48.20% either strongly agreed or agreed that domestic goat meat is safer than imported goat meat; only 13.25% disagreed or strongly disagreed. This may imply that Georgia goat meat consumers prefer domestic over imported goat meat. As of today, a large quantity of imported goat meat comes to market, which suggests that strategies for promoting domestic goat meat may encourage buyers to purchase domestically produced meat.

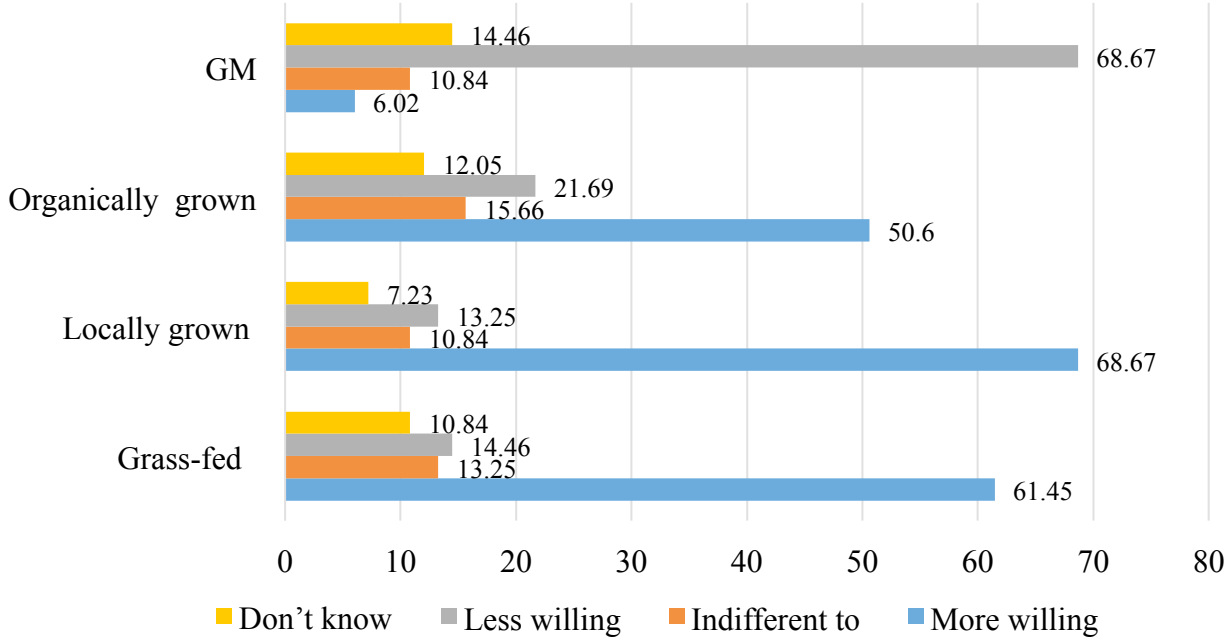
Loureiro and Umberger (2003) found that respondents wanted to pay more for products labeled "U.S. Certified Steak" and "U.S. Certified Hamburger." Consumers' confidence may therefore positively reflect demand for domestically produced goat meat because many U.S. food firms exceed regulated food safety standards or requirements (USDA-ERS, 2017b).

Willingness to Buy Locally Grown

Defining local food can be complex, and the definition varies with purpose, geography, and data availability. Local food represents local ownership of the farm and is associated with natural, organic, and other specialty foods marketed through direct consumer outlets (Martinez et al., 2010; Adams and Adams, 2011; Low et al., 2015). Consumers', producers', and policy makers' interest in local foods appears to be growing, and local food has been the subject of federal, state, and local government policies in recent years (Low et al., 2015). Several studies have examined consumers' preferences for various meat products. Maynard, Burdine, and Meyer (2003) found that locally produced ground beef with higher fat content was most preferred in terms of juiciness, texture, and overall palatability when compared to chicken. A large majority of consumers preferred every attribute of the product purchased from the grocery store to the locally produced free-range chicken. Feldman and Ham (2014) found that, unlike organic food, local food was not perceived to be expensive. Hence, information about consumers' preferences for local goat meat is important in understanding the impact on local and regional goat meat industries across the country. Will Americans be more willing to buy more of local goat meat versus organic, grass fed, or genetically modified (GM) goat meat? The current goat meat consumers were asked whether they would be more willing, indifferent to, or less willing to buy

goat meat with different production attributes—such as grass-fed, organic, locally grown, and GM—if they were available. Consumers were more willing to purchase locally grown goat meat (68.67%) than grass-fed (61.45%) and organic goat meat (50.6%) (Figure 1). Only 6.02% were more willing to purchase GM goat meat, and 68.67% were less willing. This may indicate that locally grown goat meat may capture a larger share at the goat meat market. However, consumers' preferences for locally grown, grass-fed, or organic may need to be examined further. Local governments also provide many fiscal incentives for local food producers, retail stores, and farmers' markets such as loans, grants, or reduced permit and license fees. Several states also have adopted legislation to provide financial incentives for food retail outlets and local food retailers to locate in areas with low access to healthy food in order to increase food access (Neuner, Kelly, and Raja, 2011; Winterfeld et al., 2012).

Figure 1. Percentage of Respondents Willing to Buy GM, Organic, Locally Grown, or Grass-Fed Goat Meat



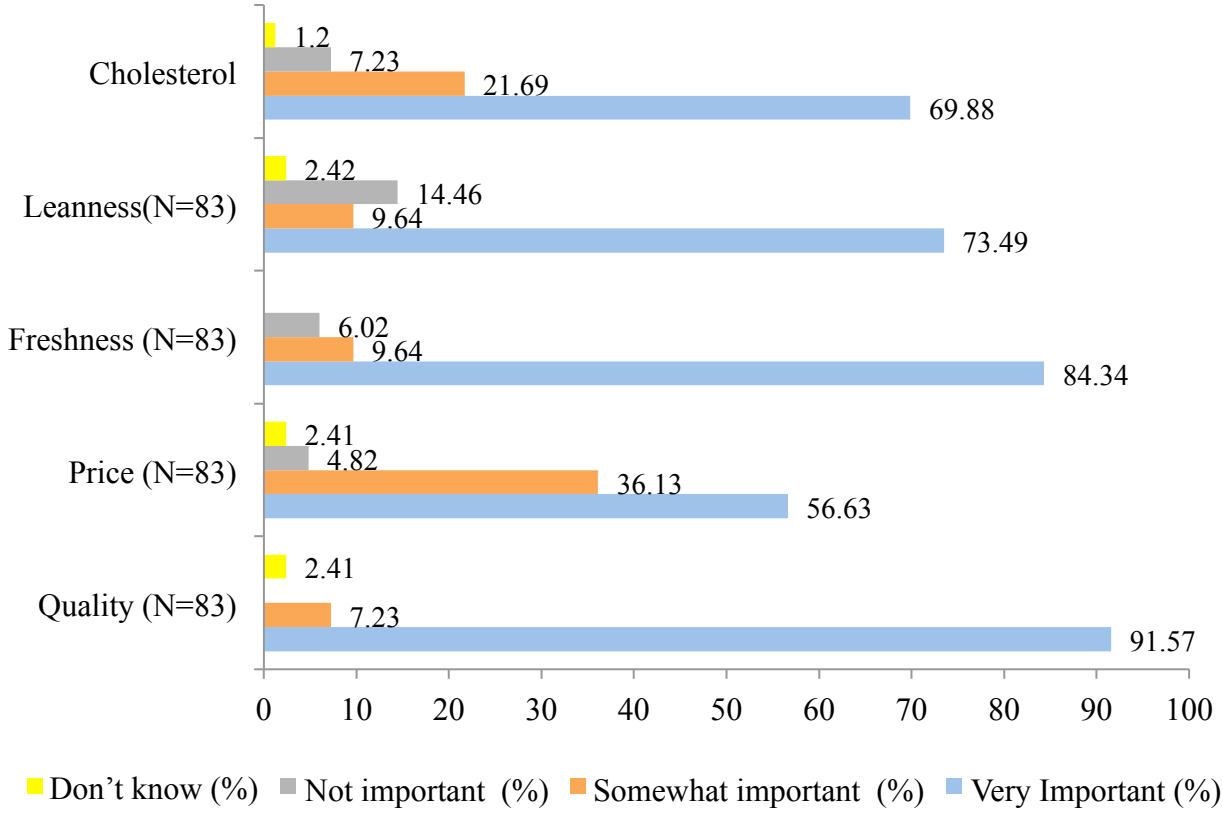
Freshness or Not Frozen Goat Meat

The survey asked whether freshness and taste/flavor of goat meat were important factors for consumers' meat purchasing decisions. Meat quality, taste, and tenderness were very important for 91.57% of the goat meat consumers, and 94% of the respondents indicated that freshness or not frozen meat was either very important or somewhat important. According to the FDA's refrigerator and freezer storage chart, fresh meat can be refrigerated (at 40° F or 4° C) for 4–5 days before spoiling. Hence, local producers may be necessary to supply consumers' demand for fresh goat meat. This could make room for larger domestic goat meat production, and emphasis to increase local production could shift demand from imported frozen goat meat to local production. However, imported frozen goat meat is much cheaper compared to locally produced (Ashby and Lantz, 2010; Luginbuhl, 2015). In our study, 56.63% of respondents said that price was a very important factor.

Health-Conscious Consumers

In addition to many other benefits, goat meat is high in protein and lower in calories, total fat, saturated fat, and cholesterol compared to chicken, beef, pork, and lamb (USDA Nutrient Database, 2018). Saturated fat can increase levels of "bad" LDL cholesterol; less saturated fat and less cholesterol mean healthier red meat for the health-conscious consumer (Harvard Medical School, 2017; Correa, 2016). This is reflected in goat meat consumers in Georgia: 73.49% stated that leanness or less fat meat was very important, and 69.88% said that less cholesterol was very important (Figure 2). Ibrahim et al. (2016) showed that Individuals with higher levels of education were more likely to consume goat meat. Therefore, using an educational strategy, goat meat can be promoted as a healthy meat in the U.S. market.

Figure 2. Respondents' Views on Various Healthy Aspects of Goat Meat



Product Marketing Strategy

The survey found that 73.56% of respondents did not purchase raw goat meat. Hence, producers can add value by marketing meat goats as locally grown, grass-fed, and organic to the various niche markets. When asked "To compare with a package of beef jerky (1 ounce) which is typically sold for between $1.29 and $2.00 in grocery store, would you willing to buy goat jerky?" 35% of goat meat consumers were positive. Hence, producers could develop value-added products analogous to existing products that are familiar to consumers (e.g., jerky, sausage, and

burgers). The survey also found that 24.42% of goat meat consumers preferred skinless and 26.74% preferred singed (skin-on burnt) types of goat meat.

Future Studies

Future studies of fresh, not frozen, goat meat and price may need to be conducted, and import policies should be enhanced so that local producers can compete with cheaper imported frozen goat meat. Food safety policies must apply to both domestic and imported goat meats, which may cut down the import quantity or raise imported goat meat price.

Conclusion

Domestic goat meat was considered by many respondents to be safer than imported goat meat, and locally grown goat meat was preferred to GM, grass-fed, and organic goat meat. Goat meat consumption can be increased through value-added products (sausage) and attributes (locally grown, organic, and grass-fed), especially among the native-born population and by targeting those who are willing to taste goat meat. A marketing strategy such as promoting health benefits may attract new consumers as well.

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