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Research Update: Consumer Responses to Price Promotion of Organic Products in Virtue and Vice Food Categories

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A substantial body of literature has examined price premiums, willingness-to-pay (WTP), and demand elasticities for organic products, but they have yielded conflicting results regarding how consumers respond to price changes of organic products. These mixed results may be attributed to a number of factors, including frequency of buying organic products, product categories, and consumers' adaptation to prices of organic products over time. This study investigates the effects of price promotions on purchases of organic products in relative virtue and vice food categories.

Consistent with prior research, we consider healthy and unhealthy foods as relative virtue and vice foods, respectively. Using data from the 2015 Nielsen Consumer Panel, our preliminary analyses focus on 57 food categories. Building on the standard log–log model of assessing the effect of price promotions on sales, we consider possible differential responses between organic and nonorganic food within each product category. The estimated demand elasticities suggest that

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consumers are less sensitive to price changes in organic foods than in conventional foods in certain categories but more sensitive in other categories.

We use a logit model to investigate how differential responses depend on food category features, especially the virtue/vice classification. The virtue feature increases the probability that consumers are more sensitive to price changes of organic foods compared to conventional counterparts. This is consistent with past findings that the own-price elasticities of organic fruits and vegetables (virtue foods) are higher than those of their conventional counterparts using data from both the United Kingdom and United States. Consumer WTP for organic products is higher among virtue products, which translates to higher price premiums for organic virtue foods, making a price discount enticing.

A price discount on organic virtue foods is more likely to trigger indulgent consumption, as consumers don't need to find justifications for consuming larger quantities of healthy products. In contrast, to mitigate the guilty feeling from consuming vice foods, consumers may impose quantity constraints on the consumption of these foods, making them less price elastic.

We conclude that price promotion effects of organic foods are stronger in virtue categories. Understanding these differential effects has important implications for both manufacturers and retailers in terms of distinctive promotion strategies for organic virtue and vice foods.

Keywords: demand elasticity, price promotion, organic foods, vice food, virtue food

Acknowledgments

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

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

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Research Update: Classifying Primary Agricultural Producers in Local Foods Marketing Channels: Using the Organizational Species Concept to Understand Strategic Profiles

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For the past 30 years, social movements have emphasized food distribution systems that provide for proximal, socially embedded transactions as alternatives to the industrialized food system that has come to be conventional in many Western economies. These systems—whichare known as local and regional food systems in the United States and short food supply chains in Europe—allow multiple modes of distribution, including consumers entering the place of primary production to make purchases, purchasing directly from producers at markets or over the Internet, arrangements where intermediaries act as guarantors of source identification and social embeddedness, and third-party certification schemes that convey information across value chains. Each of these distributional frameworks can be expected to have differing costs and benefits to firms at the primary production stage. However, it is naïve to presume that all primary agricultural producers (PAPs) will adopt the same strategic mix of various channels. Classifying PAPs in a meaningful way helps develop an understanding of agent behaviors and can inform policy choices about system-level outcomes.

In this update, I create such a classification, applying the *Organizational Species Concept* and attendant methodology developed by Entsminger and Westgren (2019) to PAPs using data from the U.S. Department of Agriculture's 2015 Local Foods Marketing Practices Survey. My classification centers on morphological traits of PAPs, including resource endowments, operator characteristics (as proxies for experience, networks, and barriers to access), production choices, channel diffusion, and proximity of sales to the farm gate. I use strategic orientations in the form of channel and product reliance to validate the groupings.

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Results indicate the presence five to eight species of PAPs engaged in U.S. local and regional food systems. These species show differences in the strategic mix of distributional channels chosen. Moreover, preliminary analysis indicates that factors of gender, status as a racial or ethnic minority, and organic certification are associated with differences in both morphological characteristics and strategic choices.

These findings show that meaningful differences among PAPs lead to the selection of different distributional strategies, which in turn has implications for policy objectives on scaling up local and regional food systems and achieving more inclusive marketing arrangements.

Keywords: channel choice, distribution strategies, farmers, food systems, local foods, organizational form, organizational species

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Research Update: One Box Does Not Check All: Investigating Farmers' Likelihood of Certifying Organic, Dropping Out of Certification, or Remaining Noncertified

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Market trends have motivated growers to take advantage of economic opportunities in the organic certified industry. Price premiums, access to markets, environmental concerns, and philosophical beliefs have been the main drivers of organic certification adoption among fruit and vegetable (FV) farmers. The production of and demand for organic products is mainly driven by consumers' concerns regarding health, the environment, and animal welfare. Still, some farmers have dropped the certification, and a vast number prefer to farm conventionally.

Understanding farmers' reasons for becoming organic certified is important for expanding the supply of organic foods. While most studies have focused on understanding why farmers become certified organic after practicing conventional or noncertified systems, our study provides an all-inclusive characterization of FV farmers and investigates their motives for choosing their status on the organic certification spectrum. Using data from an online survey of 1,559 FV producers registered in Food Industry MarketMaker, this study investigates key drivers influencing farmers to (i) stay in the conventional agriculture, (ii) produce noncertified organic food, (iii) get certified as organic, or (iv) drop their certification status.

Using a multinomial logit regression, we calculate the marginal effects to estimate the drivers and barriers that lead farmers to choose their status from among the organic and conventional

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categories. Results show that market access and farmers' demographics, sources of information, and perceptions are key factors influencing growers' status with regard to organic agriculture.

Market access is a major factor influencing farmers' certification status. Using multiple market channels drives farmers to certify. One explanation for this may be that these producers are potentially taking advantage of their certification status to access price premiums and diversify their produce distribution.

Results also suggest that organic certification costs are a barrier to certification, and they are likely too high for small FV operations. Bigger farms, which have more resources, may be more likely to become and remain certified.

Farmers obtaining information from extension services and growers associations were more likely to farm conventionally.

Finally, perceptions about organic agriculture and its certification process were leading drivers affecting farmers' decisions to produce organic food (certified or not).

This study provides insights into characteristics and drivers of conventional, organic noncertified, certified, and certified dropped out operations. Our findings can help policy makers, industry stakeholders, extension agents, and researchers derive incentives and programing to enhance the organic objectives and support the long-term sustainability of organic agriculture.

Keywords: barriers, conventional, drivers, fruit, organic, perceptions, market access, vegetable

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Research Report: Market Integration in the Staple Food Derivatives Markets in Uganda

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Abstract

This paper examines the integration of staple food derivatives markets in Uganda. Monthly retail prices for white maize and cassava flour are collected from the Kampala central market and four geographically separated regional markets. Findings confirm significant long-run market integration among three of the eight market pairs and the presence of symmetric adjustment processes for all market pairs. Unidirectional and bidirectional Granger causality running from the central market of Kampala to the regional markets was confirmed, implying that while Kampala serves as the exogenous market, in some instances it is also influenced by regional market prices.

Keywords: cassava flour, Granger causality test, Kampala, staple food derivatives markets, TAR and M-TAR threshold autoregressive models, white maize flour

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Introduction

As documented in previous literature, food scarcity persists when food markets are not integrated because deficient markets fail to send the right signals to the surplus markets (Ghosh, 2003; Mukhtar and Javed, 2007; Katengeza, Kiiza, and Okello, 2013). This study, therefore, extends the literature by analyzing the level of market integration and determining the causal relationships among geographically separated staple food markets in Uganda. Although price integration in the staple food markets has been widely studied (Maleko, 2013; Minot, 2014; Yovo, 2017), very few studies exist for staple food derivatives markets in Uganda. The analysis focuses on two staple food derivatives markets—white maize and cassava flour. White maize flour is an important staple food derivative for the urban poor and those associated with institutional settings—hospitals, prisons, schools, and internally displaced person (IDP) refugee camps in northern Uganda (Benson, Mugarura, and Wanda, 2008; Famine Early Earning System, 2017). Similarly, cassava flour is essential for those in Eastern Uganda, where it is often mixed in various proportions with millet flour to produce a more nutritious and tasty composite meal to meet household dietary needs (Kleih et al., 2012).

Kampala, which accounts for about 50% of the formal staple food trade in Uganda, serves as the reference market. The selected regional markets are Mbarara in the west, Iganga in the east, and Gulu and Lira, which are critical markets serving the structurally deficit Karamoja subregion (Famine Early Warning System, 2017), in the north. Threshold autoregressive approaches (TAR and M-TAR) and Granger causality tests are employed to examine integration between the selected regional markets and the central market.

Methodology

Cointegration Testing

There are several time-series techniques for testing the different components of price transmission and thus ultimately assessing the extent of market integration. This study uses the threshold autoregressive approach, extended by Balke and Fomby (1997) to a cointegration framework and by Enders and Siklos (2001) to allow asymmetric adjustments when testing for a long-run relationship between two time series. Consider, for instance, the long-run equilibrium relationship between price series $P^C{}_t$ (price at the central market) and $P^L{}_t$ (price at the local, regional markets), such that

(1) $$P_t^C = \alpha_0 + \alpha_1 P_t^L + e_t,$$

where $P^C{}_t$ and $P^L{}_t$ are nonstationary series, e_t is a random error term with constant variance, α_0 is an arbitrary constant that accounts for price differential (e.g., transportation costs) and α_1 is the estimated parameter of the cointegration regression. Then, according to Engle and Granger (1987), the long-run market integration within this framework involves testing whether the marketing margin (e_t) is stationary by estimating the following relationship:

(2) $$\Delta e_t = \rho e_{t-1} + \varepsilon_t,$$

where the lags of the dependent variable can be included by relying on information criterions (such as the Akaike information criterion) to ensure that the error term (ε_t) is a white-noise process. Accordingly, stationarity of the residuals (i.e., $-2 < \rho < 0$) with mean 0 indicates rejection of the null hypothesis of no cointegration ($\rho = 0$), where the *t*-statistic is compared to the Dickey–Fuller critical values for unit root test.

In the presence of asymmetric adjustment, however, the Engle and Granger (1987) cointegration approach is incorrectly specified since it implicitly assumes linear and symmetric adjustment mechanism (Enders and Siklos, 2001). Enders and Siklos have extended the famous two-step symmetric Engle–Granger procedure, providing an approach that allows asymmetric adjustments toward long-run equilibrium to occur when testing for a long-run relationship. Their threshold autoregressive (TAR) and momentum-threshold autoregressive (M-TAR) testing procedures account for a nonzero threshold to reflect positive transaction costs. The TAR-consistent model takes the form

(3) $$\Delta e_t = I_t \rho_1 e_{t-1} + (1 - I_t)\rho_2 e_{t-1} + \sum_{i=1}^{p} \gamma_i \Delta e_{t-i} + \varepsilon_t,$$

where I_t is the Heaviside Indicator function, such that

(4) $$I_t = \begin{cases} 1 & \text{if } e_{t-1} \geq \tau \\ 0 & \text{if } e_{t-1} < \tau, \end{cases}$$

and τ is the threshold value. As an alternative adjustment process, the M-TAR-consistent model is specified as

(5) $$\Delta e_t = M_t \rho_1 e_{t-1} + (1 - M_t)\rho_2 e_{t-1} + \sum_{i=1}^{p} \gamma_i \Delta e_{t-i} + \varepsilon_t,$$

where I_t is the Heaviside Indicator function, such that

(6) $$M_t = \begin{cases} 1 & \text{if } \Delta\hat{e}_{t-1} \geq \tau \\ 0 & \text{if } \Delta\hat{e}_{t-1} < \tau. \end{cases}$$

According to Enders and Granger (1998), the M-TAR-consistent model is especially valuable when the series exhibits more "momentum" in one direction than in the other. It allows the autoregressive decay to depend on Δe_{t-1}. The adjustment is then modeled by $\rho_1 e_{t-1}$ if Δe_{t-1} is above the threshold and by $\rho_2 e_{t-1}$ if Δe_{t-1} is below the threshold. If $|\rho_1| > |\rho_2|$, the M-TAR model exhibits little decay for negative Δe_{t-1} but substantial decay for positive Δe_{t-1}. Estimating the threshold models requires some method for estimating the threshold parameter, τ. This study employs Chan's (1993) method, and the lag selection is based on the AIC.

To test for threshold cointegration, Enders and Siklos (2001) proposed two types of tests: the Φ and *t*-Max statistics. The Φ statistic (using an *F*-statistic) involves procedure testing for the null hypothesis of no cointegration ($H_0 : \rho_1 = \rho_2 = 0$); the *t*-Max statistic (employing a *t*-statistic) requires the test for the null hypothesis with the largest $\rho_i = 0$ between ρ_1 and ρ_2. The threshold parameter τ, which is restricted to the ranges of the remaining 70% of $\hat{e}_t$ or $\Delta\hat{e}_t$ when the largest and smallest 15% values are discarded, is selected as an unknown value to minimize the sum of the squared residuals obtained from equations (3) and (5). In the presence of asymmetric cointegration, the null hypothesis $(H_0 : \rho_1 = \rho_2)$ is tested using the standard *F*-statistics. Accordingly, the evidence in support of asymmetric adjustment of the error correction term is indicated when both $H_0 : \rho_1 = \rho_2 = 0$ and $H_0 : \rho_1 = \rho_2$ are rejected.

Testing for Causality

The focus here is on the question of whether price at the central market (P^C) causes price at the regional market (P^L) and vice versa (Engle and Granger, 1987). This is accomplished by examining how much of the current price at the regional markets can be explained by past values and then whether adding lagged values of P^C can improve the explanation. The Granger model can be represented as

$$\Delta P_{it} = \sum_{i=1}^{m} a_i \Delta P_{i(t-1)} + \sum_{j=1}^{n} a_j \Delta P_{j(t-1)} + \ell_t, \tag{7}$$

where *m* and *n* are the number of lags determined by a suitable information criterion. Rejection of the null hypothesis would imply that prices in market *j* Granger-cause prices in market *i*. If prices in market *i* also Granger-cause prices in market *j*, this implies bidirectional causality. If the Granger causality runs one way, implying unidirectional Granger causality, the market that Granger-causes the other is tagged the exogenous market.

Data

The data consist of monthly retail prices (in Ugandan shillings (UGX)/kg) of white maize flour and cassava flour at the central market of Kampala (Owino) and four geographically separated markets: Mbarara, Gulu, Iganga, and Lira. Data from January 2010 through July 2018 are sourced from the World Food Programme (2019).[1] Figures 1 and 2 plot these data for cassava and white

[1] Missing data were a problem, particularly price data in Iganga and Mbarara, where six to eight intermediate monthly data points were missing. These were approximated using the square root of the month immediately before and immediately after the missing data point. When two consecutive data points were missing, the average of the last three immediate data points before was used for the first missing data point and the square root process was followed for the second missing data point.

maize flour, respectively. The series exhibits a relatively uniform pattern, with sharp changes occuring in the short term (within 2–3 months). The high degree of inter- and intra-annual variation observed, particularly in Gulu, is more likely caused by political insecurity, which limits the supply of commodities from both within the district and nearby areas, and World Food Programme distributions of maize in the region (Famine Early Warning System, 2017).

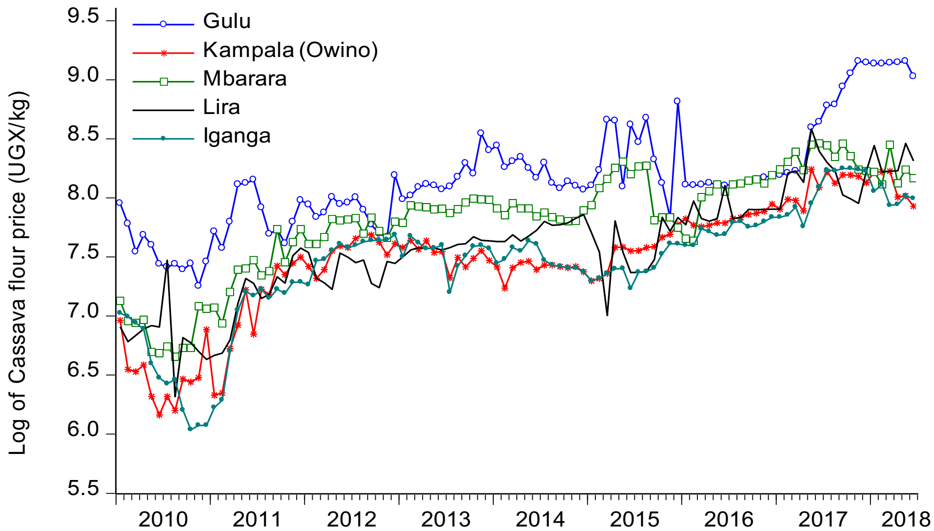

Figure 1. Cassava Flour Price Series

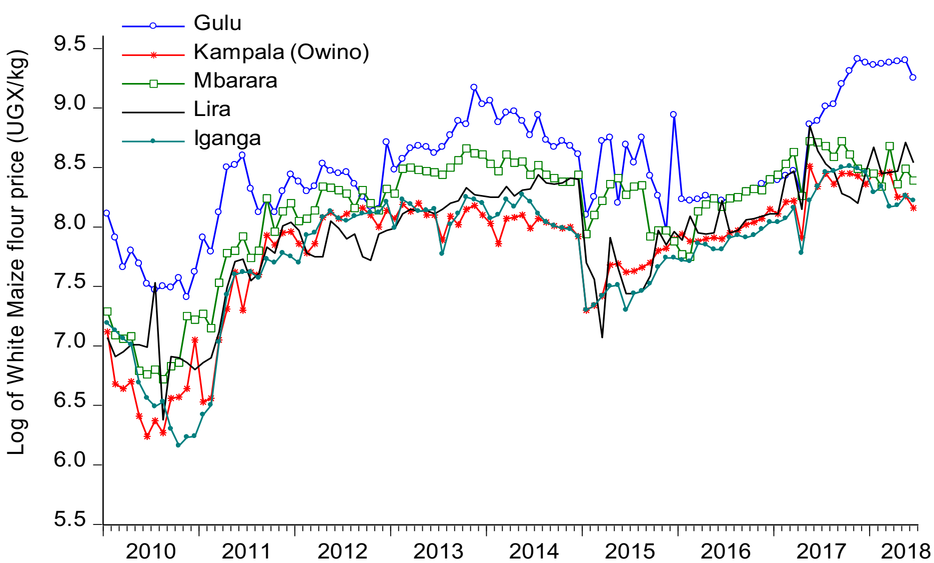

Figure 2. White Maize Flour Price Series

Empirical Results

Before performing cointegration analysis, all data series were adjusted for inflation using a monthly composite consumer price index (CPI) for food,[2] which was sourced from the Uganda Bureau of Statistics (Uganda Bureau of Statistics, 2011–2018) and transformed logarithmically. The hypothesis of nonstationary was tested using the augmented Dickey–Fuller (ADF) and the Phillips–Perron (PP) tests (Table 1). The optimal number of lags was automatically determined based on the Schwarz information criterion (SIC) using EViews 9 software package. All tests confirmed a single unit root, implying that prices in the derivatives markets are nonstationary. In the second step, Enders and Siklos (2001) threshold cointegration approaches (TAR and M-TAR models) were conducted. Table 2 reports the results.

Table 1. ADF and PP Unit Root Tests

	Augmented Dickey–Fuller (ADF) Test				**Phillips–Perron (PP) Test**			
	Levels	**Lag**	**Diff.**	**Lag**	**Levels**	**Lag**	**Diff.**	**Lag**
Maize flour								
Gulu	−1.461	1	−13.746**	0	−1.880	6	−14.290**	4
Iganga	−1.414	0	−9.357**	0	−1.606	4	−9.405**	3
Lira	−2.512	0	−14.480**	0	−2.200	1	−15.470**	8
Mbarara	−1.965	1	−13.173**	0	−1.827	1	−13.216**	1
Kampala	−1.747	0	−12.710**	0	−1.617	1	−12.990**	4
Cassava flour								
Gulu	−1.079	1	−14.173**	0	−1.505	5	−14.173**	0
Iganga	−1.034	0	−8.790**	0	−1.327	5	−8.918**	4
Lira	−1.530	1	−15.624**	1	−1.918	1	−25.395**	16
Mbarara	−1.699	1	−12.901**	0	−1.543	2	−12.958**	2
Kampala	−1.477	1	−14.273**	0	−1.272	1	−14.687**	5

Note: Double asterisks (**) denote rejection of the null hypothesis at the 1% level. Lag lengths in the ADF test are based on the SIC and on the Newey–West bandwidth in the PP test.

The TAR and M-TAR findings show that the *F*-joint statistics ($\rho_1 = \rho_2 = 0$) for the cassava flour model are greater than the critical values calculated using a Monte Carlo experiment approach for the Kampala–Iganga market pair, implying the existence of a long-run relationship between the Kampala central market and the Iganga regional market. However, the *F*-equal statistics ($\rho_1 = \rho_2$) are lower than the simulated critical values at the 5% significance level, suggesting that the null hypothesis of symmetric adjustments cannot be rejected across all cassava flour market pairs. Together, the results help to conclude that cassava flour prices are only cointegrated between the Kampala central market and the Iganga regional market, depicting symmetric adjustment processes.

[2] The CPI series (2011–2015, 2016–2017, and 2018) obtained were generated using different base years. For uniformity, the old series were rebased using the base from the latest series, and a consistent CPI was generated with a uniform base year.

Table 2. Enders and Siklos Cointegration among Cassava and White Maize Flour Price Series

	Cassava Flour Market				**White Maize Flour Market**			
	TAR		**M-TAR**		**TAR**		**M-TAR**	
	Coeff.	**SE/CV**	**Coeff.**	**SE/CV**	**Coeff.**	**SE/CV**	**Coeff.**	**SE/CV**
Kampala–Gulu market pair								
ρ_1	−0.057	0.081	−0.070	0.073	−0.064	0.082	−0.092	0.075
ρ_2	−0.212*	0.085	−0.267*	0.107	−0.235*	0.092	−0.251*	0.114
τ	−0.217		−0.064		−0.292		−0.069	
$\rho_1 = \rho_2$	1.864	[6.548]	2.248	[8.015]	2.080	[6.475]	1.393	[8.152]
T-max value	−0.707	[−1.902]	−0.961	[−1.847]	−0.787	[−1.893]	−1.229	[−1.813]
$\rho_1 = \rho_2 = 0$	3.284	[7.037]	3.485	[8.081]	3.471	[6.972]	3.111	[8.036]
Lags	2		2		2		2	
Kampala–Iganga market pair								
ρ_1	−0.523*	0.142	−0.855*	0.162	−0.652*	0.163	−0.784*	0.158
ρ_2	−0.715*	0.148	−0.506*	0.124	−0.440*	0.121	−0.390*	0.117
τ	−0.063		−0.090		0.141		0.088	
$\rho_1 = \rho_2$	1.191	[6.694]	4.389	[8.249]	1.425	[6.526]	5.534	[8.005]
T-max value	−3.680*	[−1.958]	−4.078*	[−1.857]	−3.633*	[−1.913]	−3.343*	[−1.857]
$\rho_1 = \rho_2 = 0$	14.776*	[6.933]	16.878*	[7.996]	11.733*	[6.860]	14.277*	[7.922]
Lags	5		5		4		4	
Kampala–Lira market pair								
ρ_1	−0.371*	0.139	−0.432*	0.154	−0.355*	0.122	−0.189*	0.097
ρ_2	−0.211	0.177	−0.224	0.142	−0.272*	0.117	−0.642*	0.150
τ	−0.193		0.051		−0.204		−0.226	
$\rho_1 = \rho_2$	0.634	[6.557]	1.424	[8.040]	0.274	[6.328]	7.217	[8.129]
T-max value	−1.188	[−2.055]	−1.578	[−1.929]	−2.336*	[−1.889]	−1.948*	[−1.905]
$\rho_1 = \rho_2 = 0$	3.768	[6.589]	4.197	[7.711]	7.274*	[7.082]	10.184*	[8.237]
Lags	9		9		1		1	
Kampala–Mbarara market pair								
ρ_1	−0.325*	0.162	−0.318*	0.123	−0.125	0.118	−0.072	0.110
ρ_2	−0.229*	0.112	−0.144	0.139	−0.237*	0.093	−0.287*	0.096
τ	0.108		−0.038		0.158		0.020	
$\rho_1 = \rho_2$	0.409	[6.582]	1.404	[8.080]	0.631	[6.701]	2.458	[8.043]
T-max value	−2.010	[−2.049]	−1.036	[−1.903]	−1.060	[−1.895]	−0.649	[−1.835]
$\rho_1 = \rho_2 = 0$	2.828	[6.629]	3.358	[7.652]	3.515	[6.908]	4.490	[8.077]
Lags	9		9		2		2	

Note: A single asterisk (*) denotes significance at the 5% level. Numbers in brackets are simulated critical values from the Monte Carlo experiment approach. Optimal lag order is based on the AIC.

In the white maize flour models, the F-joint statistics are higher than the simulated Monte Carlo critical values only for the Kampala–Iganga and Kampala–Lira market pairs. It implies that for the maize flour markets, the null hypothesis of no cointegration is rejected at the 5% level only for Kampala-Inganga and Kampala-Lira market pairs. Similar to the cassava model, the estimated F-equal statistics for all maize flour market pairs are lower than the simulated critical values at the 5% significance level, which is an indication of the symmetric adjustment process. The results for the maize flour market pairs help to conclude that although the adjustment process is symmetric for all white maize flour market pairs, the long-run relationship exists only between the central market of Kampala and Iganga and Lira regional markets.

Table 3. Granger Causality Test for Staple Food Derivatives Markets in Uganda

Null Hypothesis	No. of Obs.	F-Statistic	Prob.	Results
Maize flour market pairs				
Gulu does not Granger-cause Kampala	100	0.045	0.956	None
Kampala does not Granger-cause Gulu		2.355	0.100	
Iganga does not Granger-cause Kampala	98	2.195*	0.076	Bidirectional
Kampala does not Granger-cause Iganga		6.027**	0.000	
Lira does not Granger-cause Kampala	101	0.276	0.601	Unidirectional
Kampala does not Granger-cause Lira		18.837**	0.000	
Mbarara does not Granger-cause Kampala	100	0.540	0.584	None
Kampala does not Granger-cause Mbarara		1.278	0.283	
Cassava flour market pairs				
Gulu does not Granger-cause Kampala	100	0.001	0.999	Unidirectional
Kampala does not Granger-cause Gulu		2.592*	0.080	
Iganga does not Granger-cause Kampala	97	2.915**	0.018	Bidirectional
Kampala does not Granger-cause Iganga		8.308**	0.000	
Lira does not Granger-cause Kampala	93	2.434**	0.018	Bidirectional
Kampala does not Granger-cause Lira		1.808*	0.081	
Mbarara does not Granger-cause Kampala	93	1.103	0.372	None
Kampala does not Granger-cause Mbarara		1.547	0.148	

Note: Single and double asterisks (*, **) denote significance at the 10% and 5% levels, respectively.

Table 3 reports the Granger causality results, revealing one unidirectional (Kampala–Lira) and one bidirectional (Kampala–Iganga) causality in the white maize flour markets and one unidirectional (Kampala–Gulu) and two bidirectional (Kampala–Iganga and Kampala–Lira) causalities in the cassava flour markets. The unidirectional causality results imply that the null hypothesis that price at the Kampala central market does not Granger-cause prices at the Lira and Gulu regional markets can be rejected but not vice versa. Thus, information on the price at the Kampala market improves the predictions on the prices at the Lira and Gulu markets. Likewise, the bidirectional causality results imply that both the null hypothesis that price at the Kampala market does not Granger-cause prices at the Lira and Iganga markets, and the null hypothesis that prices at the Lira and Iganga markets do not Granger-cause prices at the Kampala market can be rejected. Thus, information on the price at the Kampala market improves the predictions on the prices at the Lira and Iganga markets and vice versa.

Conclusions

The long-run price-adjustment mechanism between the retail prices of white maize and cassava flour at the Kampala central market and four regional markets—Gulu, Lira, Mbarara, and Iganga—were tested using monthly data from January 2010 through July 2018. Unit root, TAR, M-TAR, and Granger causality tests were employed. The results lead to a few conclusions on the status of market integration in Uganda. First, long-run market integration was confirmed for three market pairs and the presence of symmetric adjustment processes was confirmed for all market pairs. Second, unidirectional and bidirectional Granger causality from the Kampala market to two regional markets was confirmed, implying that Kampala serves as the exogenous market for white maize prices in Lira and cassava prices in Gulu. Thus, price information from the Kampala market improves price predictions at the Lira (white maize) and Gulu (cassava) regional markets. On the other hand, price information from the Kampala market improves price predictions at the Iganga (for both derivatives) and Lira (for cassava) regional markets and vice versa.

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Research Report:
Producer Response to Drought Policy in the West

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Abstract

The study assesses Utah producers' preferred drought management strategies, the level of drought at which producers adopt specific management strategies, and the level at which they exit farming/ranching. Results show that preferred strategies differ across producer groups. Fresh produce growers prefer adopting a water-saving technology, hay growers prefer switching to a more efficient irrigation system, and cattle producers prefer purchasing feed or reducing the herd. Producers would only exit farming in dire circumstances, such as no water availability. Policies aimed at assisting with drought adaptation should focus on preferred strategies.

Keywords: drought management, experimental economics, producer adoption, Utah

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Introduction

Agricultural production is responsible for approximately 80% of all consumptive water use in the United States (U.S. Department of Agriculture, 2019). Persistent drought negatively impacts agricultural production, often leading to severe economic consequences in agriculture-based communities (Lal et al., 2012; Howitt et al., 2017). Drought is especially problematic in arid and semi-arid regions in the Western United States. Previous studies have confirmed the negative impacts of climate change and drought on agriculture in terms of reduced yields (Fisher et al., 2012; Kuwayama et al., 2018). In response to drought, producers were found to increase their adoption of water-conservation technologies, fallowing land with low-value crops, groundwater pumping (Zilberman et al., 2002), and conservation tillage (Ding, Schoengold, and Tadesse, 2009).

In this study, we examine producers' preferred drought management strategies in the southwest United States, specifically in Utah, where 65% of the state experienced dry conditions between 2000 and 2019 (National Integrated Drought Information System (NIDIS), 2019a). Utah is the second-driest state in the nation; in 2018–2019, 40.7% of the state suffered moderate to severe drought (NIDIS, 2019b). This level of drought damages pastures and crops and leads to economic losses in agriculture. Water shortages are common, especially in late summer, and water restrictions are often imposed. Agriculture is one of Utah's top five industries contributing to state gross domestic product (GDP); maintaining agricultural production and adapting to drought is important to the Utah economy.

Livestock, hay, and fresh produce are Utah's primary agricultural commodities in terms of sales. Livestock production is the most important agricultural sector, with 70% of all agricultural sales or $1,278 million/year (U.S. Department of Agriculture, 2017). Hay, a high-water-use crop and one of the primary feed sources for livestock, generated $182 million in sales in Utah in 2017 (Utah Department of Agriculture and Food (UDAF), 2018), not including the value of hay grown and consumed by the same operation. Fresh produce is a high-value crop and is very important to the Utah economy, especially on the Wasatch Front, with $56 million in sales annually (U.S. Department of Agriculture, 2017). Fresh produce is grown on smaller farms (< 100 acres) that often use water-conserving irrigation systems.

Production processes for livestock, hay/forage, and fresh produce differ in their water resource needs and likely face distinct challenges in the presence of drought. The objectives of this study are to examine preferred drought management strategies in each of these producer groups, the drought conditions under which they are willing to adopt a particular strategy, and the point at which they would exit farming/ranching. Our findings can inform policies needed to improve the ability of growers and producers to prevent or mitigate the negative effects of drought.

Data

The data for the study were collected separately for fresh produce growers ($N = 26$), hay/forage growers ($N = 88$), and livestock producers ($N = 64$) at producer meetings in 2019. The majority of respondents indicated their farm is located in Utah (91%), and the remainder in Idaho (5%),

Table 1. Selected Grower/Producer Characteristics

	Fresh Produce Growers		Hay/Forage Growers		Livestock Producers	
Characteristic	**Class**	**Count (% share)**	**Class**	**Count (% share)**	**Class**	**Count (% share)**
Acres farmed/animals managed	≤ 10	19 (79)	n/a	4 (6)	< 50	8 (24)
	11–25	2 (8)	≤ 100	14 (23)	51–200	16 (48)
	26–100	0 (0)	101–300	17 (27)	201–400	7 (21)
	> 100	3 (13)	301–1,000	15 (24)	401–700	0 (0)
			> 1,000	12 (19)	> 700	2 (6)
Primary crop/livestock type	Veggies	22 (85)	Hay	37 (61)	Calf/cattle	43 (81)
	Tree fruit	2 (8)	Cattle	16 (26)	Sheep/lamb	4 (8)
	Other	2 (8)	Other	8 (13)	Poultry/eggs	1 (2)
					Dairy/milk	1 (2)
					Other	4 (8)
Irrigation system used	n/a	0 (0)	n/a	2 (3)	–	–
	Flood	3 (12)	Flood	14 (23)		
	Wheel	0 (0)	Wheel	20 (33)		
	Pivot	1 (4)	Pivot	24 (39)		
	Drip	17 (65)	Drip	1 (2)		
	Other	5 (19)	Other	0 (0)		
What is a large % of crop loss/grazing efficiency reduction to you?	100%	0 (0)	100%	0 (0)	100%	0 (0)
	80%–99%	0 (0)	80%–99%	3 (7)	80%–99%	1 (4)
	60%–79%	3 (13)	60%–79%	15 (36)	60%–79%	6 (25)
	40%–59%	11 (46)	40%–59%	11 (26)	40%–59%	9 (38)
	20%–39%	7 (29)	20%–39%	12 (29)	20%–39%	6 (25)
	< 20%	3 (13)	< 20%	1 (2)	< 20%	2 (8)

Arizona (2%), Nevada (2%), Colorado (1%), and Oregon (1%). Table 1 provides an overview of selected producer characteristics. The sampled fresh produce growers farm on less than 10 acres of land (79%), grow vegetables as their primary crop (85%), and use drip as their primary irrigation system (65%). The largest portion of hay/forage growers manage 101–300 acres of cropland (27%), hay is their primary crop (61%), and they use pivot irrigation (39%). Among sampled livestock producers, 48% manage 51–200 animals, and their primary livestock type is calf/cattle (81%).

Methods

We employed choice experiments to examine how reductions in crop harvested and grazing efficiency, as a result of drought, affected producer preferences for drought management strategies. Fresh produce and hay/forage growers were asked whether they would adopt a particular strategy (= 1 if yes, = 0 otherwise) given the percentage of crop harvested, which was varied at 40%, 60%, and 80% for three strategies that varied across grower groups. In total, growers answered nine choice questions. The analysis for each grower group was completed using binary logit models, estimated using a penalized maximum likelihood estimation (PMLE) procedure.[1]

Livestock producers were asked which one of several strategies they preferred most (= 1 if the strategy is chosen, = 0 otherwise) given the percentage reduction of grazing efficiency. The reduction was varied at 20%, 40%, 60%, and 80% across the questions, while the offered strategies remained the same and consisted of "change livestock type," "purchase feed or rent additional grazing area," "reduce the herd," and "transition out of livestock." In total, producers answered four choice questions. Their choices were analyzed using multinomial logit models.

The utility of producer *n* from choosing strategy *i* is (Train, 2009)

$$U_{nit} = \alpha_i + \beta_i X_t + \varepsilon_{nit}, \tag{1}$$

where X_t is the percentage of crop harvested (growers) or reduction of grazing efficiency (livestock producers) in choice scenario t, β_i represents marginal effect of X_t on the utility, constant α_i represents effect of unobserved factors, and ε_{nit} is an *i.i.d.* type I extreme value. For growers, we can calculate the percentage of crop harvested at which the grower is indifferent between adopting and not adopting the strategy i as

$$WTA_i = -\frac{\alpha_i}{\beta_i} \times 100\%, \tag{2}$$

which represents the minimum crop harvested for which the grower is willing to adopt strategy i instead of not adopting; thus, it is a measure of willingness to adopt (WTA). It is important to note that a lower WTA_i value represents higher willingness to adopt and vice versa. We can also compare the minimum percentage of crop harvested necessary for different strategies to examine growers' preferences for the strategies: If $WTA_i < WTA_j$ for strategies i, j, then strategy i is said

[1] PMLE has been found to improve the MLE estimates by reducing the variance and bias, in particular in smaller samples (Rainey and McCaskey, 2015), which is the case in this study.

to be preferred over strategy j. For livestock producers, equation (2) calculates the percentage reduction of grazing efficiency for which the producer is indifferent between adopting strategy i and base strategy j; efficiency reduction greater than this value will result in strategy i being preferred over base strategy j.

In addition to the choice experiments, we also asked growers/producers directly which one of the offered drought management strategies they preferred most to avoid a large loss of crop/grazing efficiency reduction, not specifying the percentage of crop harvested/grazing efficiency reduction. We also asked them an open-ended question about the drought circumstances under which they would exit ranching/farming.

Results

Tables 2–4 report the results of logit models. For each grower group, the strategies are presented in the column headers, and they follow in the order of preference from most preferred (1) to least preferred (3), based on the calculated WTA_i values. For growers, the analysis is performed using two datasets: dataset A, which contains all collected data, and dataset B, which contains only responses from growers who answered at least one question related to each strategy. Overall, the results are consistent across the two datasets, and we focus on the results from dataset B.

Fresh produce growers (Table 2) are the most willing to adopt a new water-saving technology, followed by switching to a drought-resistant variety and sacrificing lower value crops. The minimum calculated percentage of crop harvested (WTA) for adopting a water-saving technology is 36%, which means that vegetable producers would be willing to adopt a water-saving technology if they can harvest at least 36% of their crop. Hay/forage growers (Table 3) prefer to switch to a more efficient irrigation system rather than adopt a water-saving technology or switch to a low water-use crop.

Table 2. Results for Fresh Produce Growers

Strategy	**(1) Adopt a Water-Saving Technology**		**(2) Switch to a Drought-Resistant Variety**		**(3) Sacrifice Lower-Value Crops**	
Dataset	**A**	**B**	**A**	**B**	**A**	**B**
Intercept α_i	−2.89**	−3.26**	−3.11***	−3.26***	−4.95***	−5.84***
	(1.41)	(1.62)	(1.07)	(1.12)	(1.29)	(1.49)
Percentage of crop harvested β_i	8.32***	9.05***	5.88***	6.11***	9.22***	10.31***
	(2.87)	(3.35)	(1.82)	(1.89)	(2.22)	(2.52)
WTA_i	34.7%**	36.0%**	52.9%***	53.3%***	53.7%***	56.6%***
No. of obs.	72	59	64	60	66	59
Log-likelihood	−25.48	−20.45	−36.47	−33.57	−30.56	−26.08
Wald χ^2	8.39***	7.29***	10.38***	10.49***	17.20***	16.71***

Note: Single, double, and triple asterisks (*, **, ***) denote significance at the 10%, 5%, and 1% levels. Standard errors are in parentheses. WTA_i is calculated as $-(\alpha_i/\beta_i) \times 100\%$. Confidence intervals for *WTA* are determined using the Krinsky–Robb method with 10,000 replications.

Table 3. Results for Hay/Forage Growers

Strategy	(1) Switch to a More Efficient Irrigation System		(2) Adopt a Water-Saving Technology		(3) Switch to a Low-Water-Use Crop	
Dataset	**A**	**B**	**A**	**B**	**A**	**B**
Intercept α_i	−1.53**	−1.67**	−3.34***	−3.23***	−3.57***	−3.00***
	(0.69)	(0.78)	(0.83)	(0.86)	(0.80)	(0.85)
Percentage of crop harvested β_i	3.81***	4.02***	6.90***	6.72***	6.62***	5.95***
	(1.16)	(1.34)	(1.47)	(1.53)	(1.34)	(1.45)
WTA_i	40.1%**	41.5%**	48.5%***	48.0%***	53.9%***	50.4%***
No. of obs.	143	110	120	109	124	104
Log-likelihood	−83.09	−63.92	−62.21	−56.87	−67.66	−57.82
Wald χ^2	10.76***	9.03***	22.01***	19.36***	24.33***	16.86***

Note: Single, double, and triple asterisks (*, **, ***) denote significance at the 10%, 5%, and 1% levels, respectively. Standard errors are in parentheses. WTA_i is calculated as $-(\alpha_i/\beta_i) \times 100\%$. Confidence intervals for *WTA* are determined using the Krinsky–Robb method with 10,000 replications.

Table 4 presents results for livestock producers. Statistically insignificant coefficients β_i mean that a reduction in grazing efficiency does not have an impact on the likelihood of choosing each strategy relative to the base strategy (i.e., purchase feed/rent additional area). A herd reduction strategy is similarly preferred as the base strategy, while the remaining two strategies ("change livestock type" and "transition out of livestock production") are less likely to be chosen. In summary, livestock producers prefer to take actions that are less costly to implement and would keep them in business. In fact, even if grazing efficiency were reduced by 80%, we find that only 3 out of 47 livestock producers would sell off all their livestock and 21 producers would prefer to purchase more feed.

Table 4. Results for Livestock Producers (N = 162)

Strategy		Estimate	Std. Error
Reduce the herd	Intercept α_i	−0.82	0.50
	Grazing efficiency reduction β_i	0.48	0.80
Change livestock type	Intercept α_i	−3.94**	1.58
	Grazing efficiency reduction β_i	3.25	2.29
Transition out of livestock production	Intercept α_i	−3.20**	1.48
	Grazing efficiency reduction β_i	1.16	2.25
Purchase feed/rent additional area (base outcome)	Intercept α_i	–	–
	Grazing efficiency reduction β_i	–	–
Log-likelihood		−162.59	
Wald χ^2		2.62	

Note: Single, double, and triple asterisks (*, **, ***) denote significance at 1%, 5%, and 10% levels, respectively.

Table 5 summarizes shares of producers selecting each strategy as their most preferred to avoid a large (unspecified) loss of crop/grazing efficiency reduction. First, across all groups, "moving out of farming"/"transitioning out of production" is selected as most preferred by a relatively small group of respondents, ranging from 0% (fresh produce growers) to 12% (hay growers). "Adoption of a water saving technology" is the most preferred strategy among fresh produce growers (40% share), in line with our findings based on the logit models. For the remaining strategies, growers' preferences vary somewhat depending on whether they have been given information on the percentage of crop harvested and whether they are evaluating the strategies directly against each other. Hay growers most prefer to switch to a low water-use crop when they are not provided with information on the harvested crop, but this strategy is least preferred for low levels of harvested crop.

Table 5. Share of Respondents Selecting Each Strategy as Most Preferred

Order	Fresh Produce Growers	Hay/Forage Growers	Livestock Producers
#1	Water-saving technology (40%)	Low-water-use crop (35%)	Purchase feed/rent additional area (50%)
#2	More water-efficient irrigation system (25%); Sacrifice lower value crops (25%)	Water-saving technology (31%)	Reduce the herd (38%)
#3	Change to a drought-resistant crop (10%)	More water-efficient irrigation system (22%)	Change livestock type (8%)
#4	Move out of farming (0%)	Move out of farming (12%)	Transition out of livestock production (4%)
#5	–	–	Other (0%)
No. of obs.	20	51	26

Finally, "purchase of feed/renting additional area" is the most preferred strategy for 50% of livestock producers, followed by "reducing the herd" (38%). The remaining options are most preferred by much smaller groups. The preferences when the reduction of grazing efficiency is not specified (Table 5) are very similar to the preferences identified using the logit model (Table 4), which is not surprising given that reducing grazing efficiency was found to not affect preferences. In addition, livestock producers (unlike growers) evaluated the strategies directly against one another in both cases.

Conclusions

In this study, we examine preferred drought management strategies among different groups of producers. We find that, while drought would have to be very serious and long-term for the producers to exit farming/ranching in general, the preferred drought strategies varied among groups. Thus, policies to improve uptake of drought management strategies need to be commodity-specific and target the most preferred options to be successful. Policies also need to compensate producers for the costs of adopting these strategies, but the costs associated with each drought management strategy are different and thus need to be identified. Future work will also examine the applicability of these findings to producers in other regions.

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Research Report: An Analysis of Consumer Perception of the Importance of Selected Attributes of Fruits and Vegetables: The Case of Tennessee

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Abstract

This paper assesses the importance of selected attributes considered by consumers in their fruit- and vegetable-buying decisions. We (i) evaluate consumer perceptions of the importance of color, freshness, variety, price, nutritional value, safety, locally grown, and knowing the grower; (ii) analyze the relationship between demographic variables and selected fruit and vegetable attributes; and (iii) discuss implications for fruit and vegetable marketing. Findings indicate that gender is significantly related to the perceived importance of color and safety. Ethnicity is related to the perceived importance of price. Education is related to perceived importance of fruit and vegetable variety. Consumers' income is directly related to perceived importance of color.

Keywords: consumer survey, preferences, demographic characteristics, fruit and vegetable attributes

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Introduction

The American food supply system is complex and ever changing. Every year, many new varieties of fruits, vegetables, and value-added products are introduced in the food marketplace. In the last few decades, Americans have become more aware of the impacts and implications of different food in their diets.

In recent years, there has been a growing interest in locally grown food (LGF) products, markets, and systems. Broadly, local foods are foods sourced from nearby producers and farmers, but the definition of LGF varies widely in the literature (Martinez et al., 2010). According to the 2008 Food, Conservation, and Energy Act, "local" includes food produced within 400 miles of its origin or within the state of its origin (Hand and Martinez, 2010). Earth Fare (2014) defines local food as sourced from within 100 miles of the store location. These definitional differences continue to challenge researchers in the debate on the importance of local food systems to local, state, and national economies (Brown et al., 2014; Ekanem, Mafuyai, and Clardy, 2016).

Palma et al. (2013) highlights the fact that the predominant food category sold at farmers' markets was fresh fruits and vegetables, as indicated in the 2007 Census of Agriculture. The literature is replete with evaluations for consumer preferences for local foods (i.e., fresh fruits and vegetables). Maples et al. (2013) survey urban consumers in major cities located in the southeastern United States on their purchases of local food directly from producers. Important consumer characteristics were college education, gender, physical activity, incidence of family illness, and knowledge of U.S. agriculture production. Willis et al. (2013) survey South Carolina consumers and evaluate their willingness to pay for locally grown foods; they conclude that consumers are willing to pay premiums for local foods under certain conditions.

Using data from the U.S. Department of Agriculture's (USDA) National Household Food Acquisition and Purchase Survey (Food APS), ERS researchers investigated the relationship between spending on fruits and vegetables and shopping at farmers' markets, roadside stands, and other direct-to-consumer (DTC) outlets. The researchers found that households that bought fruits and vegetables directly from farmers spent an average of $12.15/week at DTC outlets on these foods (USDA, 2019a).

This paper examines demographic differences in consumer perceptions of quality in fruit and vegetable on purchase behavior in a Tennessee local food market. The specific objectives are to (i) evaluate consumer perceptions of the importance of color, freshness, variety, price, nutritional value, safety, locally grown, and knowing the grower, (ii) analyze the relationship between demographic variables and selected fruit and vegetable attributes, and (iii) discuss implications for fruit and vegetable marketing.

Our hypothesis is that there is a significant relationship between consumer perceptions of the importance of the characteristics listed above and consumer gender, ethnicity, educational level, marital status and gross family income in their fruit and vegetable buying decision.

Methodology

Data for this paper were collected in 2019 using a 12-item face-to-face survey questionnaire administered to 555 shoppers from Nashville, Tennessee, metropolitan area farmers' markets. Additional data from secondary sources were used to supplement data presented in this paper. A chi-square (χ^2) test of independence was used to test for significant relationships between selected demographic variables and consumer perceptions of the importance of fruit and vegetable attributes (i.e., freshness, color, whether or not the fruit and vegetable was locally produced, price, safety, variety, nutritional value, and whether the buyer knew the farmer or grower). The χ^2 procedure examines the relationship between two or more categorical variables. IBM Statistics v. 24 and Microsoft Excel were used to analyze the data.

Results and Discussion

Approximately 33.2% of survey respondents were males, while 66.4% were females (Table 1); 66.1% were Black or African American, 23.1% were white, 6.2% identified themselves as "other," and only 4.3% did not respond. In terms of education, 16.3% of study participants had attained a high school diploma, 47.6% had attended some college, 23.6% were college graduates, 10.3% had advanced degrees, and 2.2% did not respond to this item. For the 555 respondents that answered the question regarding their marital status, 22% were married, 62.9% were single, 6.6% were divorced, 3.0% were widowed, and 5.5% did not respond to this question.

Table 1. Frequency Distribution of Demographic Variables

Demographic Variable	Percentage (%)	Demographic Variable	Percentage (%)
Gender		Marital Status	
0 = Male	33.2	0 = Married	22.0
1 = Female	66.4	1 = Single	62.9
		2 = Divorced	6.6
Ethnicity		3 = Widowed	3.0
0 = Black	66.4	4 = No response	6.6
1 = White	23.1		
2 = Other	6.2	Gross family income	
3 = No response	4.3	0 = Low (≤ $40,000/year)	35.3
		1 = High (> $40,000/year)	58.1
Educational level		3 = No response	6.6
0 = High school	16.3		
1 = Some college	47.6		
2 = College graduate	23.6		
3 = Advanced degree	10.3		
4 = No response	5.5		

Table 2 reports results of the χ^2 tests of significance. Re-categorizations of selected demographic variables of gender, ethnicity, educational attainment, marital status and gross family income were as defined in Table 1. Shoppers were asked to rank the perceived importance of color, locally grown, knowing the grower, price, safety, variety and nutrition using a 4-point scale (0 = not important at all, 1 = somewhat important, 2 = important, and 3 = very important).

Gender was significantly related to the perceived importance of color when buying fruits and vegetables ($\chi^2 = 9.594$, $p = 0.008$) as well as the perceived importance of price ($\chi^2 = 6.559$, $p = 0.087$), safety ($\chi^2 = 23.456$, $p = 0.001$), and variety ($\chi^2 = 6.277$, $p = 0.043$). While gender was significantly related to the perceived importance of color and safety at the 1% levels, it was significantly related to the perceived importance of variety and price at the 5% and 10% levels, respectively.

When buying fruits and vegetables, ethnicity is shown to be weakly related to the perception of importance of color ($\chi^2 = 10.380$, $p = 0.096$) and price ($\chi^2 = 22.634$, $p = 0.007$). These results are significant at the 10 % and 1 % levels respectively.

Table 2. Results of χ^2 Tests

Demographic Variables	Attribute	χ^2 Value	Levels of Significance (p)
Gender	Color	9.594	0.008***
	Price	6.559	0.087*
	Safety	23.456	0.001***
	Variety	6.277	0.043**
Ethnicity	Color	10.380	0.096*
	Price	22.634	0.007***
Education	Locally grown	14.808	0.096*
	Know seller	19.828	0.019**
	Variety	20.944	0.002***
	Nutrition	19.974	0.018**
Income	Freshness	4.603	0.100*
	Color	8.506	0.014**
	Variety	5.520	0.060*

Note: Single, double, and triple asterisks (*, **, ***) indicate significance at the 10%, 5%, and 1% levels, respectively.

The χ^2 tests were also conducted to investigate the relationships between educational level of the consumer and the importance of locally grown, knowing the seller, variety, and nutrition. Results show that there is a significant relationship between education and the perception that fruits and vegetables were locally grown ($\chi^2 = 14.808$, p =0.096). Education is significantly related to the perceived importance of knowing the seller ($\chi^2 = 19.828$, $p = 0.019$),variety ($\chi^2 = 20.944$, $p = 0.002$), and nutrition, ($\chi^2 = 19.974$, p =0.018). Finally, income plays a significant role in the perceived importance of freshness ($\chi^2 = 4.603$, $p = 0.100$), color (χ^2 =8.506, $p = 0.002$), and variety, ($\chi^2 = 15.520$, $p = 0.060$).

Conclusions

Previous consumer studies have shown that many factors influence consumer willingness to buy fruits and vegetables (Moser, Raffaelli, and Thilmany-McFadden, 2011; Thomas, Gunden, and Miran, 2015). This paper focuses on the physical characteristics that are observable, valuable, and known to fruit and vegetable consumers.

We find that consumers' gender, ethnicity, education, and income play important roles in the perception of fruit and vegetable attributes such as color, freshness, variety, price, nutritional value, safety, locally grown, and knowing the grower. The χ^2 tests showed the existence of relationships between demographic variables and selected fruit and vegetable attributes: Gender was significantly related to the perceived importance of color, price, safety, and variety; ethnicity was related to the perceived importance of color and price. Education was related to the perceived importance of locally grown, knowing the seller, variety, and nutrition. Income was related to the perceived importance of freshness, color, and variety.

Policy Implications

A preliminary analysis of frequency distributions shows that color, freshness, safety were important attributes influencing consumers' decisions to purchase fruits and vegetables. The U.S. food market is complex and dynamic and has experienced double-digit expansion in the last few decades. Consumers are demanding more attributes from the foods they consume. Understanding what consumers want will allow food marketers offer products that meet these demands, which will help improve sales revenues and profits for producers and lead to a vibrant U.S. food sector. Carefully targeting consumers and their demands could translate into money for producers and sellers of fruits and vegetables in Tennessee.

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Research Report: Coordinating Intermediaries and Scaling Up Local and Regional Food Systems: An Organizational Species Approach to Understanding the Roles of Food Hubs

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Abstract

Food hubs are one strategy identified for scaling up local and regional food systems. They act as coordinating intermediaries, aggregating, assorting, distributing, and transforming source-identified food products in short food supply chains. As a newly emergent form, the population of these organizations is characterized by heterogeneity. New taxonomic work aims to classify these organizations using an organizational species concept. This report extends that, identifying the roles different food hub species play within distribution channels, especially those which are likely to increase scale. Results indicate that there may be a trade-off between scaling up and behaviors enacting a "commitment to place."

Keywords: distribution strategies, food hubs, food systems, local foods, organizational form, organizational species

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Introduction

Scaling-up local and regional food systems (LRFS) is a central topic in food distribution policy (Clancy and Ruhf, 2010; Mount, 2012; Wittman, Beckie, and Hergesheimer, 2012; Nost, 2014; Clark and Inwood, 2016). Food hub organizations (FHO) are one avenue for achieving this goal. Key to the ability of FHOs to scale up is that they "coordinate" food distribution networks while transmitting information key to proximal transactions. As intermediaries, FHOs reduce transaction costs, increase economies of size and scope, and fulfill (or stimulate) latent demand for food products that are source-identified or have other attributes of social embeddedness. FHOs exist within a dynamic agri-food sector and as a nascent organizational form exhibit a degree of heterogeneity. However, assuming absolute heterogeneity does a disservice to managing food distribution networks and public policy goals. Applying an organizational species concept (OSC) to classify FHOs provides an escape from this trap.

The OSC and resulting FHO species was published in a working paper by Entsminger and Westgren (2019). The underlying conceptual framework integrates the notion of *natural kinds* taken from philosophers of science with allegory to the *ecological niche*—a well-developed allusion in the management literature (Cattani, Porac, and Thomas, 2017; Popielarz and Neal, 2007; Astley, 1985; Astley and Van de Ven, 1983). Using data from the 2015 National Food Hub Survey, Entsminger and Westgren (2019) propose six species of FHOs. Here, I provide a supplement, discussing implications for LRFS policy, management, and scaling up. I investigate differences in key performance, financial, and supplier elements via means testing using analysis of variance (ANOVA) and independent samples *t*-tests (ISTT). I use regression analysis to investigate performance differences while accounting for exogenous elements. Results indicate that different species of FHOs suit different contexts and goals.

Species Morphology and Strategic Orientations

Table 1 summarizes key attributes of FHO species. These are based on observations for morphological and strategic orientation variables from mean profiles, reported in Entsminger and Westgren (2019), and ISTT results, reported here in Table 2. Small-Scale Startups have a morphological profile that implies under-capitalization. This matches their strategic niche, which is highly reliant on direct-to-consumer (DTC) channels despite having the second-highest product reliance on meat and poultry (which generally have higher relative asset needs for cold chains). Conversely, Community Service Providers (CSPs) have many capital-intensive features, but their footprint is small overall. Based on their strategic orientation, CSPs likely use these assets for intensive community engagement programs, while the product and channel strategy of the CSP is highly diversified. Coops are consistently below average for community service offerings, implying that Coops FHOs enact the social consciousness sought by the local foods movement solely by serving the economic and social needs of producers.

Heavy reliance on fresh produce and DTC and direct-to-retail (DTR) channels raises substantial questions about the performance of FHOs in scaling up LRFSs through product diversification and by targeting high-volume buyers. Implicated in the strategic orientations of these species is that

Table 1. Summary of Food Hub Organization Species ($N = 151$)

Species	Freq.	% Overall	% Samp.	Strategic Orientation	Product	Channel	Comm. Services
1. Average Joes	32	21.2	31.1	Highly dependent on fresh produce (65.3%) supplemented by meat and poultry (14.36%). Most sales to DTR channels (52.98%) with some DTC (28.98%) and DTI (13.35%). Offer roughly the sample-average number of Community Services (4.97).	Fresh produce + meat and poultry	DTR + (DTC & DTI)	Average
2. Small-Scale Startups	14	9.3	13.6	Predominately fresh produce (53.86%) with a higher share in meat and poultry (24.8%) to supplement. Most sales go to DTC channels (64.14%) with some DTR (20.05%). Offer few Community Services (3.71), especially those focused on community food systems issues.	Fresh produce + meat and poultry	DTC + DTR	Fewer
3. Processors	19	12.6	18.4	Greatest reliance on processed products [Processed Produce (12.84%) and Other Value-aded (9.89%)], largest of any group. Fresh Produce still a plurality at 46.01%. Sales channels are diversified, with roughly half (49.04%) to DTC and the remained relatively evenly split between DTR, DTM, and DTI. Offer slightly more Community Services than average at 5.95.	Fresh produce + processed	DTC	Slightly more
4. Community Service Providers (CSPs)	9	6.0	8.7	Take a market-basket approach to product coverage, with only 34.17% of sales from Fresh Produce, 17.00% of sales from Milk and Dairy (the highest for any group and more than 3-times the sample average) and some Processed Produce, Meat and Poultry, and Eggs. Rely on the DTC-DTR channel combo (45.13% and 29.4%, respectively) with some DTI sales supplementing (17.47%). Offer the greatest number of Community Services at 7.33.	Market basket	(DTC & DTR) + DTI	Many
5. Coops	17	11.3	16.5	Greatest reliance on Meat and Poultry (30.33%) the largest of any group, along with Fresh Produce (50.92%) and double the sample-average of Unclassified Sales (at 4.13%). Rely on the DTC-DTR channel combo (46.34% and 39.42%, respectively) with some DTM sales supplementing (13.58%). Offer the lowest number of Community Services at 3.06.	Fresh produce + meat and poultry	(DTC & DTR) + DTM	Lowest
6. Traditional Produce Warehousers (TPWs)	12	7.9	11.7	Highly dependent on fresh produce (67.66%) supplemented by small amounts of other products. Most sales go to DTR channels (50.57%) with some DTC (37.28%). Offer roughly the sample-average number of Community Services (5.08).	Fresh produce	DTR + DTC	Average
Missing data	48	31.8					

Note: Based on findings from Entsminger and Westgren (2019).

Table 2. ISTT Results for Morphological and Strategic Profile Variables

	Mean Difference					
	1	**2**	**3**	**4**	**5**	**6**
Profit motivated	**−0.44**	**0.57**	**0.57**	−0.02	−0.01	0.04
Co-operative form	**0.28**	0.08	0.13	−0.24	**−0.88**	0.06
Firm age (ln)	0.12	**0.49**	0.13	−0.67	−0.45	−0.40
Acts as broker	**0.28**	−0.16	−0.15	**−0.89**	−0.36	**0.45**
Nonsales percentage of revenue	0.08	0.08	**−0.19**	**−0.26**	**0.09**	0.07
Total warehouse space in square feet (in '000s)	**6.41**	**8.32**	−7.10	−12.48	2.93	−13.95
Number of delivery vehicles on hand	0.68	**2.53**	−2.73	1.42	1.47	−5.64
Offer transport services to producers	**−0.39**	**0.78**	**−0.35**	0.15	−0.01	−0.15
Add. packaging involv.	0.10	−0.21	**−0.83**	−0.18	**0.78**	0.15
Processing facilities	**0.34**	0.13	**−0.73**	**−0.43**	**0.30**	0.10
Rental space for other businesses	**0.24**	**0.21**	0.09	**−0.87**	**0.21**	**−0.89**
Retail space for the hub	−0.08	0.09	0.01	**−0.83**	**0.25**	**0.24**
Licensed shared use kitchen	**0.15**	0.08	−0.14	**−0.56**	**0.16**	**0.16**
Fresh produce and herbs	−11.25	3.74	13.39	**24.26**	7.32	−11.77
Processed produce (e.g., canned, frozen, dried)	**3.43**	1.51	−10.38	−4.36	2.16	3.11
Meat and poultry	2.84	−9.56	1.32	8.90	**−16.36**	**10.37**
Fish	0.02	−0.15	−0.01	0.29	**0.51**	−1.27
Milk and other dairy products	−1.65	**3.14**	2.68	−12.52	**2.82**	−2.56
Baked goods/bread	0.08	−0.57	−0.40	0.11	−0.57	**1.32**
Coffee/tea	0.04	**0.26**	0.14	−0.79	−0.36	**0.42**
Other processed or value-added food products	1.83	**3.90**	−6.46	1.69	**3.32**	−0.98
Nonfood items	−0.45	0.31	**0.41**	−0.41	−0.44	**0.44**
All unclassified sales	1.17	0.36	0.89	−1.68	−2.81	−0.97
DTC total percent of sales to consumer	**20.50**	**−23.26**	−6.08	−1.27	−2.88	7.49
DTR total percent of sales to retail	**−21.14**	**20.16**	**23.33**	8.57	−2.20	−14.64
DTM total percent of sales to intermediaries	3.47	1.33	−4.92	−1.18	−7.98	**6.68**
DTI total percent of sales to institutions	−3.45	1.14	−9.63	−6.96	**12.13**	1.25
UNC total percent of sales to unclassified	0.53	0.56	−2.76	0.77	**0.87**	−0.27
Total community services offered	−0.26	**1.16**	**−1.35**	**−2.73**	**1.93**	−0.34
Paid employment opportunities for youth	0.04	**0.35**	**−0.30**	−0.14	0.09	**−0.29**
Accepting SNAP benefits	−0.04	0.10	**−0.32**	**−0.38**	0.10	−0.14
Accepting WIC or FMNP benefits	0.08	0.11	−0.12	−0.29	0.10	0.07
Matching programs for SNAP benefits	**−0.20**	**0.21**	−0.11	−0.04	0.02	−0.16
Nutrition or cooking education	0.09	0.09	−0.08	**−0.52**	**0.37**	0.10
Health screenings	0.04	**0.07**	−0.05	−0.17	**0.07**	−0.02
Transportation services for consumers to access your operation	−0.02	0.01	**−0.21**	−0.14	0.01	**0.10**
Operating a mobile market	−0.15	0.02	**−0.26**	−0.19	**0.29**	0.05
Subsidized farm shares	−0.01	0.11	−0.11	0.08	0.02	−0.16
Education about community and food systems issues	−0.07	**−0.15**	0.06	**−0.22**	**0.36**	−0.05
Education for programs in community or school gardening	0.05	−0.02	0.01	−0.32	**0.21**	0.07
Food donation to local food pantries/banks	**−0.17**	0.13	**−0.13**	0.06	0.01	−0.09
Other community services or activities	0.01	**0.28**	−0.12	**−0.22**	**0.24**	0.02

Note: Boldface indicates statistical significance at or above the 10% level.

some fill specific roles in food distribution systems. Coops, for example, have the highest mean reliance on meat and poultry products, which fits neatly with the theoretical expectation that co-operative organizations arise in situations with thin markets. Were data available, it would not be surprising if CSPs showed atendency to exist in urban settings and food deserts, filling roles as food social work organizations. Unfortunately, detailed geographic data were not be provided by the primary data collectors at Michigan State University. (See Hardy, Hamm, Pirog, et al., 2016, for more information on this data set.)

Suppliers

The makeup of FHO suppliers is relevant to increasing scale, transaction cost regimes, and equity of distribution arrangements. Figure 1 presents mean profiles for dichotomous variables on the types of suppliers, and Figure 2 presents demographics. Across species, over 80% of FHOs source from farms. The overall mix of supplier types across species varies some. Small-Scale Startups primarily source from farms and food processors. CSPs have approximately the same proportion of cases utilizing food processors as farms and are most likely to purchase from nonfood and unclassified businesses. Traditional Produce Warehousers (TPWs) are most likely to purchase from other distributors. CSPs and TPWs are engaged in extended (less proximal) transactions. On average, FHOs in the sample are doing poorly at inclusion of suppliers owned by females (30% of suppliers) and people of color (20%). There is divergence among species for suppliers of color; Coops have the lowest average (10%) rate and CSPs have the highest (60%). On average, there are a maximum of 78 different suppliers for each organization, but as Table 3 shows, these numbers change dramatically within species. Therefore, FHOs of a given species may have a differing impact on the number and types of suppliers they are able to connect to markets for proximal, source-identified products.

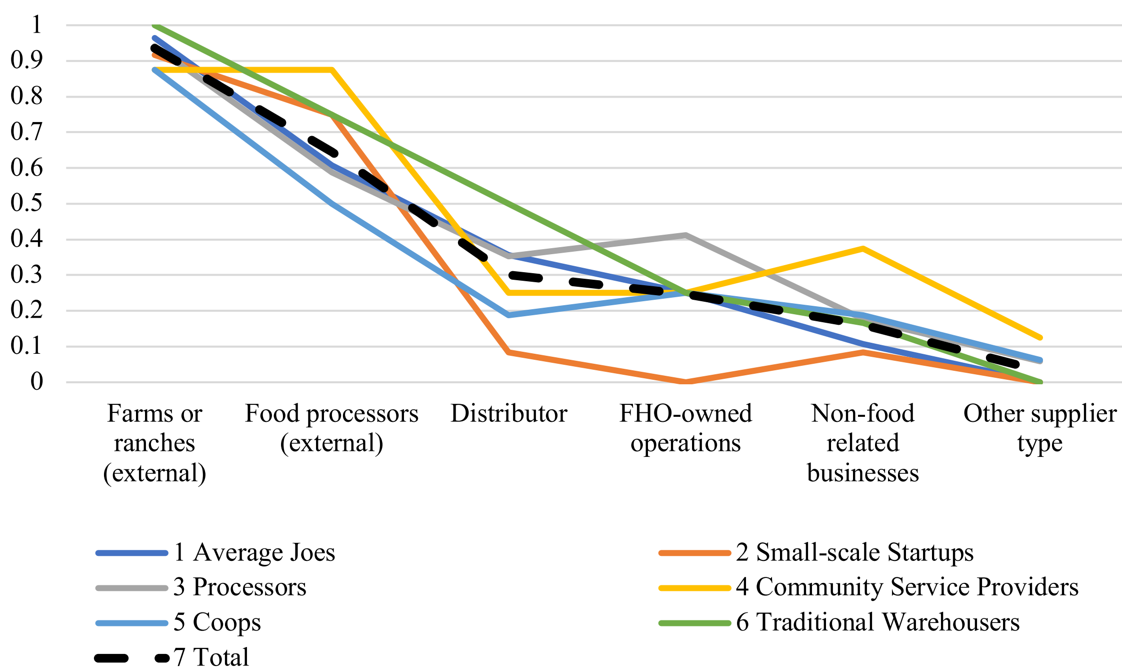

Figure 1. Mean Profiles: Types of Suppliers Used

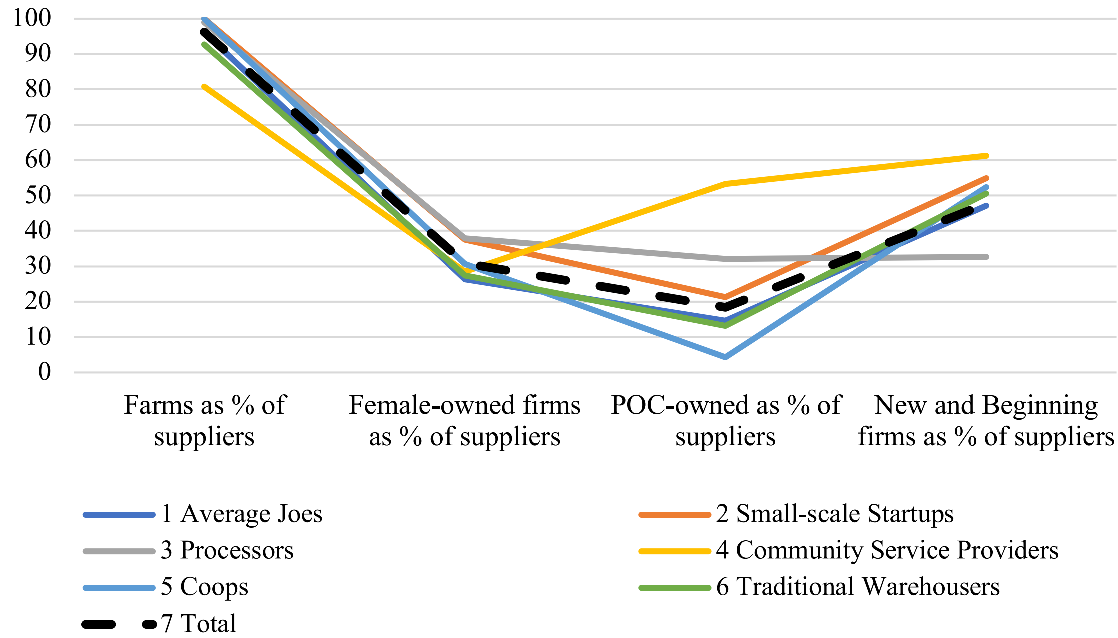

Figure 2. Mean Profiles: Supplier Demographics

Table 3. ISTT Results for Supplier and Managerial Variables

	Mean Difference					
	1	**2**	**3**	**4**	**5**	**6**
Farms or ranches not owned or managed by the food hub	−0.07	−0.01	−0.04	0.04	0.04	**−0.10**
Food processors not owned or managed by the food hub	0.00	−0.16	0.02	**−0.29**	0.12	−0.16
A different food distributor	−0.06	**0.26**	−0.04	0.07	0.15	−0.21
The food hub's own farms, ranches and/or other enterprises	0.00	**0.28**	−0.19	0.00	0.00	0.00
Nonfood related businesses	0.06	0.08	−0.03	−0.24	−0.04	−0.02
Other (specify)	0.08	**0.07**	0.01	−0.07	0.00	**0.07**
Total number of supplying enterprises - all types	25.86	57.83	−25.91	60.05	44.38	−210.21
Number of supplying enterprises - Farms or ranches only	−1.40	15.38	−0.86	22.31	−1.31	**−41.93**
Estimated max number of suppliers (maximum of 6.4 and 6.9)	26.38	46.33	−24.58	48.26	27.86	−160.61
Percent of suppliers who are farms or ranches	−0.02	−0.05	−0.02	−0.09	0.03	0.07
Femaled-owned firms (% of suppliers)	6.38	−7.46	−7.85	2.68	0.41	4.21
People of color-owned firms (% of suppliers)	6.63	−2.07	−14.62	**−35.29**	**17.67**	7.47
Firms in operation less than 10 years (% of suppliers)	4.05	−5.41	**20.84**	−11.97	−2.72	−0.56
Age of most senior manager	−2.94	3.33	1.01	−6.47	0.81	−0.22
Education level of most senior manager	0.21	−0.34	**−0.42**	0.73	0.50	−0.46
Warehousing/distribution of food	**−0.70**	**0.94**	0.07	−0.41	0.36	**−0.85**
Management, including financial and capital planning	**−0.77**	**1.15**	−0.42	−0.52	0.68	−0.49
Strategic planning	**−0.71**	0.44	−0.42	0.29	0.59	**−0.75**
Food processing	0.25	0.11	−0.74	−0.18	0.58	−0.31
Food marketing and sales	−0.26	0.44	0.38	−0.41	0.36	−0.39
Food retail	−0.09	0.03	**0.87**	−0.63	0.65	−0.12
Agricultural production	−0.01	−0.32	**−1.27**	−0.84	0.50	0.87
Utilizing other, food hub related skills	−0.33	0.20	−0.74	0.20	**1.22**	−1.31

Note: Boldface indicates statistical significance at or above the 10% level.

Managerial and Financial Elements

Coops senior managers consistently have fewer years of experience in each of the key functional areas, despite Coops being older organizations and their senior managers having similar ages and education levels as those of other species. CSP managers are most experienced. Processors have the highest average experience in agricultural production, while TPW managers have the highest average experience in warehousing, strategy, and other, unclassified managerial skills.

Results indicate a number of realms for potential policy interventions (Figure 3). FHO managers across species have low levels of experience in processing functions, which are key elements of value addition. Coops managers are at an experiential disadvantage and are a key group to target with training and mentorship programs. Small-Scale Startup managers substantially lack experience in warehousing and management; programs for new FHOs should prioritize these aspects. TPW managers lack experience in agricultural production; given their high reliance on fresh produce and new food safety regulations, this will be a critical need.

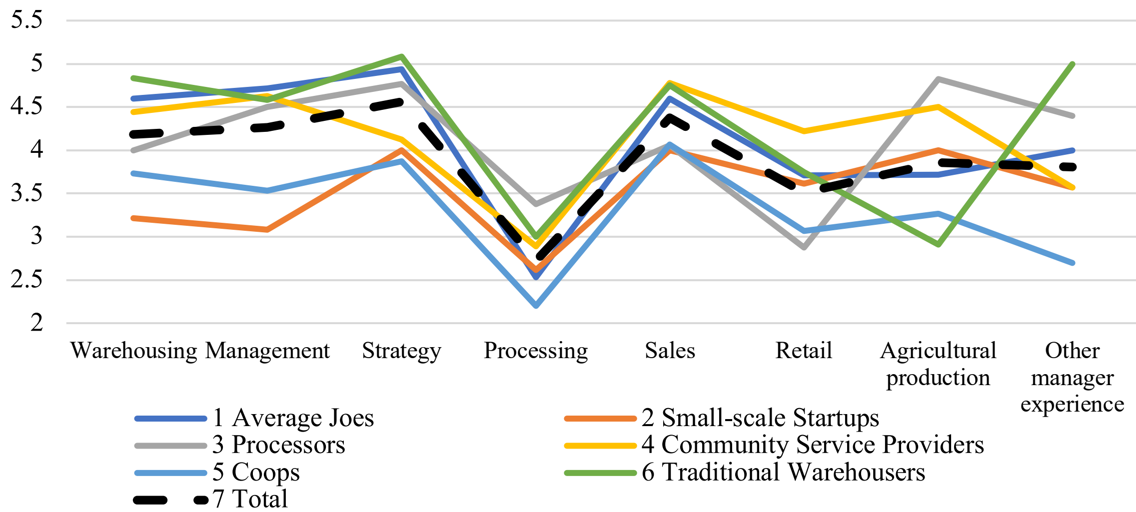

Figure 3. Mean Profiles: Manager Experience in Key Functions

Coops are the most likely to have relied on membership fees at founding (Figure 4 and Table 4). TPWs have the most diversified startup sources (mean 4.33), predominately program transfers, foundation grants, individual donations, and founder capital. Average Joes, Small-Scale Startups, and CSPs all sit near averages of three total sources. The most likely sources are membership fees for Coops; founder capital for Processors, Average Joes, and CSPs; and membership fees or individual donations for Small-Scale Startups. CSPs reported no use of local government funds and only moderate use of federal and state funds and foundation grants. Founder capital is the only source with majority use across all. Coops the have lowest revenue from nonsales and grant-dependency measures, indicating they are financially autonomous. CSPs and Processors have the highest average reliance on nonsales revenues. However, CSPs' dependence on grants is below the sample average, while Processors have the second highest dependence. This borders on the counterintuitive. Striking, and worthy of future investigation, is the source of nonsales revenues for the different species, if it is not grants.

Table 4. ISTT Results for Financial and Performance Variables

	Mean Difference					
	1	**2**	**3**	**4**	**5**	**6**
Income from other programs of the organization	0.05	−0.11	−0.18	**0.19**	**0.20**	−0.51
Business loans	−0.13	0.01	−0.08	**0.10**	**0.11**	0.10
Federal government funding	0.18	0.06	−0.12	−0.09	0.08	−0.01
State government funding	0.06	0.17	−0.22	0.04	−0.02	−0.10
Local government funding	−0.01	0.00	0.02	**0.19**	−0.08	−0.16
Foundation grants	0.02	−0.02	0.02	0.16	−0.03	**−0.68**
In-kind support	0.00	0.07	0.10	−0.07	−0.05	0.00
Donations from organizations	0.01	−0.14	−0.02	**0.16**	0.03	**0.16**
Donations from individuals	0.15	−0.13	0.00	−0.16	0.00	**−0.43**
Infrastructure provided by a government entity	−0.04	**0.08**	**0.08**	−0.14	−0.06	0.07
Membership fees	**0.16**	−0.18	0.15	0.01	**−0.47**	**0.22**
Bank loans	−0.07	**0.16**	−0.03	−0.07	−0.27	**0.14**
Private investors	**−0.21**	0.06	−0.03	**0.15**	**0.16**	**0.14**
Organization’s and/or founder’s own capital	−0.21	0.24	−0.13	−0.14	0.11	−0.20
Other (specify)	0.07	**0.11**	0.02	**0.10**	−0.03	0.10
Total number of startup funding sources	0.04	0.37	−0.43	0.45	−0.31	−1.16
Grant dependency rating	0.08	−0.08	−0.07	0.08	0.24	−0.05
Food and/or product purchases from producers/suppliers	−0.03	0.04	−0.03	0.22	−0.01	−0.06
Packaging equipment and supplies	−0.01	0.01	−0.02	0.01	0.01	0.00
Payments toward facilities	−0.01	−0.03	0.00	−0.06	**0.03**	0.02
Payments toward trucks or other automotive equipment	−0.01	**0.02**	−0.01	**−0.07**	**0.02**	**0.01**
Gasoline and tolls	0.00	0.01	0.00	−0.03	0.00	−0.01
Repair/maintenance	0.00	**0.01**	−0.01	−0.03	0.00	0.01
Utilities	0.00	**0.01**	−0.01	−0.06	**0.01**	0.00
Advertising and promotional materials	**0.01**	−0.02	0.01	−0.01	0.00	0.00
Credit card and bank service charges	**0.02**	−0.03	**0.02**	−0.01	0.01	0.01
Employee salary and benefits	0.02	0.05	−0.04	−0.02	−0.03	−0.02
Other administrative expenses (e.g., office supplies)	0.01	0.01	0.01	−0.01	−0.02	0.01
Data and computer services	**0.01**	−0.03	**0.01**	−0.01	0.00	0.01
All types of insurance	−0.01	0.01	0.01	−0.02	0.01	0.01
Consulting services	0.01	−0.04	**0.02**	0.02	−0.02	**0.02**
Telecommunications	0.00	0.00	0.00	0.00	**0.00**	0.00
Other	−0.01	−0.02	0.03	0.09	0.00	−0.01
Total expenses (in '000,000s)	1.75	**2.28**	−2.70	1.98	1.06	−6.26
Total value of product moved (in '000,000s)	**2.78**	3.18	−0.39	2.79	−5.39	−6.38
Profit (in '000,000s)	1.70	1.62	1.00	1.46	−7.17	1.70

Note: Boldface indicates statistical significance at or above the 10% level.

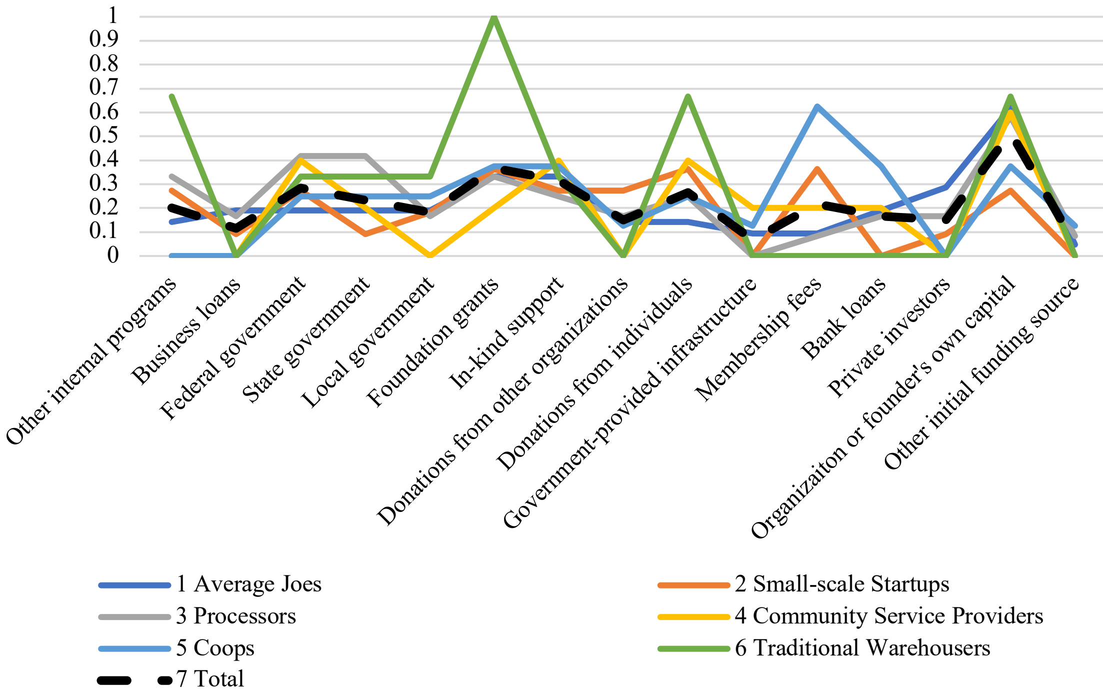

Figure 4. Mean Profiles: Startup Funding

Performance

Firm performance is examined via total value of product moved through the FHO, revenue, and profit. TPWs, Coops, and Processors have substantially greater economic impact in terms of TVPM and revenue. Average Joes, CSPs, and Small-Scale Startups are all within a \$1 million ceiling. Coops are the most profitable, in large part due to low expense levels. Only Average Joes show statistically significant mean differences for the core performance variables of TVPM and profit (see Table 4), with \$2.78 million less profit than all other cases. Results from regression analyses on these variables (Table 5) are consistent with Entsminger and Westgren (2019): (i) The only species showing a statistically significant coefficient is Coops; (ii) only Region 3 has a statistically significant environmental effect;[1] (iii) offering more types of community services has a positive and significant impact on profit; and (iv) for both TVPM and profit greater reliance on meat and poultry is positive and significant, while greater reliance on eggs has a negative and significant impact.

Discussion

Results here indicate that different species of FHOs play distinct roles in food distribution systems, coordinating actors at different levels, with different backgrounds, in different ways, and with different impacts. For example, Coops are consistently below population averages for most variables and yet are the only species consistently indicated as having high impact through the total value of product moved and profitability. Other results indicate that there may be efficiency or financial concerns for the species with the largest overall scale (TPWs). Within decisions of

[1] Region 3 includes AK, ID, MT, OR, WA, and WY.

Table 5. Regression Results for Performance Variables

		Total Value of Product Moved ('000,000s)								Profit ('000,000s)							
		B	***p*-Value**	**B**	***p*-Value**	**B**	***p*-Value**	**B**	***p*-Value**	**B**	***p*-Value**	**B**	***p*-Value**	**B**	***p*-Value**	**B**	***p*-Value**
	Intercept	1.07	0.70	2.52	0.50	−2.64	0.40	−13.24	0.12	0.23	0.91	0.03	0.99	−0.68	0.82	−12.19	0.12
Species	[2.00]	−0.91	0.86	−5.10	0.37	−4.78	0.33	−3.06	0.64	−0.21	0.96	−5.03	0.23	−5.69	0.23	−4.37	0.48
	[3.00]	2.72	0.56	1.34	0.79	3.37	0.40	0.93	0.85	0.38	0.92	−0.85	0.81	−0.63	0.87	−5.10	0.27
	[4.00]	−0.52	0.93	−2.17	0.74	−0.47	0.93	−1.96	0.78	−0.14	0.98	−2.23	0.64	−1.87	0.71	−3.85	0.56
	[5.00]	7.44	0.10	6.81	0.14	**7.60**	0.06	**9.27**	0.09	**7.15**	0.04	**6.44**	0.06	**6.64**	0.08	**8.72**	0.10
	[6.00]	6.35	0.21	4.19	0.42	−3.92	0.36	−3.02	0.51	−0.26	0.95	−2.61	0.49	−3.72	0.37	−3.02	0.49
Region	[1.00]			−1.04	0.84	0.98	0.83	2.82	0.61			2.09	0.57	2.41	0.58	4.20	0.42
	[3.00]			**10.36**	0.08	**14.46**	0.00	**18.82**	0.00			**13.68**	0.00	**14.50**	0.00	**17.73**	0.00
	[4.00]			−3.96	0.47	−0.31	0.94	3.65	0.47			−0.90	0.82	−0.43	0.92	2.98	0.53
	[5.00]			−0.89	0.91	0.90	0.89	10.09	0.36			2.05	0.71	1.46	0.82	7.93	0.45
	[6.00]			0.40	0.94	4.56	0.28	5.93	0.21			0.85	0.82	1.49	0.71	3.35	0.45
	[7.00]			−4.32	0.39	−1.79	0.66	−5.13	0.26			−1.08	0.77	−0.84	0.83	−4.49	0.29
Total number of suppliers (estimated max)						**0.05**	0.00	**0.07**	0.01					0.01	0.35	0.03	0.19
Strategic Orientation	Total community service types							1.19	0.15							**1.43**	0.07
	DTR % sales							0.06	0.27							0.04	0.41
	DTM % sales							0.11	0.31							0.06	0.53
	DTI % sales							−0.08	0.49							−0.08	0.47
	Processed produce							−0.02	0.88							0.07	0.51
	Meat							**0.11**	0.08							**0.14**	0.02
	Fish							−1.69	0.44							−2.33	0.26
	Milk and dairy							0.01	0.94							0.03	0.85
	Eggs							**−0.58**	0.07							**−0.54**	0.08
	Dry goods							0.06	0.63							0.06	0.61
	Baked goods							0.97	0.26							0.87	0.28
	Coffee and tea							−0.78	0.73							−1.11	0.60
	Other value added							0.12	0.33							0.14	0.22
	Non-food							−3.24	0.11							−2.90	0.13
	Unclassified products							0.24	0.48							0.20	0.54
Adj. R^2		−0.01		−0.01		0.41		0.43		0.01		0.08		0.07		0.14	

Note: Boldface indicates statistical significance at or above the 10% level.

organizational form, trade-offs may be made between profit-maximizing behavior and producing social welfare goods and services. Organizational species of larger scale had the lowest numbers of community service provision, inclusion of under-represented minorities, and in some cases more extended upstream transactional arrangements. Also of note is that the majority of FHOs still operate at small scales. Across species of FHOs, no single organizational form appears to have broken off into a *radically* divergent product and/or channel strategy. Most movement by FHOs is to increase scale through retail and restaurant markets. None of the species prioritize intermediated or institutional markets.

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Research Report: Economic Analysis of Producing Satsuma Citrus in Georgia Using an Enterprise Budget

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Abstract

Spanish explorers introduced citrus to Saint Augustine, Florida, in 1565; since then, Louisiana and Florida have become major producers of satsuma in the United States (Krewer, Powell, and Westerfield, 2015). South Georgians have recently become interested in producing satsuma citrus, which are more cold tolerant than other citrus fruits and have a consistent production cycle. Most importantly, satsuma unique in being "self-fruitful" and having an early maturity. While satsuma acreage in Georgia has increased exponentially, there are serious concerns over whether this emerging industry will generate positive returns on investment. The need for an economic analysis has become paramount for multiple stakeholders.

Keywords: citrus, fixed costs, fruits, prices, profitability, satsuma, sensitivity analysis, variable costs, yields

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Introduction

In 1565, Spanish explorers introduced citrus to the Western Hemisphere in Saint Augustine, Florida. The fruit was later introduced to Arizona in 1707; California in 1769; and the Gulf of Mexico, North Charleston, South Carolina, and the Gulf states around the 1890s. However, the crops were destroyed by extreme freeze. The freeze-resistant satsuma re-emerged in the 1940s and production skyrocketed to 12,000 acres in Louisiana, Alabama, and North Florida before again being destroyed by extreme freeze. Since then, Louisiana and Florida have become established commercial growers of satsuma (Andersen and Ferguson, 1996; Krewer, Powell, and Westerfield, 2015; Mahr, 2018).

Recently, South Georgians have become interested in producing satsuma citrus production (Krewer, Powell, and Westerfield, 2015; Mahr, 2018), which are more cold tolerant than other citrus varieties, have consistent production cycles and yields, and (unlike other citrus cultivars) seldom need cold protection (Krewer, Powell, and Westerfield, 2015). Most important is the cultivar's "self-fruitful" nature and early maturation between September and November (Mahr, 2018). In a very short space of time, satsuma acreage in Georgia has increased exponentially.

However, there are serious concerns as to whether this emerging satsuma industry will generate positive returns on investment (ROI) (Ahmadiani et al., 2016; Awondo, Fonsah, and Gray, 2017; Fonsah, Price and Cantrell, 2019). An economic analysis to determine profitability margins, if any, has become paramount to growers, county agents, specialists, researchers, financial institutions and stakeholders in the Georgia satsuma citrus industry (Fonsah and Hudgins, 2007; Fonsah et al., 2008, 2018). Although climate conditions in Georgia are favorable for satsuma production, quality, overall cosmetic appearance, freshness, and seediness are all marketable attributes that determine consumer purchasing preferences and willingness to pay (WTP) a premium price (Campbell et al., 2004, 2006).

Satsuma citrus (*Citrus unshiu* Marcovitch)—also called satsuma mandarin and satsuma tangerine—is believed to have originated in China. The cultivar was reported in Japan over 700 years ago and has been cultivated in Spain, Central China, Korea, Turkey, Russia, South Africa, South America, Central California, and Northern Florida. Cultivars grown in Georgia are 'Owari', 'Silverhill', and 'Changsha'.[1] 'Owari' is the most preferred because of its availability in nurseries and fruit quality (Krewer, Powell, and Westerfield, 2015). 'Xie Shan'—an early-maturing variety—has been planted in Georgia as well. Although satsuma citrus is grown strictly for the fresh market, they are grown in other parts of the world for canning and fruit juice (Andersen and Ferguson, 1996; Krewer, Powell, and Westerfield, 2015; Mahr, 2018).

[1] However, 'Changsha' (*C. reticulata* Blanco) is not a true satsuma cultivar.

Material and Methods

A team of University of Georgia (UGA) Extension specialists, researchers, and agents visited various satsuma growers in South Georgia to collect data on various inputs, including land preparation, lime, pre- and post-emergent herbicides, fungicides, trees, and tissue and soil analyses. Other important inputs included scouting, labor, fuel, repair, and maintenance. Inputs were classified as preharvest variable or operating costs (P-VC), harvesting and marketing costs (H&MC), variable costs (VC), and fixed costs (FC). A traditional enterprise budget analysis was adopted to compute profitability margins (Fonsah and Hudgins, 2007; Fonsah et al., 2008, 2018). Secondary data and information was obtained from scientific and Extension publications.

Results

This study considered five yields: best, optimistic, median, pessimistic, and worst. Our calculations were based on the median; we assumed that producers would achieve the median yield and price 50% of the time (Table 1).

Table 1. Estimated Yield per Acre and Price per Pound for Satsuma Citrus in Georgia, 2019

Description	Best	Optimistic	Median	Pessimistic	Worst
Yield (lb/acre)	35,000	27,000	20,000	12,500	5,000
Price ($/lb)	1.50	1.25	1.00	0.75	0.50

Production input in the fourth year included fertilizers, pre- and post-emergence herbicides, insecticides, fungicides, tissue and soil analyses, scouting, labor, fuel, repairs and maintenance, irrigation, and frost protection (Table 2). We do not include land preparation among production inputs for the fourth year, since we had already included this cost in the estimated and establishment costs for the first year of production (Fonsah and Hudgins, 2007; Fonsah et al., 2007, 2008, 2018). We estimate total preharvest variable costs in the fourth year of satsuma production to be $4,484/acre (Table 2).

Harvesting and marketing costs (H&MC) were calculated based on 95% median yields. We assumed 5% field loss during harvesting, although losses could be as high as 25% if a grower fails to adopt good agricultural practices that would reduce culls caused by sunburn and puffy fruits. Total harvesting and marketing cost (TH&MC) was $2,090/acre while total variable cost (TVC) was $6,574/acre.

Fixed costs (FC) included tractor and equipment, irrigation, recaptured establishment costs, overhead, and management, which was 15% of total preharvest variable costs (TP-VC). Our study shows that total fixed costs (TFC) were $4,524/acre, for a total cost (TC) of $11,098/acre to produce satsuma citrus in Georgia (Table 3).

A sensitivity risk rated returns over total costs of producing satsuma citrus in Georgia (Table 4) showed that a grower could obtain a total loss of −$3658 under the worst-case scenario 7% of the time, while a profit of $21,461 could be obtained once in 10 years. Our expected return was $8,902/acre (Fonsah and Hudgins, 2007; Fonsah et al., 2007, 2008, 2018).

Table 2. Estimated Input Costs in the Fourth Year of Producing Satsuma Citrus in Georgia, 2019

Preharvest Variable Costs	Unit	Quantity	Price ($)	$/Acre
Fertilizer (10–10–10)	Acre	1,000.00	0.30	300.00
Micro-nutrient sprays	Acre	2.00	10.00	20.00
Pre-emergence herbicides	Acre	2.00	40.00	80.00
Post emergent herbicides	Acre	5.00	10.00	50.00
Insecticides	Acre	5.00	15.00	75.00
Fungicides	Acre	2.00	50.00	100.00
Trees replacement (15 × 20)	Tree	5.00	15.00	75.00
Tissue analysis	Acre	1.00	35.00	35.00
Soil analysis	Acre	1.00	6.00	6.00
Scouting	Acre	1.00	75.00	75.00
Labor	Hours	200.00	10.00	2,000.00
Fuel	Acre	1.00	29.98	29.98
Repair & maintenance	Acre	1.00	37.00	37.00
Irrigation/frost protection	Acre	1.00	1,413.32	1,413.32
Interest on operation		2,882.98	0.07	187.39
Total pre-variable costs			4,483.70	4,483.70

Table 3. Estimated Harvesting and Marketing (H&MC), and Fixed Costs (FC) of Producing Satsuma Citrus in Georgia, 2019

Harvest and Marketing Costs	Unit	Quantity	Price	$/Acre
Harvesting & hauling	Acre	19,000.00	0.10	1,900.00
Packing & cooling	Acre	19,000.00	0.01	190.00
Total harvesting and marketing costs	$			2,090.00
Total variable costs				6,573.70
Fixed Costs	**Unit**	**Quantity**	**Price**	**$/Acre**
Tractor & equipment	Acre	1.00	527.75	527.75
Irrigation	Acre	1.00	2,077.93	2,077.93
Recaptured establishment costs	Acre	1.00	1,246.22	1,246.22
Overhead and management	Acre	4,484.00	0.15	672.55
Total fixed costs ($)	$			4,524.46
Total budgeted cost per acre ($)				11,098.16

Table 4. Sensitivity Risk-Rated Returns over Total Costs of Producing Satsuma Citrus in Georgia, 2019

	Best	Optimistic		Expected	Pessimistic		Worst
Returns ($)	21,461	17,275	13,088	8,902	4,715	529	−3,658
Chances	7%	16%	31%	50%	0.69%	0.84%	1%
Chances	93%	84%	69%	50%	31%	16%	7%
	Chances for profit =	86%		Base budgeted net revenue ($) =			8,902

A sensitivity analysis and economic risk-rated returns of price and yield over total cost of producing satsuma citrus in Georgia reveal that a grower could expect a return of −$1,867/acre 50% of the time (an expected yield of 20,000 lb/acre, with a drop in price from $1 to $0.50). In the worst-case scenario, the grower could obtain −$10,358/acre 7% of the time. Even with a price of $1.00 and expected yield of 20,000 lb, a grower could still obtain −$4,466/acre in the worst-case scenario (Table 5).

Table 5. Sensitivity Analysis and Economic Risk-Rated Returns for Price and Yield over Total Costs of Producing Satsuma Citrus in Georgia, 2019

Price/lb	Best ($)	Optimistic ($)	($)	Expected (20,000)	Pessimistic ($)	($)	Worst ($)	Chance of Profit (%)
0.50	6,785	3,901	1,017	−1,867	−4,697	−7,528	−10,358	37
0.75	13,533	10,053	6,573	3,093	−387	−3,867	−7,346	67
1.00	20,653	16,466	12,280	8,092	3,907	−280	−4,466	83
1.25	28,004	23,034	18,063	13,093	8,123	3153	−1,817	91
1.50	35,482	29,692	23,893	18,093	12,294	6,494	694	94

Table 6 shows that the preharvest costs in year 1 were $4,828/acre, while TC were $7,088/acre. In year two, preharvest costs reduced to $2,769/acre, while TC were $4,719/acre. In year four—which is considered full production—P-VC were $4,484/acre, TVC were $6,684/acre, and TFC were $5,112/acre, for TC of $11.786/acre.

Table 6. Summary of Different Costs Component for Producing Satsuma Citrus in Georgia, 2019

Years	Preharvest Variable Costs (P-VC)	Total Variable Costs (TVC)	Total Fixed Costs (TFC)	Total Costs (TC)
1	$4,828	$4,828	$2,260	$7,088
2	$2,769	$2,769	$1,951	$4,719
3	$3,872	$3,872	$2,116	$5,988
4	$4,484	$6,684	$5,112	$11,786

A breakeven (BE) analysis finds that a minimum yield of 12,000 lb is required to stay in business. BE costs were \$0.60/lb (\$0.33/lb in variable costs and \$0.27/lb in fixed costs) (Table 7).

Table 7. Breakeven (BE) Analysis for Satsuma Citrus Production in Georgia, 2019

BE harvesting & marketing costs per lb	\$0.22
BE fixed costs per lb	\$0.27
BE total costs per lb	\$0.60
BE variable costs per lb	\$0.33
BE yield per acre (lb)	12,000

Conclusion and Remarks

Results from this study show that satsuma citrus production can be a lucrative business in Georgia if sustainable good agricultural practices (SGAP) are maintained. Our sensitivity analysis based on total costs predicts an expected fresh market net return of \$8,092/acre, assuming an expected yield of 20,000 lb/acre and expected price of \$1.00/lb. The price sensitivity analysis also shows that profitability varies based on price and yield fluctuations. Finally, our study shows a breakeven yield of 12,000 lb/acre. Our studies depict that with a price drop from \$1 to \$0.50, a grower could expect a return of −\$1,867/acre 50% of the time. In a worst-case scenario, the grower could also obtain −\$10,358/acre 7% of the time. Even with a price of \$1.00 and expected yield of 20,000 lb, a grower could still obtain −\$4,466/acre in the worst-case scenario.

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Research Report: The Role of Healthy Diet Belief in Mediating the Organic Label Effect on Increased Food Consumption

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Abstract

This study investigates the effect of consuming organic foods on perceived dietary health and how the healthy diet belief mediates the organic label effect on increased organic food consumption. We find that consumers who buy organic foods rate their dietary health significantly higher than those who do not. The mediation analysis suggests that observing an organic label is associated with higher ratings of dietary health, which in turn promotes organic food consumption. This mechanism has important implications for organic food marketing in that purchasing organic food can be fostered by using the healthy diet perception as a marketing cue.

Keywords: dietary health, organic label effect, propensity-score matching

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Introduction

Findings on the nutritional differences between organic and conventionally grown foods have been inconsistent (Kushi et al., 2012). It is largely unknown whether observed differences in pesticide residues and antibiotic-resistant bacteria may translate into health benefits such as lower risk of cancer (Kushi et al., 2012). In spite of these uncertainties, nationally representative data indicate that an increasing number of American families have made organic foods part of their everyday diet. About 82.3% of the 100,000 households in an Organic Trade Association study (2019) reported purchasing organic foods in 2016, up 3.4% from 2015.

Frequent purchase of organic products has been associated with sociodemographic characteristics, health concerns, and environmental awareness (Van Doorn and Verhoef, 2011). Consumers consider organic foods to be superior to conventional foods in many aspects such as health, flavor, quality, and safety (Vega-Zamora et al., 2014). Perceived health benefits are one of the major forces driving the increasing demand for organic food consumption (Grankvist and Biel, 2001; Magnusson et al., 2003; Vega-Zamora et al., 2014). Previous studies have found that consumers underestimate the calorie content of organic products relative to their conventional counterparts, even though their calorie content is the same (Lee et al., 2013; Schuldt and Schwarz, 2010).

Past research indicates that package elements—such as labels—can influence consumer consumption of a product as well as how they evaluate that food product (Bublitz, Peracchio, and Block, 2010). Under routine buying situations, such as weekly grocery shopping, consumers have low involvement when searching for product information; little consideration in brand and product choice leads to a halo effect (Lee et al., 2013), which occurs when a consumer's perception of one product attribute strongly biases his or her perception of other attributes of the same product. The perceived health benefit of observing the organic label may lead to omission of information from the nutrition facts panel (organic halo effect), underestimation of calorie content, and increased consumption of organic foods.

Most previous research has studied health benefits as the motivational antecedent for consuming organic food. Rarely has any prior studies examined perceived healthy diet as the consequence of organic consumption. To addresses this gap in research, this study aims to investigate (i) the effect of consuming organic foods on perceived dietary health and (ii) how the healthy diet belief mediates the organic label effect on increased organic food consumption.

Method

Using data from the 2009–2010 National Health and Nutrition Examination Survey, we first described the differences in dietary health and food consumption behaviors between buyers of organic and conventional food. Second, we used propensity-score matching to compare the self-rated dietary health of organic food buyers with that of consumers who do not buy organic foods but have similar demographic characteristics and dietary composition. The matching variables included gender; age; race; education; marital status; household size and income; and at-home consumption of fruits, vegetables, snacks, milk, and soft drinks . Third, we used a regression analysis to examine the various factors associated with dietary health rating (dependent variable). Dietary health rating measures the healthfulness of the overall diet on a scale from 1 (poor) to 5 (excellent). Organic buyer is a dummy variable identifying consumers who bought food with an organic label in the 30 days prior to the survey. As a proxy for food consumption behaviors, availability of different foods at home—including fruits, dark green vegetables, fat-free/low-fat milk, salty snacks, and soft drinks—is measured on a scale from 1 (never) to 5 (always). Demographic variables—gender, age, race, education level, marital status, household size, and annual household income—are included as covariates. Finally, we used a mediation model to test whether the effect of organic label on increased consumption is mediated by the belief of having a healthier diet.

Results and Discussion

Approximately 36.23% of respondents ($n = 5{,}060$) had bought organic foods in the 30 days prior to the survey, and about 56.63% of them reported that they had seen the USDA organic seal (Table 1). Consumers who buy organic foods rate their dietary health significantly higher than those who do not (mean difference = 0.33, $p < 0.001$) (Figure 1 and Table 1). However, this effect might stem from underlying differences in their dietary composition: Organic buyers consume significantly higher amounts of fruits, vegetables, fat-free/low-fat milk and significantly lower amounts of salty snacks and soft drinks, making their diets healthier than others (Figure 2 and Table 1). Organic food buyers also differ from nonorganic food buyers in demographic characteristics: Organic buyers have a higher proportion of female and white respondents and a lower proportion of Mexicans and blacks than conventional buyers. Organic buyers have a higher education level and annual household income and are more likely to be married. The average household size is smaller among organic buyers.

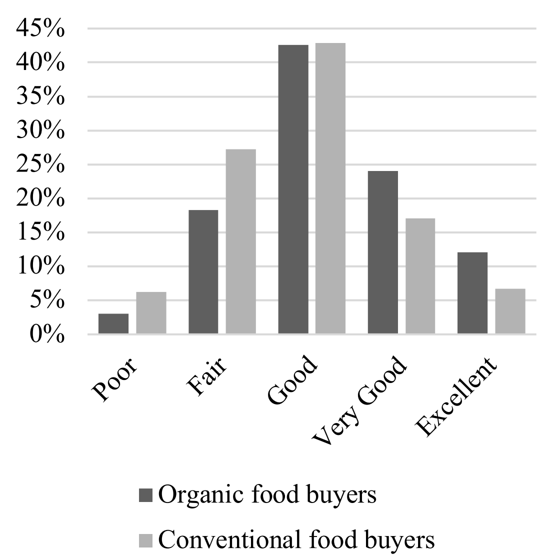

Figure 1. Rating of Dietary Health among Organic and Conventional Food Buyers

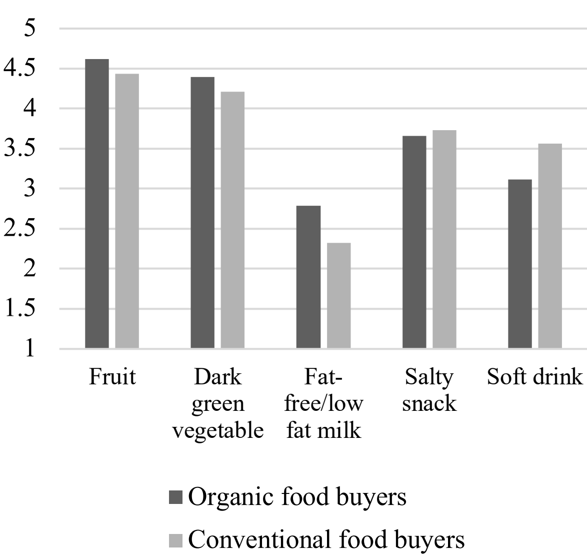

Figure 2. Food Consumption at Home among Organic and Conventional Food Buyers

Table 1. Descriptive Statistics of the Sample

Variable	Whole Sample (N = 5,060) Mean	Organic Food Buyer (N = 1,833) Mean	Conventional Food Buyer (N = 3,227) Mean	Mean Difference	p-Value
Dietary health rating	3.03	3.24	2.91	0.33	< 0.001
	(0.99)	(0.99)	(0.97)		
Organic seal (yes = 1, no = 0)	0.57				
	(0.50)				
Fruit	4.50	4.62	4.43	0.19	< 0.001
	(0.82)	(0.75)	(0.85)		
Dark green vegetable	4.28	4.40	4.21	0.19	< 0.001
	(0.97)	(0.88)	(1.01)		
Fat-free/low-fat milk	2.49	2.79	2.32	0.47	< 0.001
	(1.80)	(1.85)	(1.76)		
Salty snack	3.71	3.66	3.73	−0.08	0.0353
	(1.23)	(1.24)	(1.21)		
Soft drink	3.40	3.12	3.56	−0.45	< 0.001
	(1.49)	(1.52)	(1.45)		
Age	45.90	46.02	45.84	0.18	0.7389
	(18.95)	(18.14)	(19.40)		
Gender (male = 1, female = 0)	0.47	0.42	0.49	−0.08	< 0.001
	(0.50)	(0.49)	(0.50)		
White (yes = 1, no = 0)	0.49	0.54	0.45	0.09	< 0.001
	(0.50)	(0.50)	(0.50)		
Mexican (yes = 1, no = 0)	0.19	0.14	0.22	−0.08	< 0.001
	(0.39)	(0.34)	(0.41)		
Other Hispanic (yes = 1, no = 0)	0.10	0.11	0.09	0.02	0.0164
	(0.30)	(0.32)	(0.29)		
Black (yes = 1, no = 0)	0.18	0.15	0.20	−0.06	< 0.001
	(0.39)	(0.35)	(0.40)		
Other race (yes = 1, no = 0)	0.05	0.06	0.04	0.02	< 0.001
	(0.21)	(0.24)	(0.19)		
Education level	3.29	3.76	3.02	0.74	< 0.001
	(1.26)	(1.18)	(1.23)		
Married (yes = 1, no = 0)	0.53	0.55	0.51	0.04	0.0042
	(0.50)	(0.50)	(0.50)		
Household size	3.35	3.21	3.44	−0.23	< 0.001
	(1.74)	(1.69)	(1.76)		
Annual household income level	7.70	8.66	7.14	1.52	< 0.001
	(3.58)	(3.60)	(3.46)		

Note: Numbers in parentheses are standard deviations. The means for binary variables indicate the proportions of respondents with a value of 1. p-values are calculated from two sample t-tests for the difference in means between organic and conventional buyers.

Results from propensity-score matching indicate that the average treatment effect (ATE) of buying organic foods on self-rated dietary health is much smaller and less significant (ATE = 0.10, $p < 0.05$) than that from a simple *t*-test without adjustment (Table 1). In the matched sample, organic buyers have similar sociodemographic characteristics and dietary composition but higher ratings of dietary health compared to conventional buyers. This study supports previous studies examining the halo effect of organic label: Consumers tend to underestimate the calorie content of organic foods, even when they are the same as their conventional counterparts (Lee et al., 2013; Schuldt and Schwarz, 2010).

Table 2 presents results from the regression analysis. Organic food buyers tend to rate their dietary health higher than conventional food buyers. Higher availability of fruits, vegetables, and fat-free/low fat milk at home is associated with higher dietary health rating, whereas higher availability of salty snacks and soft drinks is related to lower self-rated dietary health. Self-rated dietary health is higher for male, older, and married consumers and those who have a higher education level and household income. Dietary health rating is lower for those living in a larger household. Compared with whites, Mexicans, other Hispanics, and blacks have lower ratings of dietary health. Studies have consistently found a positive effect of household income on organic consumption, but previous findings on the effects of gender, educational level, and marital status on organic consumption are mixed (Rödiger and Hamm, 2015).

Table 2. Results from Regression Analysis of Perceived Dietary Health Rating

Independent Variable	**Coefficient**	***p*-Value**
Organic food buyer (yes = 1, no = 0)	0.1430	< 0.001
Fruit	0.1492	< 0.001
Dark green vegetable	0.1217	< 0.001
Fat-free/low fat milk	0.0236	0.005
Salty snack	−0.0425	0.001
Soft drink	−0.0382	< 0.001
Gender (male = 1, female = 0)	0.0606	0.038
Age	0.0069	< 0.001
Married (yes = 1, no = 0)	0.0725	0.025
Education level	0.0926	< 0.001
Annual household income	0.0092	0.054
Household size	−0.0354	0.001
White (reference group)		
Mexican (yes = 1, no = 0)	−0.2055	< 0.001
Other Hispanic (yes = 1, no = 0)	−0.1370	0.012
Black (yes = 1, no = 0)	−0.1088	0.009
Other race	0.0063	0.931
Constant	1.4151	< 0.001

Results from the mediation analysis indicate the direct effect of seeing an organic label on increased organic food consumption (coefficient = 0.19, $p < 0.001$) (Figure 3). Observing a USDA organic seal is also significantly associated with higher ratings of dietary health, which in turn increases consumption of organic foods (Figure 3). A Sobel test for the significance of the mediation confirms the indirect effect of an organic label on organic consumption via the healthy diet belief (coefficient = 0.01, $p < 0.001$). This study echoes a previous finding that perceived health benefits of organic foods mediate the underlying pathway from organic label to increased food consumption (Lee et al., 2018).

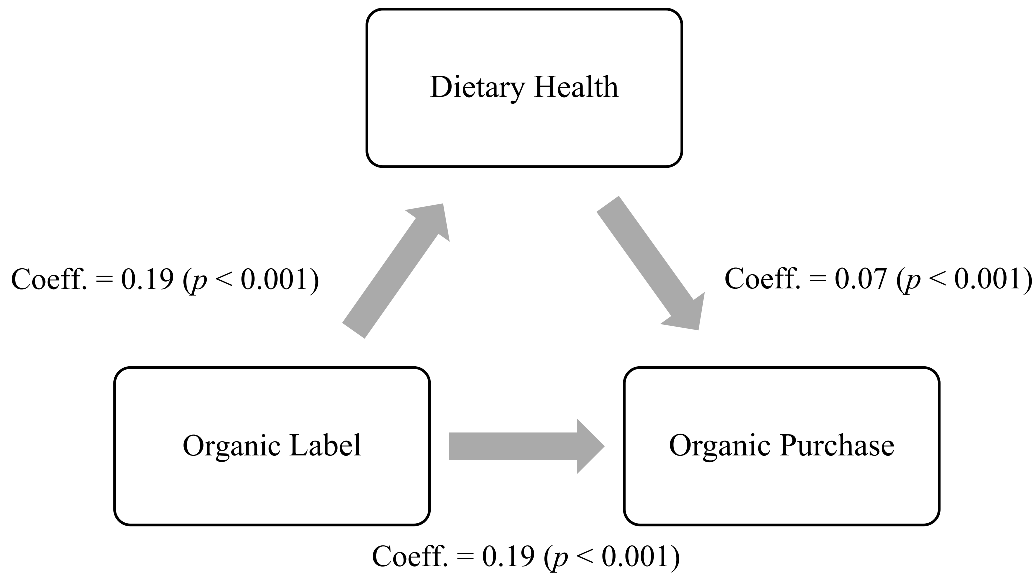

Figure 3. Results from Mediation Analysis

Conclusion

Despite inconsistent findings on the nutritional difference between organic and conventionally grown foods, demand for organic food has increased. This study aims to investigate the role of healthy diet belief in mediating the organic label effect on increased organic food consumption. Using data from the National Health and Nutrition Examination Survey, we first find that consumers who buy organic foods have a significantly higher rating of their dietary health than those who do not (difference = 0.34, $p < 0.001$). To reduce the observed bias stemming from the underlying differences in their dietary composition, we use propensity-score matching to compare the self-rated dietary health of organic food buyers with conventional food buyers with similar demographic characteristics and dietary composition. The resulting ATE of buying organic foods on self-rated dietary health is much smaller and less significant (ATE = 0.10, $p < 0.05$), confirming an organic label effect on healthy diet belief. Second, we use a mediation model to test whether the effect of organic label on increased consumption is mediated by the belief of having a healthier diet. Results from the mediation analysis indicate the direct effect of observing an organic label on increased organic food consumption (coefficient = 0.19, $p < 0.001$) and the indirect effect of organic label on organic consumption via the healthy diet belief (coefficient = 0.01, $p < 0.001$). Adding to previous research studying health benefits as the motivational antecedent for consuming organic food, this study not only confirms perceived healthy diet as the consequence of organic consumption, but also suggests that observation of an organic label is associated with the healthy diet belief which in turn promotes organic food consumption. This mediation mechanism has important implications for organic food marketing in that purchase of organic food can be fostered by using the healthy diet perception as a marketing cue.

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Research Report: Factors Affecting Goat Meat Demand and Willingness to Pay a Premium Price for Domestically Produced Goat Meat in the Southern United States

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Abstract

A consumer survey in Arkansas, Georgia, and Missouri was conducted to determine the drivers of goat meat demand and explore consumers' willingness to buy goat meat on various festive occasions. Two logistic models were introduced to examine factors affecting current goat meat demand and willingness to pay more for the domestically produced goat meat. Results indicate that goat meat consumption in the South is driven by factors associated with younger age, being nonwhite, and having attained a bachelor's degree. The study also revealed that willingness to buy goat meat on various festive occasions is highly influenced respondents' willingness to pay more for domestically produced goat meat.

Keywords: festive occasions, goat meat consumption, logistic model, marketing strategies

Introduction

Growing demand for goat meat and meat goats in the United States is reflected by the increase in meat goat inventory from 591,543 head in 1990 to 2,075,000 head in 2018 (U.S. Department of Agriculture, 2019b). Similarly, goat meat imports grew fourfold from 2000 to 2017, reaching 33 million pounds in 2018 (U.S. Department of Agriculture, 2019c). Currently, the United States is one of the world's major goat meat importing countries; most of its imported goat meat comes from Australia (U.S. Trade Numbers, 2019). This growing demand is the result of changes in U.S. population demographics. In recent years, most immigrants have come from countries where goat meat is a favorite, including Mexico, China, India, Philippines, and El Salvador (Pew Research Center, 2019).

Ibrahim et al. (2017) examined characteristics of goat meat consumers in Georgia and found that education, gender, and household size significantly affected respondents' willingness to consume goat meat. As most meat goats are farmed in the southern states (U.S. Department of Agriculture, 2019b), several questions can be raised: (i) Who are the goat meat consumers in the southern states? (ii) Can domestically produced goat meat compete with imported meat? (iii) What are the best ways to sell meat goats? The objectives of this study were to (i) determine the factors that influence goat meat demand in southern United States and (ii) determine the specific times/ occasions that may influence people to pay a premium price for domestically produced goat meat.

Methods

A consumer survey was conducted in Arkansas, Georgia, and Missouri in 2018. The survey instrument consisted of questions related to consumer characteristics, general meat-buying practices, and satisfaction with various meat qualities. A total of 1,201 respondents participated. Table 1 presents variable definitions and associated respondent percentages. To assess current consumers, respondents were asked, "Have you or any of your family members ever tasted or eaten goat meat?" The survey found that 57% had tasted goat meat. Further, respondents were asked, "Suppose your area grocery store is giving out goat meat samples. Would you be willing to try it?" This question helps to determine potential consumers in these southern states.

Table 1. Variable Definitions and Percentages of Respondents

Variable	Description	Percentage (%)
Dependent	Have you or any of your family members ever tasted or eaten goat meat? (yes = 685)	57
Dependent	Are you willing to pay more for domestically produced goat meat than imported goat meat? 1= if respondent said Yes; 0 otherwise (yes = 667, no = 534)	56
AGE	Age of participant	
Gender	If respondent is male	50
EDU	Bachelor's degree or higher	52
Race	If respondent is white	83
Ethnicity	If respondent is Hispanic	3
U.S. born	Were you born in the United States?	95

Food, especially meat, is a focal point of many celebrations. Goat meat is particularly important to migrants' celebrations and holidays. Hence, respondents' were asked for their willingness to purchase more goat meat on special holidays or occasions: "Please identify the top three occasions that you might purchase more goat meat." Eight occasions and other were listed: Christmas, Easter, Ramadan, Eid-al-fitr, Eid-al-adha, wedding, July 4th, and other. More than 50% of respondents indicated that they would be more willing to purchase goat meat for Christmas, Easter, and July 4th (Table 2). We found that 667 respondents (56%) indicated that they would be willing to pay more for domestically produced goat meat than for imported goat meat.

Table 2: Respondents Are More Willing to Purchase Goat Meat for Various Occasions

Occasion	No	Yes	Occasion	No	Yes
Christmas	39%	60%	Ramadan	85%	15%
Easter	37%	62%	Eid-al-fitr (feast after fasting month)	83%	16%
Wedding	61%	38%	Eid-al-adha (month of sacrifice)	85%	15%
July 4th	47%	53%	Other	60%	39%

Results

We introduce two binomial logistic models. The first model attempts to determine consumers' willingness to buy goat meat. Six demographic independent variables were considered: gender, age, education, race, ethnicity, and U.S. born. Table 3 reports the analysis of maximum likelihood estimates for model 1. The probabilities for likelihood ratio, score, and Wald tests were less than 0.0001 for the global null hypothesis test, which means the models were of good fit. The parameters that were less than 10% were considered significant. Similar to Ibrahim et al. (2017), the education variable had a positive impact on goat meat consumption. Consumers with higher education levels may be aware of the heart-healthy nutritional benefits of goat meat relative to beef, pork, and chicken. The age variable was negative and significant at the 5% level, indicating older people were less willing to try goat meat. We also found that white people were less likely to purchase goat meat in the southern states.

Table 3. Maximum Likelihood Estimates for Willingness to Consume Goat Meat

Parameter	**Estimate**	**Std. Err.**	**Pr > χ^2**
Intercept	1.3272***	0.3616	0.0002
Gender (male)	0.1887	0.1199	0.1155
Age	−0.0076**	0.0037	0.0380
Education (bachelors or higher)	0.3472***	0.1201	0.0039
Race (white)	−0.7821**	0.1801	0.0001
Ethnicity	0.4872	0.3817	0.2018
U.S. born	−0.3118	0.2926	0.2865

Note: Single, double, and triple asterisks (*, **, ***) indicate significance at the 10%, 5%, and 1% levels.

The second model was introduced to determine factors influencing willingness to pay more for domestically produced goat meat than for imported goat meat. Seven festive occasions were considered as the independent variables. Table 4 reports the analysis of maximum likelihood estimates for model 2. The model confirms that all seven occasions influence willingness to pay more for domestically produced goat meat.

Table 4. Maximum Likelihood Estimates for Willingness to Pay More for Domestically Produced Goat Meat than for Imported Goat Meat

Parameter	**Estimate**	**Std. Err.**	**Pr > χ^2**
Intercept	−2.0112***	0.3255	< 0.0001
Christmas	0.9097***	0.1643	< 0.0001
Easter	0.8399***	0.1627	< 0.0001
Ramadan	0.5759***	0.2080	0.0056
Eid-al-fitr	0.9184***	0.2256	< 0.0001
Eid-al-adha	0.4927**	0.2272	0.0301
Wedding	0.9322***	0.1670	< 0.0001
July 4th	0.9441***	0.1698	< 0.0001

Note: Single, double, and triple asterisks (*, **, ***) indicate significance at the 10%, 5%, and 1% levels.

Conclusion

This study found that goat meat consumption in the South is driven by factors associated with younger age, being nonwhite, and having attained, at least, a bachelor's degree. Hence, suggested marketing strategies for producers are to target younger, nonwhite, and more educated populations. Producers may also consider value-added goat meat products that may appeal to younger people. Since goat meat is new to many Americans, providing goat meat recipes may also attract people to buy goat meat. Additionally, promoting the health benefits of goat meat compared to other meats may encourage educated and younger people consume more goat meat. This study also found that consumers are willing to pay a premium for domestically produced goat meat relative to imported goat meat during festive occasions. Domestically produced goat meat can be promoted and producers can target holidays and festivals.

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Research Report: Measuring Undergraduate Students' Knowledge of Selected Nutrients

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Abstract

Based on the study's findings, students' overall knowledge of the selected nutrients was extremely low. However, students who lived in smaller households, non–African Americans, and those who ranked their health status as being poor/fair or good/very good were more likely to correctly answer the question on protein. Knowledge of carbohydrates was higher among older and female students. Non–African Americans and students who ranked their health status below excellent were more knowledgeable about vitamin C. Older students knew more about vitamin D than younger students, while non–African American and female students were more knowledgeable about saturated fat, trans fat, and cholesterol.

Keywords: binomial logit models, carbohydrates, nutritional knowledge, protein, saturated fat, Nutrition Facts, cholesterol, undergraduate students

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Introduction

The *Dietary Guidelines for Americans*, now in its 8th edition (U.S. Department of Health and Human Services and U.S. Department of Agriculture, 2016), was first introduced in 1980 to help Americans to make healthier food choices. Each subsequent 5-year issue has continued that core goal. The *Guidelines* encourage Americans to eat a wide variety of fruits, vegetables, protein foods, grains, and fat-free or low-fat dairy and to limit daily intake of sugars, saturated fats, trans fats, sodium, and alcohol. In essence, the recommendations aim to foster healthier eating habits to mitigate rising overweight and obesity rates, incidences of chronic diseases, and healthcare costs, among others.

The Nutrition Labeling and Education Act was passed in 1990 and implemented in 1994 to give consumers another source of uniform, reliable nutritional information through Nutrition Facts labels on food products. Despite the easy access and prevalence of nutritional information, the most recent report from the Trust for America's Health (2019) indicated that the U.S. obesity rate was high, that it had increased among certain segments of the population, and that it varied racially, ethnically, and regionally. The report also indicated that Louisiana's obesity rate stood at 35%+ and that the largest increases were among young adults. In 2018, for example, 27.9% of those aged 18–24 years in Louisiana and 37% of those aged 25–44 years old were obese, ranking the state 2nd and 10th nationally in those categories.

Over a decade ago, Nelson et al. (2008), in describing the U.S. obesity problem and subsequent public health concerns, argued that more research was needed on the segment of the population that was transitioning from adolescence to young adulthood or emerging adulthood. They observed that obesity rates had been rising rapidly among young adults because of unhealthy eating habits and lack of physical activity. Because most undergraduates fell in the emerging adulthood category, the authors suggested that colleges, universities, and other postsecondary institutions were fertile grounds for implementing strategies to combat obesity. They also theorized that the impact could be widespread because of the large numbers of students from racially and economically diverse backgrounds who enrolled in these institutions annually and the weight gain often associated with college matriculation.

In their study, Racette et al. (2008) found that—although some variability existed between male and female college students—overall, both groups gained weight throughout their undergraduate matriculation and that the weight gain was associated with poor dietary habits and low levels of physical activity. Based on their findings, Jung and Bice (2019) suggested that college students' weight gain resulted from having busier schedules than in high school and greater responsibilities for their own meal planning. Consequently, many college students consumed more high-calorie foods, skipped more meals, and drank more sugary and alcoholic beverages than they did prior to enrolling in college. Unfortunately, these eating patterns place them at higher risks for developing diet-related diseases later in life. In fact, coronary heart disease is now a leading cause of death among 18–24-year-olds in the United States (Karabulut, et al. 2018).

Yahia et al. (2016) alluded to the association between saturated fat, trans fat, and cholesterol and coronary heart disease and conducted a study exploring whether nutritional knowledge reduced fat consumption among a selected group of university students. Their findings indicated that there was an inverse relationship between students' nutritional knowledge and consumption of unhealthy fats and cholesterol. Downes (2015) found that over 80% of college students sampled did not meet the recommended guidelines for physical activity and or for the daily consumption of fruits and vegetables. In her view, other high-risk behaviors such as alcohol and drug use got more attention on college campuses than physical activity and dietary choices and that this short-sighted strategy could have long-term health consequences. In their assessments of college students' health status, Abraham, Noriega, and Shin (2018) acknowledged that students needed to know about nutrition because inadequate nutrition could affect their health and academic success.

As argued previously, college students are likely to gain weight in the transitional years between 18 and 24 because of their low levels of physical activity and daily consumption of fruits and vegetables (Karabulut, et al. 2018). Therefore, nutritional intervention strategies are needed for this segment of the population. However, for these programs to be effective, researchers must have baseline data on students' levels of nutritional knowledge about basic nutrients such as protein, carbohydrates, fats, and cholesterol, among others. This study examines undergraduate students' knowledge of selected nutrients and factors associated with their levels of knowledge and recommends ways to help students to expand their nutritional knowledge so that they can make better food and lifestyle choices.

Objectives

The study's main objective is to determine students' knowledge of basic nutrients and their roles in fostering good health. The specific objectives are (i) to document students' general knowledge of protein (PROTEIN), carbohydrates (CARBOHYDRATES), vitamin C (VITAMIN C), vitamin D (VITAMIN D), saturated fat, trans fat, and dietary cholesterol (FATS); and (ii) to determine whether selected sociodemographic characteristics—age (AGE), household size (HSIZE), income levels (INCOME), race (RACE), gender (GENDER), body mass indices (BMI), and health status rankings (HEALTH1, HEALTH2, and HEALTH3)—influence performance on a nutritional knowledge quiz.

Methods and Procedures

The study's data were compiled from a random sample of 402 undergraduate students and were designed to capture nutritional knowledge and sociodemographic characteristics. The sampled students were asked to select the correct answers from the following statements:

> (i) Protein is required by the body for (a) energy production only, (b) insulation of the body, or (c) growth, maintenance and repair of all cells.
>
> (ii) Carbohydrate (a) maintains healthy skin and vision, (b) maintains normal function of the nervous system, (c) acts as the body's main source of energy, or (d) all of the above.

(iii) Vitamin C (a) maintains healthy gums and teeth, (b) maintains strong blood vessel walls, (c) produces energy for the body, or (d) both a and b.

(iv) Vitamin D (a) aids in the absorption and utilization of calcium in the formation and maintenance of strong bones and teeth, (b) provides insulation for the body, (c) maintains healthy skin and vision, or (d) none of the above.

(v) Consumption of saturated fat, trans fat, and dietary cholesterol (a) raises bad cholesterol levels, (b) increase the risk for heart disease, (c) none of the above, or (d) a and b.

These dependent variables were paired with sociodemographic variables, BMI, and health perceptions (Table 1). BMI was determined using the formula (weight in pounds ÷ height in inches^2) × 703. Binomial logit modeling techniques were used to estimate the relationships between each dependent and the selected independent variables.

Table 1. Variables and Definitions

Variables	**Definitions**
Independent variables	
AGE	Participants' age in years
HSIZE	Number of persons living at participants' permanent address
INCOME	Family's total household income: < \$15,000; \$15,000–\$24,999; \$25,000–\$34,999; \$35,000–\$49,999; \$50,000–\$74,999; ≥ \$75,000
RACE	African American = 0; otherwise = 1
GENDER	Male =1; female = 0
BMI	Body mass indices
HEALTH 1	Poor or fair health
HEALTH 2	Good or very good health
HEALTH 3	Excellent health (reference variable)
Dependent variables	
PROTEIN	Correct = 1; incorrect = 0
CARBOHYDRATE	Correct = 1; incorrect = 0
VITAMIN C	Correct = 1; incorrect = 0
VITAMIN D	Correct = 1; incorrect = 0
FATS	Correct = 1; incorrect = 0

Empirical Results and Discussion

Table 2 shows the results for students' responses to the protein question. Students from smaller households, non–African Americans, and those who ranked their health status below excellent were more likely to answer the protein question correctly. For example, the logarithms of the odds ratios are 2.831 times higher for non–African Americas than for African American students and 2.576 and 2.656 times higher, respectively, for students who regard their health status as poor to very good compared to those who view their health status as excellent. The model is significant at the 5% level of probability and predicts 60% of the data correctly. Performance is invariant to age, household income level, gender, and BMI.

Table 2. Binomial Logit Model's Results for Protein

Variables	Estimated Coefficients	Std. Err.	Wald	*p*-Value	Exp(β)
Constant	−0.573	0.750	0.585	0.444	0.564
AGE	0.027	0.019	1.930	0.165	1.027
HSIZE	−0.155**	0.063	6.043	0.014	0.856
INCOME	−0.031	0.064	0.236	0.627	0.969
RACE	1.041**	0.473	4.845	0.028	2.831
GENDER	0.218	0.225	0.932	0.334	1.243
BMI	−0.003	0.015	0.028	0.867	0.997
HEALTH 1	0.946*	0.485	3.813	0.051	2.576
HEALTH 2	0.977**	0.471	4.294	0.038	2.656
Likelihood ratio test					
χ^2 (8)	17.497**			0.025	
Correctly predicted	60%				

Note: Single and double asterisks (*, **) indicate statistical significance at the 10% and 5% levels, respectively.

Based on the results reported in Table 3, the logarithms of the odds ratios that older and female students answered the carbohydrate question correctly are higher than for younger students and for male students. Household size, household income level, race, BMI, and health perceptions do not affect students' performance on the carbohydrate question. The model is statistically significant at the 1% level of probability and predicts 72% of the observations correctly.

Based on knowledge of vitamin C's role in the body, the logarithms of the odds ratios imply that non–African American students and those who ranked their health status as poor/fair or good/very good are more likely to correctly answer the question than African Americans and those who perceived themselves as being in excellent health (Table 4). Older students are more likely to correctly answer the question on vitamin D compared to younger students (Table 5).

Table 3. Binomial Logit Model's Results for Carbohydrates

Variables	Estimated Coefficients	Std. Err.	Wald	*p*-Value	Exp(β)
Constant	−1.977**	0.796	6.165	0.013	0.138
AGE	0.070***	0.020	11.891	0.001	1.073
HSIZE	−0.077	0.072	1.132	0.287	0.926
INCOME	−0.068	0.070	0.936	0.333	0.935
RACE	0.434	0.439	0.974	0.324	1.543
GENDER	−0.438*	0.253	3.000	0.080	0.645
BMI	0.020	0.016	1.483	0.223	1.020
HEALTH 1	−0.219	0.509	0.185	0.667	0.803
HEALTH 2	−0.566	0.500	1.261	0.258	0.560
Likelihood ratio test					
χ^2 (8)	28.848***			0.000	
Correctly predicted	72%				

Note: Single, double, and triple asterisks (*, **, ***) indicate statistical significance at the 10%, 5%, and 1% levels, respectively.

Table 4. Binomial Logit Model's Results for Vitamin C

Variables	Estimated Coefficients	Std. Err.	Wald	*p*-Value	Exp(β)
Constant	−0.583	0.781	0.557	0.455	0.558
AGE	−0.013	0.018	0.527	0.468	0.987
HSIZE	0.032	0.062	0.267	0.605	1.033
INCOME	−0.015	0.064	0.056	0.813	0.985
RACE	0.877*	0.451	3.784	0.052	2.404
GENDER	−0.334	0.222	2.268	0.132	0.716
BMI	−0.020	0.015	1.695	0.193	0.980
HEALTH 1	1.757***	0.553	10.085	0.001	5.794
HEALTH 2	1.563***	0.541	8.333	0.004	4.772
Likelihood ratio test					
χ^2 (8)	20.281***			0.000	
Correctly predicted	59%				

Note: Single, and triple asterisks (*, ***) indicate statistical significance at the 10% and 1% levels, respectively.

Table 5. Binomial Logit Model's Results for Vitamin D

Variables	Estimated Coefficients	Std. Err.	Wald	*p*-Value	Exp(β)
Constant	−1.344*	0.798	2.838	0.092	0.261
AGE	0.065***	0.024	7.118	0.008	1.067
HSIZE	−0.028	0.063	0.201	0.654	0.973
INCOME	0.089	0.065	1.882	0.170	1.093
RACE	−0.198	0.406	0.239	0.625	0.820
GENDER	−0.234	0.223	1.106	0.293	0.791
BMI	−0.009	0.016	0.333	0.564	1.009
HEALTH 1	−0.085	0.471	0.032	0.857	0.919
HEALTH 2	0.109	0.457	0.056	0.812	1.115
Likelihood ratio test					
χ^2 (8)	17.497**			0.047	
Correctly predicted	60%				

Note: Single, double, and triple asterisks (*, **, ***) indicate statistical significance at the 10%, 5%, and 1% levels, respectively.

The model for students' knowledge on saturated fat, trans fat, and dietary cholesterol is statistically significant at the 1% level of probability and implies that it performs better than the intercept-only model (Table 6). The model also predicts 75% of the results correctly. Further, the logarithms of the odds ratios for answering this question correctly is higher for older students (1.065) compared to younger students and for non–African Americans (2.612) compared to African Americans but are lower for male students (0.584) compared to female students (1.71). Performance on this question is not influenced by household size, income level, BMI, or health perceptions.

Table 6. Binomial Logit Model's Results for Saturated and Trans Fats and Cholesterol

Variables	Estimated Coefficients	Std. Err.	Wald	*p*-Value	Exp(β)
Constant	−0.852	0.925	0.848	0.357	0.427
AGE	0.063**	0.030	4.374	0.037	1.065
HSIZE	0.076	0.074	1.048	0.306	1.079
INCOME	−0.049	0.073	0.453	0.501	0.952
RACE	0.960*	0.568	2.860	0.091	2.612
GENDER	−0.539**	0.245	4.860	0.028	0.584
BMI	0.015	0.018	0.700	0.403	1.015
HEALTH 1	0.046	0.497	0.008	0.927	1.047
HEALTH 2	0.368	0.485	0.575	0.448	1.444
Likelihood ratio test					
χ^2 (8)	20.153***			0.010	
Correctly predicted	75%				

Note: Single, double, and triple asterisks (*, **, ***) indicate statistical significance at the 10%, 5%, and 1% levels, respectively.

Summary and Conclusions

The study's objectives were to document students' general knowledge of protein, carbohydrates, vitamin C, vitamin D, saturated fat, trans fat, and dietary cholesterol and then determine whether age, household size, income level, race, gender, BMI, or health status ranking influenced nutritional knowledge. Although overall nutritional knowledge was low, students from smaller households, non–African Americans, and those who ranked their health status below excellent performed better on the protein question.

A higher percentage of older and female students answered the question on carbohydrates correctly, and a larger percentage of non–African Americans and those who ranked their health status below excellent correctly answered the question on vitamin C. Older students also were more likely to correctly answer the vitamin D question, while older, non–African Americans, and female students were more likely to correctly answer the question on saturated fat, trans fat, and cholesterol.

U.S. consumers now have easier access to nutrition information than previously. However, over the past 30 years, overweight and obesity rates have skyrocketed, especially among young adults. The risks of becoming overweight or obese are high among undergraduate students because of educational and financial stress and other stressors associated with living away from home for the first time. Research suggests that these stressors can cause sleep deprivation, poor eating habits, or ill health. To effectively address undergraduate students' health and well-being, researchers need baseline information on students' basic knowledge about nutrition. This study was conceived on that premise. It analyzed undergraduate students' general knowledge about selected nutrients—proteins; carbohydrates; vitamins C and D; saturated fat, trans fatty acids, and dietary cholesterol; and factors affecting that knowledge. The low overall scores on the nutritional quiz suggest that students need help to understand nutrition information to enable them to develop healthier eating habits now and in the future. Those of us in higher education must increase our nutritional knowledge so that we can help and encourage our students to read and learn about nutrition and health. Greater emphasis also needs to be placed on students' diets and health through course offerings such as through mandatory courses in the biological sciences, nutrition, and health and wellness.

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Research Report: For Young Americans, Sustainable Is Not Organic

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Abstract

Millennials and Gen Z consumers are some of the most consumption-oriented groups in the United States. As these young Americans transition into higher paying jobs, their impact on the food industry is expected to compound. Data from a web-based survey of 1,351 young Americans were used to conduct a cluster analysis and an ordered probit used to investigate the impact of demographics and purchasing behavior on cluster membership. Four costumer segments were identified: committed, farm-to-fork, unattached, and skeptic. Results suggest that cluster membership is driven by personal motives, particularly the desire to contribute to the local food system and support local communities.

Keywords: agriculture, cluster analysis, consumer segment, local foods, ordered probit, organic, sustainable, young consumers

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Introduction

Individuals belonging to the Millennial and Gen Z generations are typically considered the most consumption-oriented Americans of all time. Millennials (those born between 1981 and 1996) are the largest living generation in the United States and usually described as progressive, open to trying new foods, and willing to value sustainable food attributes (Macke, 2016). Gen Z consumers (those born between 1997 and 2008) were introduced to healthy lifestyle choices and sustainable living at an earlier age than previous generations (Twenge, 2017). Several studies have reported that these young consumers seem to have abundant access to information on food, value healthy eating, and are willing to pay for it.

As Americans increase their consumption of fruits and vegetables (U.S. Department of Agriculture, 2019) and young Americans transition into higher paying jobs, it is likely that a larger portion of their income will be dedicated to consuming fruits and vegetables. These trends are likely to increase the influence of Millennials and Gen Z consumers in food systems and presents important opportunities for growers and food handlers.

Understanding consumers' values and beliefs can help predict consumers' attitudes and purchasing intentions. Previous studies have shown how well environmental and social values correlate with attitudes and buying behavior. Researchers have reported the strong connection between messages that convey how foods are produced and marketed and consumers' values and attitudes (Zepeda and Deal, 2009; Lusk, 2018; Heo and Muralidharan, 2019). This study investigates the values of Millennials and Gen Z individuals toward organic, local, sustainable, and small family farming systems. Among all food attributes, environmental (i.e., organic and sustainable) and social (i.e., local and small-family farms) features seem to be gaining attention among Americans (Darby et al., 2008; Hu et al., 2011). While most young adults seem to prefer attributes that convey environmental and social benefits, marketing strategies and policies will likely have different effects for different groups of consumers.

Market Segmentation

Markets are rarely homogeneous, and market segmentation is a common and effective approach to reach groups of consumers who think and behave similarly. Cluster analysis has been widely used to segment consumers based on their food values and attitudes. Market segmentation can help industry marketers generate appropriate targeting, communication, and encouraging messages to help different clusters of consumers make sustainable purchases. Using market segments can allow food marketers to make attribute claims more relevant by providing insights on how clusters of young consumers value different environmental and social attributes. Supplying foods with attributes that align with values can help marketers develop trust relationships with these two generations, which can result in long-term loyalties for products and businesses. This study complements previous research with a comprehensive empirical analysis that identified different young consumer segments with regards to their values on environmental (i.e., organic and sustainable) and social (i.e., local and small family farms) food attributes.

Data and Methodology

Data for this analysis come from a 2017 web-based survey of university students, who provide a convenient sample to investigate Millennials and Gen Z consumers' perceptions toward food attributes (Heo and Muralidharan, 2019). The invitation email included the link to the Qualtrics survey. To increase participation rate, a drawing of ten $5 gift cards was offered for those who completed the survey before April 5, 2017. We received 2,047 responses, of which 1,954 were complete surveys, for a 96% completion rate.

The questionnaire covered four thematic areas of students' perceptions of food. Specifically, the questionnaire asked students to report the importance they placed on fresh produce attributes such as organic (*ORGANIC*), local (*LOCAL*), sustainable (*SUSTAINABLE*), and small family farms (*SMALL*). The survey asked about respondents' perceptions of the importance of credence attributes by asking them to slide bars from 0 (not important) to 100 (very important). Slider bars are an interactive tool that capture respondents' perceptions in a way that is more engaging, more mobile friendly, and may produce superior data relative to traditional Likert-type scales (Roster, Lucianetti, and Albaum, 2015). The questionnaire included 21 questions that ranged from student demographics to respondents' involvement in extracurricular activities.

The subsample for this study included 1,351 undergraduate students enrolled in 2017 at a large Midwestern university. Of them, 385 (29%) were freshmen, 352 (26%) were sophomores, 304 (22%) were juniors, and 313 (23%) were seniors. The proportion of students by year of enrollment was consistent with records from the university admissions office for 2017 (personal interview with Admissions officer).

Segments of Millennials and Gen Z consumers with similar perception functions were identified using a cluster analysis performed in a two-stage process. First, we used a hierarchical clustering with Ward's minimum-variance method to analyze the relative factor scores for *LOCAL*, *ORGANIC*, *SUSTAINABLE*, and *SMALL* using the squared Euclidean distance as the (dis)similarity measure. Ward's linkage combines observations whose merger increases the overall within-cluster variance (i.e., the homogeneity of clusters) to the smallest possible degree. One of the advantages of using Ward's linkage is that it yields clusters of similar size with similar degrees of tightness (Mooi, Sarstedt, and Mooi-Reci, 2018). The number of clusters was determined using a combination of the Duda–Hartand index, the Kalinksi–Harabasz pseudo-*F*-index, and the ω_k criterion.

Taking indices and criterion together, the results suggest a four-cluster solution for segments. Clusters were profiled using a one-way analysis of variance (ANOVA) comparison of means, which confirmed that attribute differences in means were significant across clusters. The second step in the cluster analysis included a partitioning *k*-means method, using the grouping from the Ward's linkage analysis as input for the starting partition of clusters. The *k*-means method selects the centers of the initial clusters from the first observations and assigns the other observations to the nearest cluster with the aim of minimizing within-cluster variation. The *k*-means process was repeated until convergence was achieved. This study explored the overlap in the two cluster procedures (Ward's linkage and *k*-means) using a cross tabulation. Results show a strong degree of overlap (> 80%) between the two cluster procedures.

Last, we used an ordered logit model to investigate the impact of demographics, purchasing behavior, and community involvement on consumer segments. The ordered logit is an appropriate framework to model cluster membership where the observed variable has natural ordering (Greene, 2003). Thus, this study assumed that cluster membership follows a natural order, in which individuals in the committed cluster (first cluster) have high expectations for all attributes and individuals in the skeptic clusters have low expectations for all attributes (fourth cluster), but the distances between adjacent levels of membership are unknown.

Results and Discussion

Table 1 illustrates the demographic characteristics for each consumer segment. Cluster 1, the largest segment, represents 33% of the sample (426 students). Individuals in cluster 1, labeled "committed," strongly valued all four credence attributes as important, as evidenced by the highest average values across all attributes (within column). The committed segment included a higher share of Millennials and Gen Z consumers purchasing at farmers' markets (53%), being female (69%), seeking opportunities for campus/community involvement (59%), being out-of-state or international students, and living in on-campus housing.

Consumers in cluster 2, labeled "farm-to-fork," made up 27% of the sample (336 students) and had high preference for attributes commonly related to local food systems,—such as local, sustainable, and small family farming—but not with organic farming. Other researchers have reported how the corporatization of organic markets is likely to drive consumers and producers away from organic food products (Hu et al., 2011). The farm-to-fork segment comprises individuals with an agricultural background (47%), coming from Midwestern states (74%), and enrolled in an agricultural major (28%). While the committed and farm-to-fork segments are different, Millennials and Gen Z consumers in the farm-to-fork cluster shared some demographic similarities with consumers in cluster 1. They reported similar shopping behavior, and similar proportions of females, involvement in campus/community events, and on-campus housing.

Consumers in cluster 3 (labeled "unattached," made up 26% of the sample (333 students) and had moderate expectations for all features. They did not show high preferences for any of the attributes. This group had mean score intermediate between cluster 2 and cluster 4 for most variables. For example, 39% of consumers in this group purchased at farmers' markets, 53% were female, and 56% were from the Midwest. These unattached consumers were characterized by actively seeking campus/community involvement activities, being international, and living in on-campus housing.

Cluster 4, labeled "skeptic," made up 14% of the sample (178 students). The skeptic segment was the smallest group and included consumers who did not express high expectations in general. Consumers in this group scored the lowest on purchasing at farmers' markets, lacked an agricultural background, and reported being international or from out of the Midwest.

Table 1. Comparison of Demographic Characteristics for Four Consumer Segments (N =1,532)

	Committed			Farm-to-Fork			Unattached			Skeptic		
	Mean	**SD**		**Mean**	**SD**		**Mean**	**SD**		**Mean**	**SD**	
FRESHMEN	0.33	0.47		0.26	0.44		0.29	0.46		0.26	0.44	
SOPHOMORE	0.23	0.42		0.27	0.44		0.28	0.45		0.29	0.45	
JUNIOR	0.23	0.42		0.19	0.39		0.21	0.41		0.25	0.43	
SENIOR	0.21	0.41		0.29	0.45		0.22	0.42		0.21	0.41	
STORE	0.97	0.16		0.98	0.15		0.97	0.16		0.96	0.21	
FARMERSMKT	0.53	0.50	A	0.49	0.50	A	0.39	0.49	B	0.26	0.44	C
GROW	0.02	0.15		0.02	0.14		0.00	0.00		0.02	0.13	
AGBACKGROUND	0.24	0.43	BC	0.47	0.50	A	0.13	0.33	C	0.16	0.37	C
FEMALE	0.69	0.46	A	0.65	0.48	A	0.53	0.50	B	0.44	0.50	B
AGE	20.23	1.76		20.36	1.58		20.14	1.54		20.26	1.62	
INVOLVED	0.59	0.49	A	0.51	0.50	A	0.53	0.50	A	0.41	0.49	B
MIDWEST	0.62	0.49	BC	0.74	0.44	A	0.56	0.50	B	0.57	0.50	B
OUT-MIDWEST	0.31	0.46	AB	0.25	0.44	B	0.35	0.48	A	0.38	0.49	A
INTERNATIONAL	0.08	0.27	A	0.01	0.11	B	0.10	0.30	A	0.05	0.22	A
ONCAMPUS	0.53	0.50	AB	0.44	0.50	B	0.56	0.50	A	0.46	0.50	B
AGMAJOR	0.10	0.30	B	0.28	0.45	A	0.06	0.24	B	0.09	0.29	B
No. of obs.		426			336			333			178	
Market size (%)		33			27			26			14	

Note: The optimal number of clusters was identified using both objective (i.e., numerous clustering algorithm) and subjective information, With the exception of AGE, the mean for each variable is the percentage of respondents with that attribute. Any two different uppercase letters show statistically significant differences across consumer clusters at the p <0.1 level using Tukey's significant difference test.

The ordered logit provided the results of cluster membership among Millennials and Gen Z consumers regarding their values on food trends. Table 2 illustrates the marginal effects of the ordered probit for each cluster membership. The marginal effects provide the impacts of explanatory variables on consumer segments. Results suggest that demographics, purchasing behavior, and community involvement are major drivers of cluster membership.

Results suggest that cluster membership is driven by personal motives, particularly the desire to contribute to the local food system and support local communities. Specific drivers that increase consumer values for social and environmental food attributes included demographics, purchasing behavior, and perceptions. Shopping in local markets, gender, and community involvement were the most important factors driving the value of environmental and social food attributes. Our findings suggest increasing access to local foods and farmers' market patronage is likely to increase consumers' value of foods with local, organic, sustainable, and small family farm attributes. From a marketing standpoint, this information can be used by food marketers and growers to understand what Millennials and Gen Z consumers value and how they choose to spend

Table 2. Marginal Effects Results from Ordered Probit for Cluster Membership of Millennial and Gen Z Consumers

	Committed		Farm-to-Fork		Unattached		Skeptic	
	M.E.	**SE**	**M.E.**	**SE**	**M.E.**	**SE**	**M.E.**	**SE**
SOPHOMORE	−6.98**	3.41	−0.68	0.42	4.08**	1.99	3.59**	3.50
JUNIOR	−0.95	4.26	−0.22	0.28	2.29	2.47	1.87	35.20
SENIOR	−4.16	5.06	−0.24	0.35	2.42	2.94	1.98	41.50
STORE	−0.83	6.96	−0.08	0.70	0.49	4.08	0.43	90.50
FARMERSMKT	11.11***	2.34	1.12***	0.42	−6.51***	1.43	−5.72***	0.00
GROW	13.20	9.70	1.33	1.06	−7.74	5.70	−6.80	17.40
AGBACKGR	8.72***	2.68	0.88**	0.40	−5.11***	1.61	−4.49***	0.10
FEMALE	12.88***	2.35	1.30***	0.47	−7.55***	1.46	−6.63***	0.00
AGE	1.34	1.09	0.13	0.12	−0.78	0.64	−0.69***	21.90
INVOLVED	6.30	2.41	0.64**	0.31	−3.69***	1.43	−3.24	0.90
OUT-MIDWEST	−2.28	2.51	−0.27	0.33	1.34	1.48	1.21	37.30
INTERNTL	2.47	5.25	0.13	0.16	−1.43	3.03	−1.16	62.20
ONCAMPUS	1.00	2.82	0.10	0.29	−0.59	1.66	−0.52	72.30
AGMAJOR	−1.86	3.27	−0.19	0.33	1.09	1.92	0.96	57.00

Number of observations = 1,265; Prob > χ^2 = 0.00; Pseudo-R^2 = 0.09. Marginal effects are expressed in percentage points. Single, double, and triple asterisks (*, **, ***) indicate significance at the 10%, 5%, and 1% levels.

their money. Understanding what these young consumers value in terms of food attributes can help food marketers develop messages and strategies that build long-term loyalties. Developing the correct messages that appeal to this niche market can help food growers, processors, and retailers better position their business in a competitive environment.

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Price Discovery and Integration in U.S. Peanut Markets

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Abstract

The United States is a major supplier in the world peanut market. Using grower-level monthly peanut price data from 1982 to 2018, we estimate market integration and price discovery patterns at the grower level by applying causality structures identified through machine-learning algorithms. Preliminary analysis shows that Georgia is a price leader and others are followers in current and lag time. Peanut prices in Texas and Georgia are important determinants of prices in other markets such as North Carolina, Virginia, and Alabama. Findings from this study are useful for peanut producers, marketers, and policy makers designing peanut marketing programs.

Keywords: directed acyclic graphs, machine learning, market integration, peanut prices, price discovery

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Introduction

The United States is a significant supplier in the world peanut market.[1] In the United States, 99% of peanuts are grown in ten states. Georgia grows about 50% of U.S. peanuts, followed by Texas (10%), Alabama (10%), Florida (9%), South and North Carolina (14%), Mississippi, Virginia, New Mexico, and Oklahoma (American Peanut Council, 2018). According to the National Agricultural Statistical Service (NASS) of the U.S. Department of Agriculture (USDA), peanut producers received a national average farm-gate price of $0.23/lb in June 2018 (U.S. Department of Agriculture, 2018). In the United States, peanut prices vary by state. As a result, it is likely that peanut price discovered in one state may affect the price-discovery process of another state, given the proximity of peanut-producing states. Information about peanut-market integration and price discovery patterns, if any, would be useful not only for U.S. peanut producers but also for marketing and promotion groups such as the National Peanut Board.

The U.S. peanut market has an annual market value of over $1 billion, with a significant economic impact on the 10 southern states that produce the majority of U.S. peanuts. Many factors, including production regions of various peanut types, agricultural policies, and the global market, are important for understanding the peanut market and price relationships among states.

Four main varieties of peanuts are grown in the United States: Runner, Virginia, Spanish, and Valencia (American Peanut Council, 2018). Runners (80% of U.S. production), which are mainly used for peanut butter, are grown in Georgia, Alabama, Florida, Texas, and Oklahoma. Sold salted or roasted, Virginia-type peanuts (15% of U.S. production) are grown in southeastern Virginia, northeastern North Carolina, South Carolina, and west Texas. Oklahoma and Texas are responsible for most of the production of Spanish-type peanuts (4% of U.S. production), which are primarily sold in candy, salted, and as peanut butter. Valencia-type (less than 1% of U.S. production) are mainly grown in New Mexico; these are roasted and sold in the shell or used for boiled peanuts. Peanuts for edible use account for the majority of peanut consumption in the United States; other uses include peanut oil, seed, and feed (U.S. Customs and Border Protection. 2008).

Until 2002, peanuts were sold under a marketing quota system that guaranteed producers with quota rights a high price on a "government-established 'quota loan rate' of $610 per ton (during 1996–2001)" (Dohlman et al., 2004, p. 3). Producers without quota rights exported their peanuts at world prices, which were much lower than the quota loan rate prices. Import restrictions were also a component of the marketing quota system, but the North American Free Trade Agreement (NAFTA) and World Trade Organization (WTO) agreements opened the peanut market through tariff rate quotas. These trade agreements, and opposition from consumer groups and peanut processors, contributed to the demise of the marketing quota system (Dohlman et al., 2004). The 2002 Farm Act ended the marketing quota system and allowed peanut producers to receive marketing assistance loans, fixed direct payments, and counter-cyclical payments, forms of government assistance that had been available to grain, oilseed, and cotton producers.

[1] China and India are the largest suppliers of peanuts worldwide. Other major producers include Senegal, Sudan, Brazil, Argentina, South Africa, Malawi, and Nigeria (Virginia Carolinas Peanuts, 2018).

Following the passage of the 2002 Farm Act, farm-level prices and total U.S. peanut plantings decreased. Major peanut-producing states in the southeast, such as Georgia and Florida, experienced stable or increased planted acreage, but other states—particularly Virginia, Texas, and Oklahoma—saw large decreases in planted acreage (Dohlman et al.. 2004). Despite these changes, changes in prices, market promotion, and dietary preferences contributed to a record 9% increase in U.S. peanut consumption over 2003–2004 (Dohlman et al., 2004). Bolotova (2018) found that yearly average area harvested decreased 13% from 2002 to 2016, yearly average yield increased 37%, and yearly average peanut price decreased 22% compared to 1980–2001.

Following the end of the marketing quota system, peanut producers managed risk by "increasing their use of marketing contracts to lock in prices and by maintaining a diversified commodity mix to spread risk" (Dohlman, Foreman, and Da Pra, 2009). Non-quota holders had primarily used marketing contracts prior to the policy change; with the end of the quota program, the percentage of producers using marketing contracts rose from 40% in 2002 to 65% in 2007 (Dohlman et al., 2004). The end of the quota system resulted in producers having less of a bargaining position with shellers. Without the minimum support price that had been set under the quota system, shellers were no longer willing to "contract at the support price" (Smith and Wolfe, 2004, p. 2). According to Adjemian, Saitone, and Sexton (2016, p. 586), "The typical contract has a one-year term, and processors make take-it-or-leave-it offers to farmers for a price equal to the US Department of Agriculture (USDA), Commodity Credit Corporation's (CCC) loan rate plus a premium."

In addition, the peanut market is relatively thin, with no futures or cash market; only two companies process 70% of U.S. peanuts (Adjemian, Saitone, and Sexton, 2016): Birdsong Peanuts and Golden Peanut Company each operate six peanut-processing facilities and over 80 buying points throughout the U.S. peanut-growing region. Ultimately, the end of the marketing quota system had a profound effect on how prices were determined. In this light, the general objective of this study is to discover market integration and price discovery patterns in major peanut producing states in the United States. Specific objectives are to determine: (i) patterns in grower-level peanut prices from 1982 through 2018 in major peanut-producing states in the United States before and after the discontinuation of the price quota system and (ii) peanut market integration and price discovery patterns across the states using machine-learning algorithms (such as directed acyclic graphs) for before and after the discontinuation of the price quota system.

Data

Data used in this study are from the USDA National Agricultural Statistics Service (NASS). These data consist of the monthly price received, measured in dollars per pounds, for six states from 1982 through 2018. These states consisted of Georgia, Alabama, Texas, Florida, North Carolina, and Virginia. Other peanut-producing states (e.g., Arkansas, Mississippi, New Mexico, South Carolina, and Oklahoma) were not considered in the study due to inconsistencies in price data. Table 1 reports summary statistics for the data.

The end of the quota system in 2002 drastically changed the peanut market and how prices were determined. Due to this difference, we split the data into two periods: 1982–2001 and 2002–2018.

Table 1. Summary Statistics: Monthly Peanut Prices, $/lb

	AL1	AL2	FL1	FL2	GA1	GA2	NC1	NC2	TX1	TX2	VA1	VA2
Median	0.274	0.198	0.254	0.198	0.273	0.202	0.281	0.236	0.268	0.241	0.278	0.227
Mean	0.273	0.205	0.274	0.270	0.270	0.280	0.280	0.270	0.270	0.274	0.274	0.231
Std Dev	0.061	0.050	0.050	0.054	0.054	0.051	0.051	0.056	0.056	0.047	0.047	0.050
Min	0.126	0.136	0.145	0.154	0.141	0.113	0.168	0.142	0.180	0.102	0.167	0.097
Max	0.586	0.360	0.455	0.360	0.547	0.355	0.463	0.374	0.520	0.565	0.391	0.354

Note: States denoted with a 1 represent the period with quota system, 1982–2001, while 2 represents the period with contract pricing system, 2002–2018. AL = Alabama, FL = Florida, GA = Georgia, NC = North Carolina, TX = Texas, and VA = Virginia.

We conducted a statistical t-test and F-test to determine the difference between the mean and variability of these prices between the periods. A 0.05 cut-off p-value was used to test statistical significance in this study. The results from this test (Table 2) suggest a clear difference in price patterns before and after the policy change for the majority of states studied. However, the test fails to reject that the means are different between the two periods in Texas and that the variances are different in North Carolina and Virginia. Despite our findings for Texas, we reject the hypothesis that the variances of the two periods are equal. The two-sample t-test also rejects the hypothesis that the means for North Carolina and Virginia from the two periods are equal. Ultimately, these tests confirm a significant difference between prices in the two periods for the majority of peanut-producing states.

The data also contained some missing values. If five or fewer values in a row were missing, then we used a random walk model to forecast these values. If more than five values were missing, then we forecasted those values using appropriate auto-regression estimates for each series using SAS statistical software. Figures 1–6 illustrate the price patterns for each individual state. Dashed lines indicate where data were split, and boxes highlight data points that were forecasted.

Methodology

We estimate market integration and price discovery patterns among grower-level peanut prices using causality structures identified through cutting-edge machine-learning algorithms applied to peanut prices from the relevant states. We develop the aforementioned causality structures using directed acyclic graphs (DAGs) (Pearl, 2009), which illustrate causal flow among a set of variables and do not contain cyclic paths (Dharmasena, Bessler, and Capps, 2016). Graphs consist of vertices and edges; in the DAGs, the edges are represented as arrows showing causal relationships among variables. For a given set of variables {A, B, C, D}, a DAG will only contain directed edges (e.g., $A \rightarrow B$) but not undirected edges (e.g., A—B) or cyclic paths in which a path the leads away from the variable and then returns to the same variable (e.g., $A \rightarrow B \rightarrow C \rightarrow A$).

We used a greedy equivalence search (GES) machine-learning algorithm to develop causality patterns among peanut prices across various states (Dharmasena, Bessler, and Capps, 2016; Kim

Table 2. Results from *t*-Test and *F*-Test of Mean Peanut Price and Variance of Price Series between Periods, 1982–2001 and 2002–2018

	Test	Calculated Value	Critical Value	*p*-Value	Results from the Hypothesis Test
AL	2-sample *t*-test	10.21	2.26**	0.000	Reject the null hypothesis that the means are equal
	F-test	2.06	1.32**	0.000	Reject the null hypothesis that the variances are equal
FL	2-sample *t*-test	8.45	2.26**	0.000	Reject the null hypothesis that the means are equal
	F-test	1.59	1.32**	0.003	Reject the null hypothesis that the variances are equal
GA	2-sample *t*-test	9.57	2.26**	0.000	Reject the null hypothesis that the means are equal
	F-test	1.44	1.32**	0.016	Reject the null hypothesis that the variances are equal
NC	2-sample *t*-test	6.12	2.26**	0.000	Reject the null hypothesis that the means are equal
	F-test	1.13	1.32	0.233	Fail to reject the null hypothesis that the variances are equal
TX	2-sample *t*-test	1.66	2.25	0.099	Fail to reject the null hypothesis that the means are equal
	F-test	2.02	1.34**	0.000	Reject the null hypothesis that the variances are equal
VA	2-sample *t*-test	7.45	2.26**	0.000	Reject the null hypothesis that the means are equal
	F-test	1.12	1.34	0.262	Fail to reject the null hypothesis that the variances are equal

Note: Significance level considered is *p*-value 0.05. AL = Alabama, FL = Florida, GA = Georgia, NC = North Carolina, TX = Texas, and VA = Virginia.

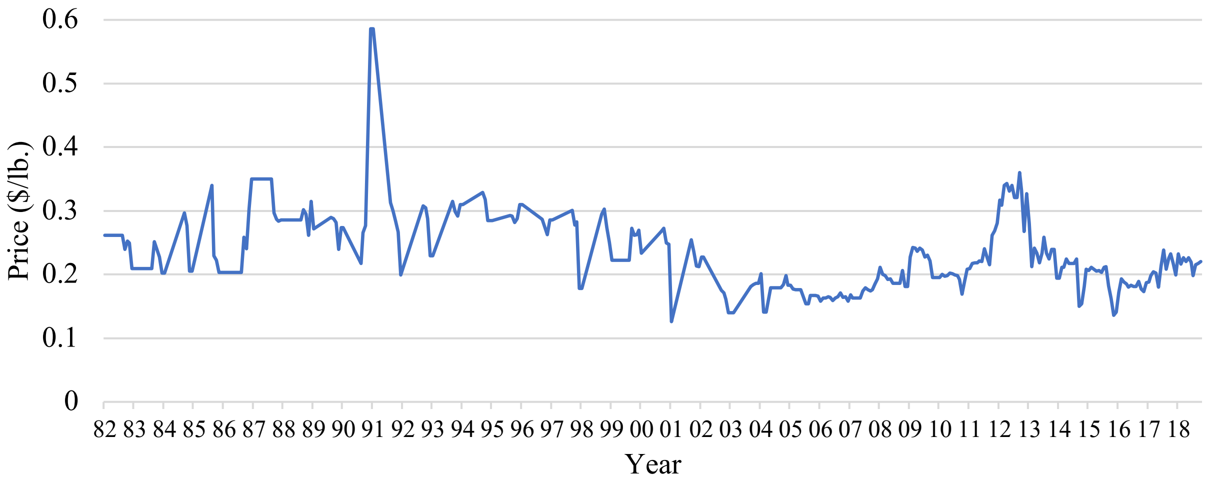

Figure 1. Alabama Monthly Peanut Price Received, 1982–2018

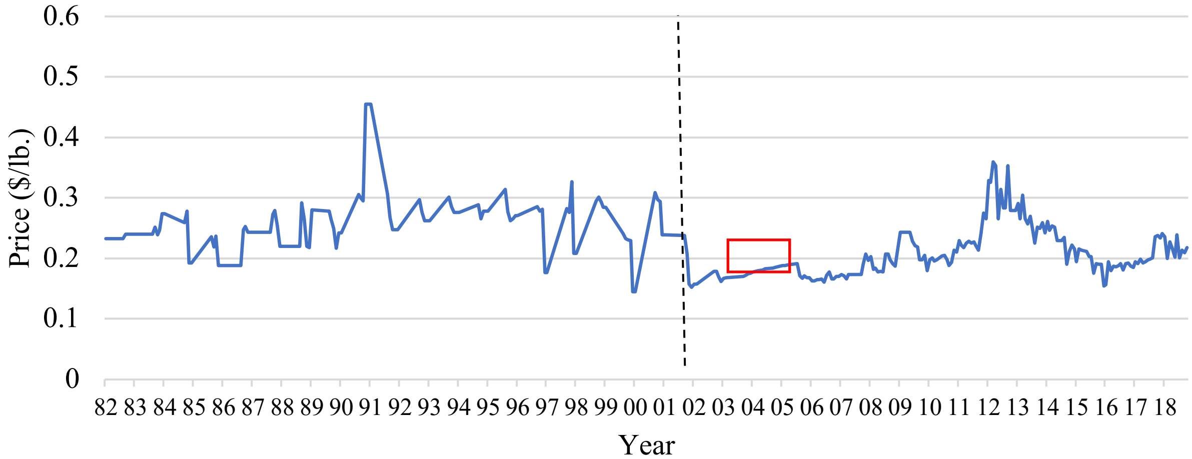

Figure 2. Florida Monthly Peanut Price Received, 1982–2018

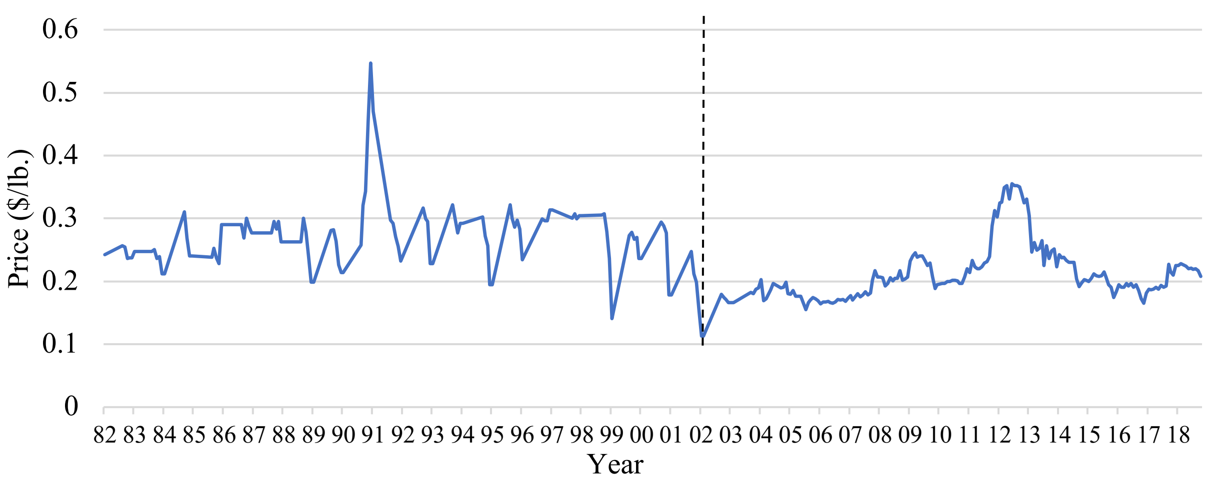

Figure 3. Georgia Monthly Peanut Price Received, 1982–2018

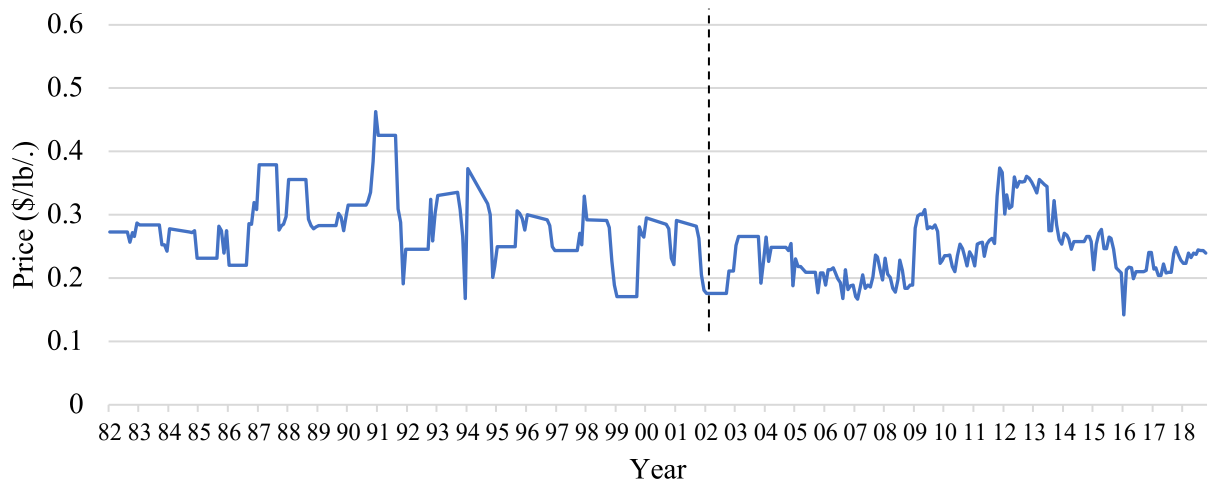

Figure 4. North Carolina Monthly Peanut Price Received, 1982–2018

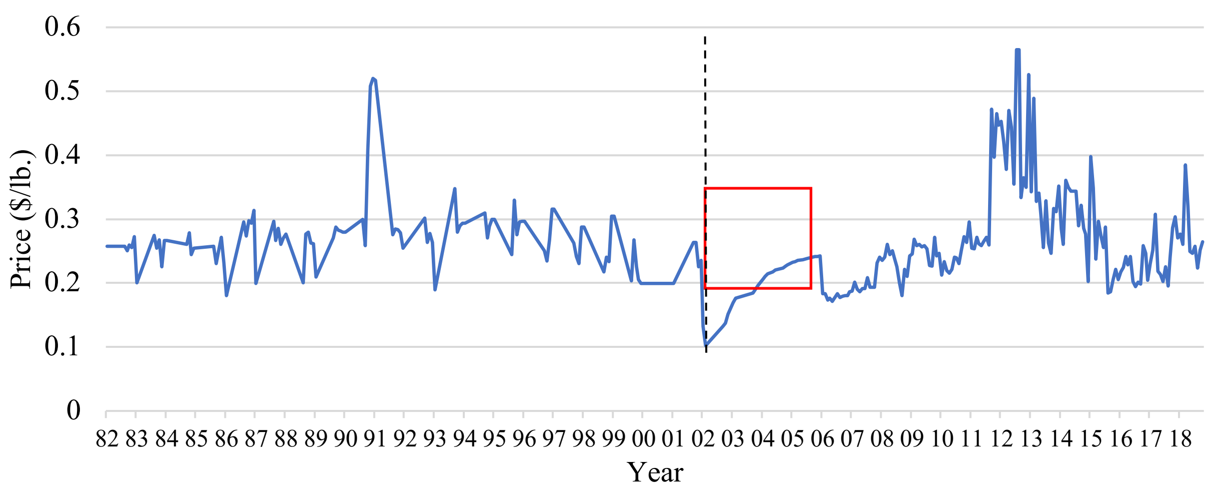

Figure 5. Texas Monthly Peanut Price Received, 1982–2018

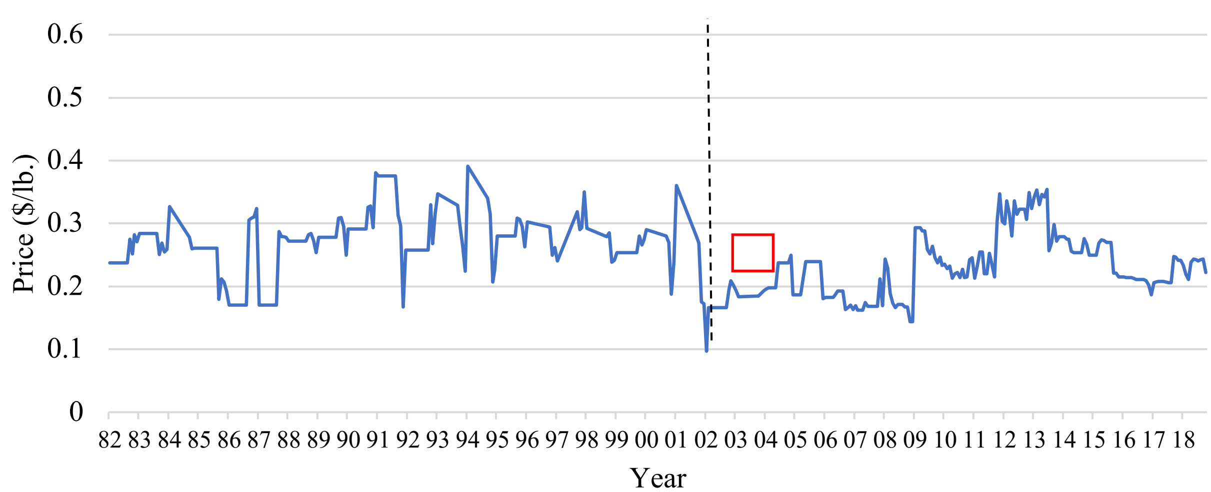

Figure 6. Virginia Monthly Peanut Price Received, 1982–2018

and Dharmasena, 2018. GES is operationalized through the TETRAD statistical package, which searches causal models with artificial intelligence and DAGs. According to Dharmasena, Bessler, and Capps and Kim and Dharmasena, GES finds the optimal causal structures to minimize a Bayesian information criterion (BIC) in two phases. First, the algorithm attempts to add edges to a DAG and scores each graph based on the BIC, repeating this process until a local maximum is reached. In the second phase, single edges are deleted until a local maximum is reached based on the score of DAG. Chickering (2002) explains the BIC approximation from the Schwarz loss function and the assumptions underlying GES. The following equation expresses the BIC approximation from Schwarz:

$$S(\mathcal{G}, \boldsymbol{D}) = \ln p(\mathrm{D}|\hat{\theta}, \mathcal{G}^h) - \frac{d}{2}\ln m, \tag{1}$$

"where $\hat{\theta}$ is the maximum-likelihood estimate of the unknown parameters, *d* is the number of free parameters (not equal to 0) of graph $\mathcal{G}$, and m is the number of observations in data, **D**. The $S(\mathcal{G}, \boldsymbol{D})$ function offers a trade-off between fit given by $\ln p(\mathrm{D}|\hat{\theta}, \mathcal{G}^h)$and parsimony is given by $\frac{d}{2}\ln m$" (Dharmasena, Bessler, and Capps, 2016, p. 168). The working of GES algorithm is based on three assumptions: causal sufficiency, causal faithfulness, and causal Markov conditions (see Dharmasena, Bessler, and Capps, 2016, for further explanation of these conditions).

Results

Figure 7 is the DAG of 1992–2001 peanut prices in six states, with two lags of price series. The marginal effects are denoted on the edges between variables, while the mean values are denoted in green on the lower right side of the state. Kim and Dharmasena (2018, p. 43) explain that

> 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).

Table 3 reports the resulting coefficients and p-values associated with Figure 7. All of the coefficients are significant at the 1% level or less. This analysis provides valuable information about how prices are related among these peanut-producing states.

Current-period prices in Georgia are positively influenced by prices from the previous two periods of Georgia. Current prices in Georgia and the previous-period price in Alabama have an impact on the current price in Alabama, which is the primary factor influencing current prices in Texas, which is a price sink. However, additional prices—such as the current, previous, and two period previous prices in Georgia—indirectly influence Texas prices through a causal chain. Texas prices from two previous periods also indirectly affect current-period prices in Alabama and therefore also indirectly influence current prices in Texas and Florida, creating causal chains. Virginia and Florida are also price sinks, with Virginia being influenced by North Carolina current prices and Florida receiving prices from previous-period prices in Florida, $FL_{(t-1)}$, and current-period prices in Alabama. North Carolina's current prices are influenced by the previous-period prices in North

Carolina, $NC_{(t-1)}$, and Texas, $TX_{(t-1)}$. In addition, North Carolina's current price is also indirectly influenced by the prices two periods ago in Texas, $TX_{(t-2)}$, and North Carolina, $NC_{(t-2)}$. Figure 7 illustrates these causal chain relationships.

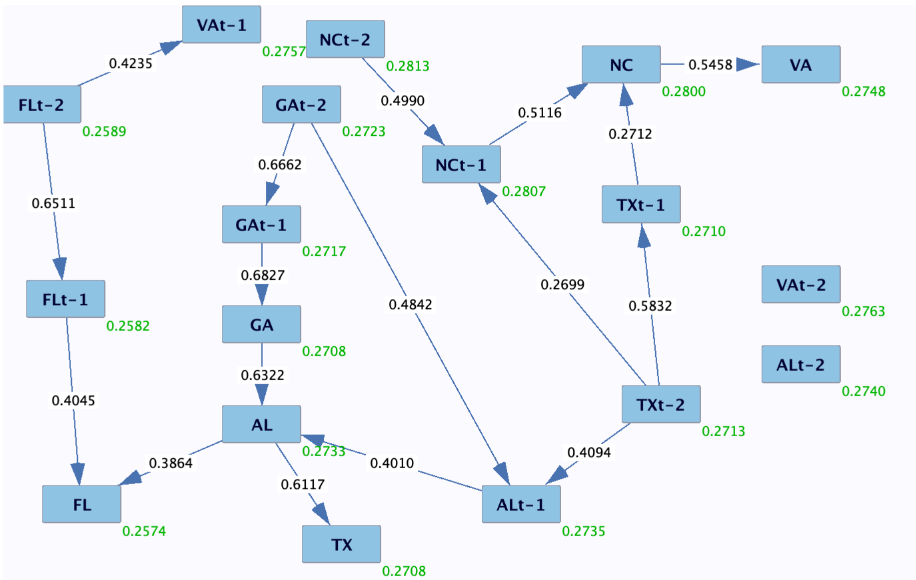

Figure 7. Directed Acyclic Graph (DAG) of Peanut Prices, 1982–2001

Table 3. Parameter Estimates for Each Edge, 1982–2001

From	To	Edge Coefficient	*p*-Value
GA	AL	0.6322	0.000
AL_{t-1}	AL	0.4010	0.000
NC	VA	0.5458	0.000
FL_{t-1}	FL	0.4045	0.000
NC_{t-1}	NC	0.5116	0.000
FL_{t-2}	VA_{t-1}	0.4235	0.000
TX_{t-2}	AL_{t-1}	0.4094	0.0001
TX_{t-2}	TX_{t-1}	0.5832	0.000
TX_{t-2}	NC_{t-1}	0.2699	0.0003
TX_{t-1}	NC	0.2712	0.0003
GA_{t-2}	GA_{t-1}	0.6662	0.000
NC_{t-2}	NC_{t-1}	0.4990	0.000
GA_{t-1}	GA	0.6827	0.000
AL	TX	0.6117	0.000
AL	FL	0.3864	0.000
GA_{t-2}	AL_{t-1}	0.4842	0.000
FL_{t-2}	FL_{t-1}	0.6511	0.000

Note: Significance level considered is *p*-value 0.05 AL = Alabama, FL = Florida, GA = Georgia, NC = North Carolina, TX = Texas, and VA = Virginia. AL_{t-1}, FL_{t-1}, GA_{t-1}, NC_{t-1}, TX_{t-1}, VA_{t-1}, AL_{t-2}, FL_{t-2}, GA_{t-2}, NC_{t-2}, TX_{t-2}, and VA_{t-2} represent peanut prices received by growers in periods $t-1$ and $t-2$ in Alabama (AL), Florida (FL), Georgia (GA), North Carolina (NC), Texas (TX), and Virginia (VA), respectively.

Figure 8 shows the DAG of 2002–2018 peanut prices, after the marketing quota system was discontinued. Table 4 reports the coefficients and p-values; all values are statistically significant at the 1% level. As in the 1982–2001 DAG, Texas is a price sink; however, current Texas prices are now influenced by the previous period's prices in Texas and Georgia. The current periods in Alabama, Florida, and Virginia are also price sinks. Current prices in Alabama are influenced by its previous periods price, $AL_{(t-1)}$, and the current price in Georgia. Prices in Georgia from two periods previous, $GA_{(t-2)}$, also impact current Alabama prices by influencing prices in Texas, $TX_{(t-1)}$, and Alabama, $AL_{(t-1)}$, which then directly and indirectly influence the current price in Alabama. Although Florida's previous price and Georgia's current prices are the only factors directly influencing the current price in Florida, prices from two periods ago in Texas, Georgia, and Florida all indirectly influence the price through various causal chains.

Table 4. Parameter Estimates for Each Edge, 2002–2018

From	To	Edge Coefficient	p-Value
GA_{t-2}	AL_{t-1}	0.5234	0.000
TX_{t-2}	TX_{t-1}	0.3307	0.000
NC_{t-2}	NC_{t-1}	0.7082	0.000
TX_{t-2}	VA_{t-1}	0.1605	0.000
GA_{t-1}	TX	0.9703	0.000
FL_{t-1}	FL	0.3936	0.000
NC	VA	0.4627	0.000
GA	FL	0.5141	0.000
GA_{t-2}	TX_{t-1}	0.9652	0.000
AL_{t-1}	AL	0.284	0.000
TX_{t-2}	FL_{t-1}	0.1131	0.000
NC_{t-1}	NC	0.6097	0.000
VA_{t-2}	VA_{t-1}	0.6941	0.000
TX_{t-1}	TX	0.3313	0.000
GA_{t-1}	GA	0.856	0.000
GA_{t-2}	GA_{t-1}	0.9436	0.000
FL_{t-2}	FL_{t-1}	0.4389	0.000
VA_{t-1}	VA	0.5151	0.000
GA_{t-2}	FL_{t-1}	0.2786	0.0001
GA	AL	0.6705	0.000
TX_{t-1}	GA	0.0729	0.0001
GA	NC	0.363	0.000
TX_{t-2}	NC_{t-1}	0.1461	0.000
AL_{t-2}	AL_{t-1}	0.4004	0.000

Note: Significance level considered is p-value 0.05 AL=Alabama, FL=Florida, GA=Georgia, NC=North Carolina, TX=Texas and VA=Virginia. AL_{t-1}, FL_{t-1}, GA_{t-1}, NC_{t-1}, TX_{t-1}, VA_{t-1}, AL_{t-2}, FL_{t-2}, GA_{t-2}, NC_{t-2}, TX_{t-2}, and VA_{t-2} represent peanut prices received by growers in periods t and $t-1$ in Alabama (AL), Florida (FL), Georgia (GA), North Carolina (NC), Texas (TX), and Virginia (VA), respectively.

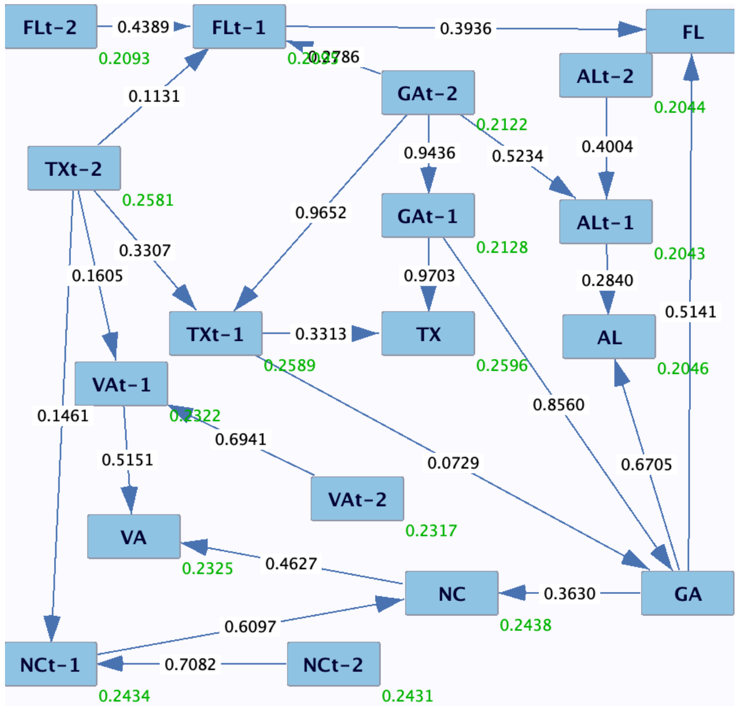

Figure 8. Directed Acyclic Graph (DAG) of Peanut Prices, 2002–2018

The current price in Virginia receives signals from the current price in North Carolina and the previous price in Virginia. Previous-period prices in Texas and Georgia also indirectly influence the price in Virginia. North Carolina's current price receives signals from its price in the previous period and the current price in Georgia. The current price in Georgia is influenced by the prices from the two consecutive previous periods in Georgia and Texas. This results in previous Texas and Georgia prices influencing the current North Carolina price. Ultimately, the previous prices from two periods ago in Texas, $TX_{(t-2)}$, and Georgia, $GA_{(t-2)}$, indirectly influence the current prices in all states. On the contrary, prices from two periods ago in Virginia, $VA_{(t-2)}$; Florida, $FL_{(t-2)}$; and Alabama, $AL_{(t-2)}$ only influence their respective current prices. North Carolina's price from two periods ago, $NC_{(t-2)}$, indirectly influences its current price and, more indirectly, Virginia's current price.

Conclusions and Implications

Georgia and Texas are price leaders: their past and current prices influence current prices in the majority of other states in both periods. Current- and previous-period prices in Georgia are strictly exogenous in the first period, 1982–2001. In the 2002–2018 period, previous-period prices in Georgia are also strictly exogenous, while the current price is weakly exogenous (GA causes prices of AL, FL, and NC and is caused by prices from GA and TX one period past). The price from the preceding periods is also a major determinant in current-period prices for almost all states. After 2002, the current price in all six states studied is directly influenced by its price in the previous period. Prior to 2002, current prices in Florida, Alabama, Georgia, and North Carolina are directly influenced by their respective prices from the preceding period; however, prices in Texas and Virginia are not influenced by their prices from the previous period.

Knowledge of direct and indirect causal relationships among peanut prices in these states is expected to be useful to peanut producers, marketers, and government policy makers to design national and state-level peanut-marketing programs.

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