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Forecasting Meat Prices Using Consumer Expectations from the Food Demand Survey (FooDS)

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Abstract

We determine whether data from the Food Demand Survey are leading indicators of retail meat prices included in the Consumer Price Index. Accurate price forecasts allow retailers to formulate appropriate marketing strategies and justify strategic procurement decisions. Accurate price forecasts should also reduce asymmetric price information. This study relies on consumers' self-reported expectations about whether prices will increase or decrease in the coming weeks. Results from maximum likelihood stepwise autoregressions indicate that survey-based price expectations are leading indicators for chicken wing prices and contain the same information as BLS ground beef, pork chop, and deli ham prices. Future researchers can use this information in combination with theories from the demand, price analysis, and machine learning literatures to construct more accurate price forecasting models.

Keywords: beef, chicken, leading indicator, pork, price expectations

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Prices, as revealed by market transactions, are the mechanism that equates marginal rates of substitution and transformation. Stated differently, prices help allocate goods to their most valued use. Not only that, prices reveal and aggregate information unknown to any individual market participant or government official (Hayek, 1945). Hence, prices of commodities affect which goods are produced and consumed as well as consumers' and firms' welfare. For this reason, among others, changes in the prices of goods and services are measured and reported by government agencies and predicted by academics, businesses, and private consultants. One of the most well-known reported prices is the Consumer Price Index (CPI) published by the Bureau of Labor Statistics. In this study, we focus on the prices of several meat items that make up the food component of the CPI.

Because of private and public interest in changing food prices, several entities attempt to forecast future food-related CPI values. For example, the U.S. Department of Agriculture (USDA) Economic Research Service (ERS) reports annual forecasts (updated monthly) for the food CPI. The ERS forecasts annual changes in food CPI using an autoregressive moving average (ARMA) framework (Kuhns et al., 2015). Other, similar approaches by academics, private industry consultants, and government agencies (ERS) have been used to forecast the food CPI (e.g., Joutz 1997). Our interests lie in predicting prices of disaggregate meat products, but we focus on monthly (rather than annual) values for disaggregate (rather than aggregate) food products. More importantly, we consider whether consumer price expectations are leading indicators of actual retail beef, pork, and chicken prices using data collected in a monthly Food Demand Survey (FooDS). In contrast to models like that used by the ERS, which use past prices to forecast future prices, our model incorporates consumers' forward-looking expectations to estimate future prices.

Accurate price data can help firms better plan and adjust to market conditions. For instance, public data and associated situation and outlook extension programs are argued to improve producer and consumer welfare by providing more accurate price expectations (Irwin, 1997; Freebairn, 1976, 1978; Lusk, 2013b). Antonovitz and Roe (1986), Bradford and Kelejian (1978), and Arrow (1951) have attempted to estimate the financial and social welfare benefits associated with improved price expectations that accrue from firms being able to more optimally determine the quantity to produce.

While previous efforts at forecasting food prices have tended to rely on econometric models using auto-regressive frameworks, there is evidence that futures markets can help produce forecasts with lower prediction errors. Specifically, futures prices in an efficient market provide forecasts of subsequent spot prices that are at least as accurate as any other forecast (Tomek, 1997; Colino and Irwin, 2010). In layman's terms, it should not be possible to "beat the market" in terms of forecast accuracy (Colino and Irwin, 2010), as futures prices should reflect all available information. Colino and Irwin (2010) note that numerous empirical studies have compared the accuracy of outlook forecasts and futures prices, including Just and Rausser (1981); Bessler and Brandt (1992); Irwin, Gerlow, and Liu (1994); Bowman and Husain (2004); and Sanders and Manfredo (2004, 2005). With a few exceptions, these studies all find that outlook forecasts are no more accurate (and are often *less* accurate) than comparable futures prices.

While there are futures markets for some farm-level products such as live cattle, there are no futures markets for retail cuts of beef (e.g., rib-eye). Although live cattle futures market prices may help in estimating future retail beef prices, it is unclear how accurate a forecast these can provide, especially considering that farmers' shares of the total beef and pork food dollar are 0.515 and 0.60, respectively (i.e., about 40%–49% of the cost of the retail product comprises goods beyond the agricultural commodity in 2015) (Hahn, 2015). In addition, many farm and retail products are not traded or sold in futures markets (such as chicken).

Aside from historical retail prices or farm-commodity futures prices, some other types of data might prove useful in predicting retail meat prices. Surowiecki (2005) popularized the idea that large groups may make more accurate predictions than any single expert. Likewise, Treynor (1987), Forsythe et al. (1992), Johnson (1998), and Maloney and Mulherin (2003) show that the aggregation of decentralized, independent factions with diversified opinions leads to optimal solutions and accurate predictions in a variety of contexts.

Studies suggest that information collected from consumer surveys is beneficial when forecasting future prices (Anderson et al., 2011; Anderson, Kellogg, and Sallee, 2013). In these studies, consumer predictions of future gasoline prices yield increased forecast accuracy relative to forecasts based on historical monthly prices. Furthermore, Zakrzewicz, Brorsen, and Briggeman (2012, 2013) find that survey-based land value estimates elicited from agricultural bankers are leading indicators of land values and land value changes reported by the USDA.

Results from these studies and others like them suggest that there may be merit in using forward-looking information gathered from surveys of diverse individuals. This research determines whether survey-based data on consumers' expectations of meat price changes are leading indicators of changes in U.S. Bureau of Labor Statistics (BLS) retail meat prices. We rely on a unique dataset created by the Food Demand Survey (FooDS) that has been repeated monthly for 5 years (2013–2018).[1]

Data

Consumer Survey Data from FooDS

FooDS is a monthly online survey completed by at least 1,000 consumers nationwide each month. The FooDS survey has been issued every month since May 2013. FooDS is sent to respondents on the 10th of every month. If the 10th falls on a weekend, FooDS is sent the following Monday. The survey is sent to a sample of consumers in a panel maintained by Survey Sampling Incorporated (SSI). Survey responses are weighted to match the U.S. population in terms of age, gender, education, and region of residence. Our econometric models use aggregate FooDS results from June 2013 through May 2018, which yields 60 monthly observations.[2]

Among other questions, respondents are asked (separately) whether they expect the prices of beef, pork, and chicken to be higher in the next 2 weeks compared to the previous 2 weeks (see Figure 1). The wording of the question yields a measurement of expected price changes. Because the

[1] Additional information pertaining to FooDS can be found at http://www.agecon.okstate.edu/ agecon_research.asp.

[2] Due to the limited sample size, we did not consider any out-of-sample forecasts, focusing instead on which variables are leading indicators.

survey is administered in the middle of each month, beef, pork, and chicken price expectation measurements are interpreted as consumers' expected (monthly) price changes.

Figure 1. Example of Consumer Expectation Questions
Q. To what extent do you agree or disagree with the following statements regarding your purchases in the next two weeks as compared to the previous two weeks?

	Strongly Disagree (1)	**Disagree (2)**	**Neither Agree nor Disagree (3)**	**Agree (4)**	**Strongly Agree (5)**
I expect the price of beef to be higher (5)	○	○	○	○	○
I expect the price of pork to be higher (6)	○	○	○	○	○
I expect the price of chicken to be higher (7)	○	○	○	○	○

To derive an aggregate measure of price expectations in each month *t*, we subtracted the proportion of respondents who expected prices to increase from the proportion of respondents who expected prices to decrease. The proportion of respondents who neither agreed nor disagreed was subtracted from 1 and multiplied by the aforementioned measure. This procedure creates a measure of price expectation weighted by those who had an opinion regarding the future of meat prices. Formally, consumer price expectations (PE) for meat type *j* in month *t* are calculated as

$$PE_{jt} = \left(1 - \frac{\sum_{i=1}^{nt} NAD_{ijt}}{n_t}\right)\left(\frac{\sum_{i=1}^{nt} AGREE_{ijt}}{n_t} - \frac{\sum_{i=1}^{nt} DISAGREE_{ijt}}{n_t}\right), \quad (1)$$

where PE_{jt} is the consumer PE for meat *j* = beef, pork, or chicken in each time period (month) *t*, where $t = 1, \ldots, 60$, and *n* is the total number of respondents at time *t*. $AGREE_{ijt}$ is a 0/1 dummy variable indicating whether respondent *i* either strongly agreed or agreed that the price of meat type *j* would increase in the coming weeks. $DISAGREE_{ijt}$ is a 0/1 dummy variable indicating whether a respondent either strongly disagreed or disagreed that the price of meat type *j* would increase in the coming weeks. Likewise, NAD_{ijt} is a 0/1 dummy variable indicating that a respondent neither agreed nor disagreed that the price of meat type *j* would increase in the coming weeks.

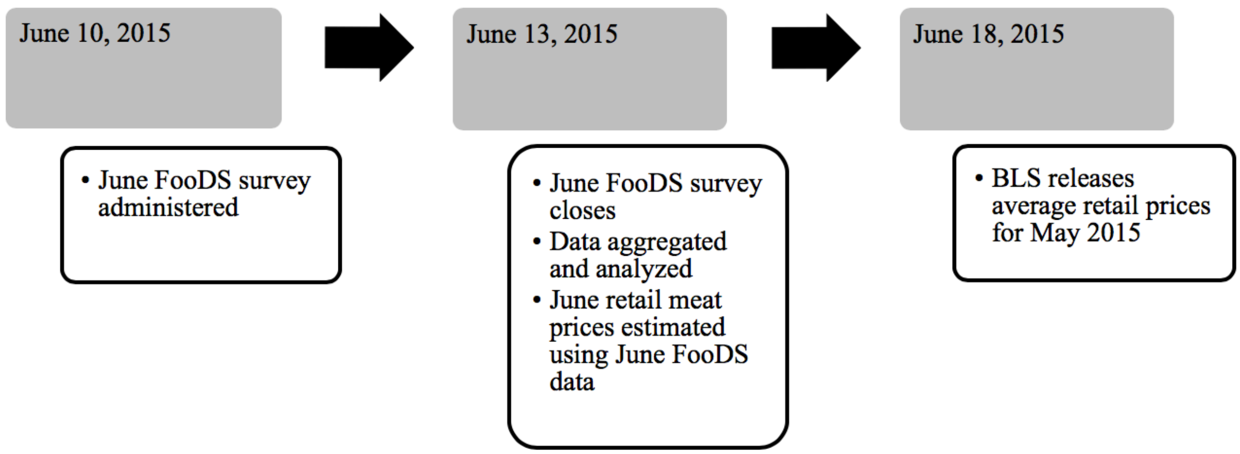
BLS Retail Prices

The Bureau of Labor Statistics publishes average prices of various consumer products in different U.S. cities on a monthly basis. Due to processing time, the monthly prices reported by the BLS are released 2–3 weeks following the month in question (BLS, 2014). For example, the average July prices are not released until mid to late August.[3] Figure 2 shows an example timeline. Average U.S. city prices for uncooked ground beef (APU0000FC1101), uncooked beef steak

[3] Because of this lag, we also investigate the use of retail meat prices reported by the Agricultural Marketing Service (AMS) as a proxy for lagged BLS prices. Results are provided in the Appendix.

(APU0000FC3101), boneless chicken breast (APU0000FF1101), and all pork chops (APU0000FD3101) for June 2013 to May 2018 were collected from the BLS website. The BLS does not report average U.S. city prices for deli ham or chicken wings. However, to provide a point of comparison with the FooDS data, we also collected BLS boneless ham excluding canned (APU0000704312) and bone-in chicken leg (APU0000706212) prices, respectively. Figures 3–8 show BLS prices and associated FooDS price expectations from June 2013–May 2018.

Figure 2. Timeline of Foods Survey Administration, Price Estimations, and BLS Price Release Dates



Methods

We seek to determine whether consumer expectations are leading indicators of retail meat prices. FooDS data for a given month are known at least 2 months prior to the release of corresponding BLS prices. Thus, we can predict price changes in the current period, say July, before the BLS release of the July data occurs (August).

After considering some simple correlations between consumer price expectations and BLS prices (see Table 1), we move to econometric models that seek to determine whether FooDS data are a leading indicator of BLS prices even after controlling for past BLS prices. Our main analysis focuses on an ordinary least squares (OLS) model,

$$BLSPrice_{j,t} = \beta_{0,j} + \beta_{1,j} BLS_{t-2} + \beta_{2,j} PE_{j,t} + \sum_{i=1}^{11} \varphi_{i,j} M_i + \varepsilon_{j,t}, \quad (2)$$

where $BLSPrice_{j,t}$ represents the BLS price of food product j at time t, $PE_{j,t}$ represents expected

Figure 3. Uncooked Beef Steak BLS Prices and FooDS Price Expectations: June 2013–May 2018

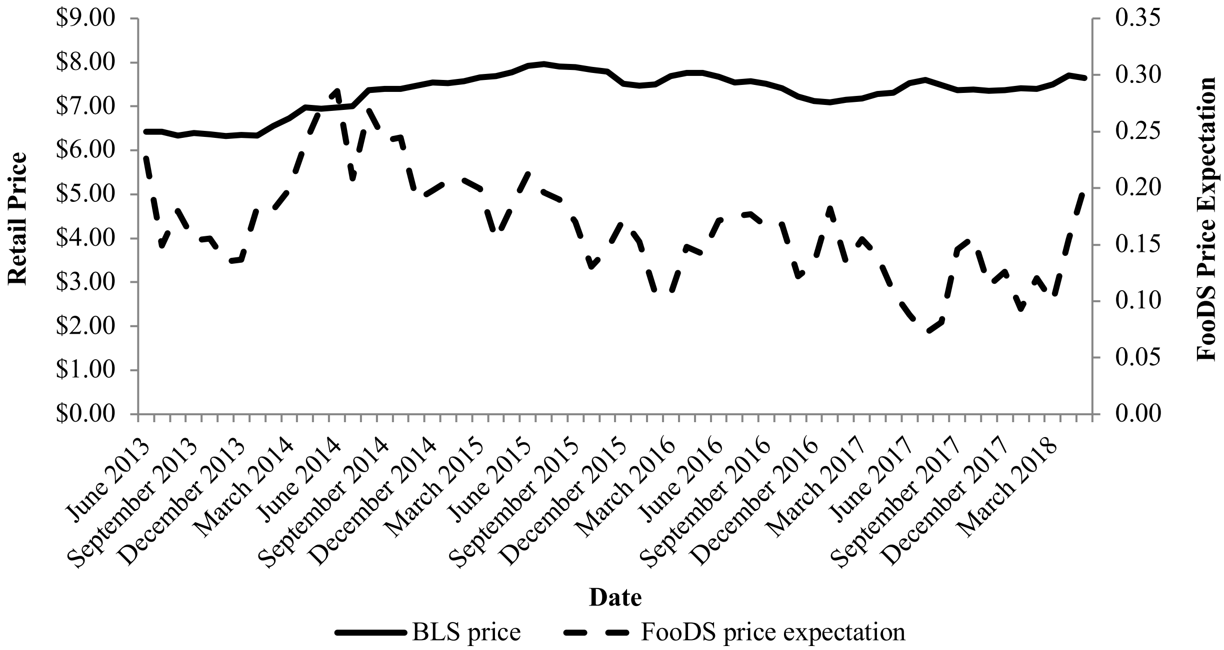


Figure 4. Uncooked Ground Beef BLS Prices and FooDS Price Expectations: June 2013–May 2018

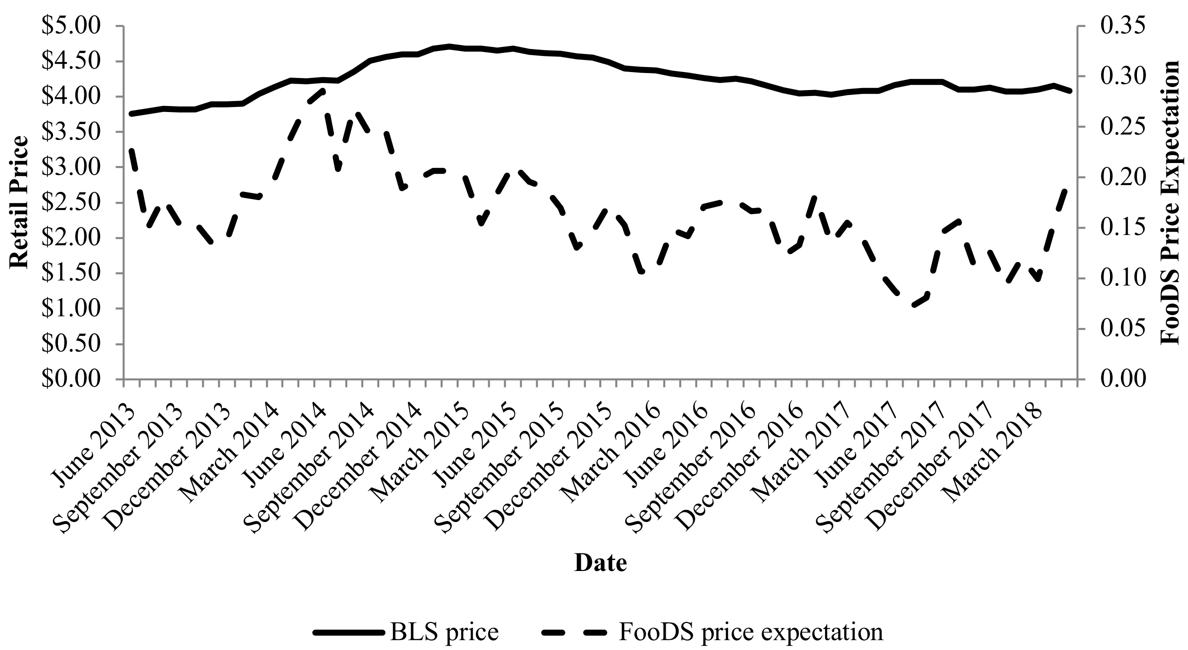


Figure 5. Pork Chop BLS Prices and FooDS Price Expectations: June 2013–May 2018

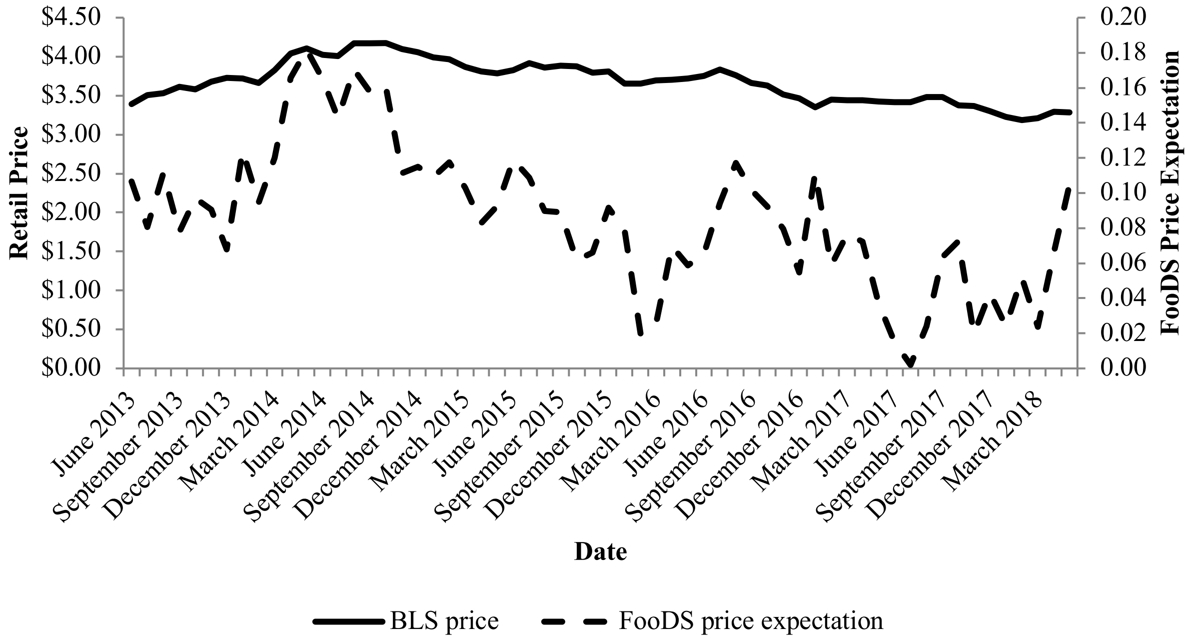


Figure 6. Deli Ham BLS Prices and FooDS Price Expectations: June 2013–May 2018

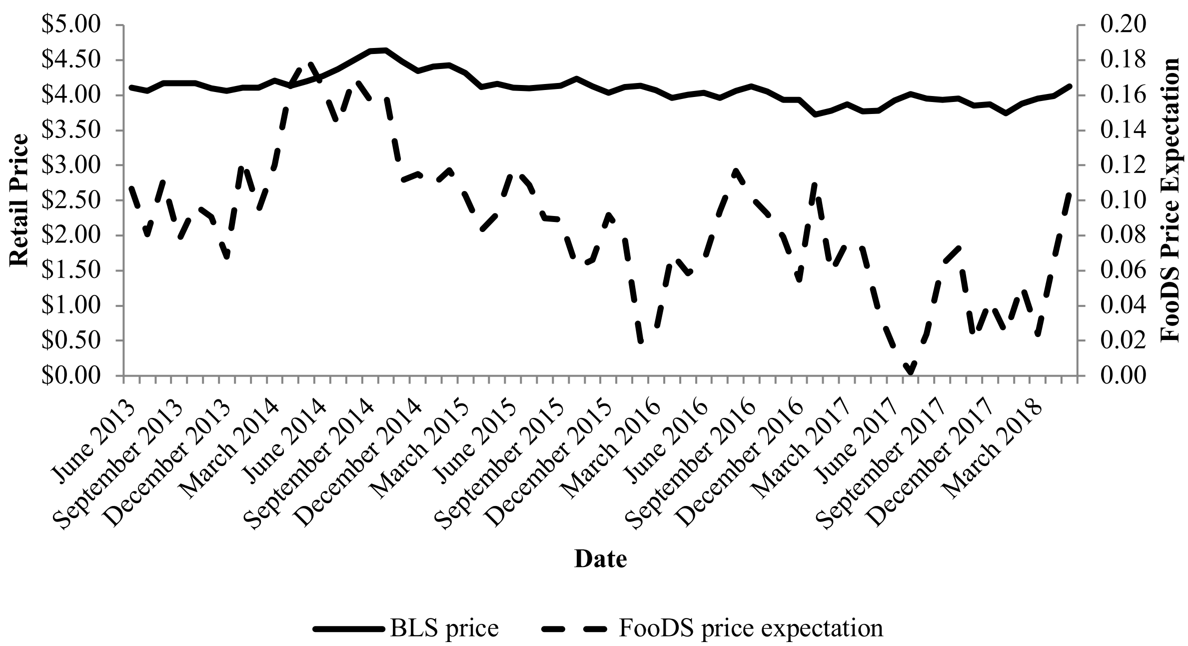


Figure 7. Chicken Breast BLS Prices and FooDS Price Expectations: June 2013–May 2018

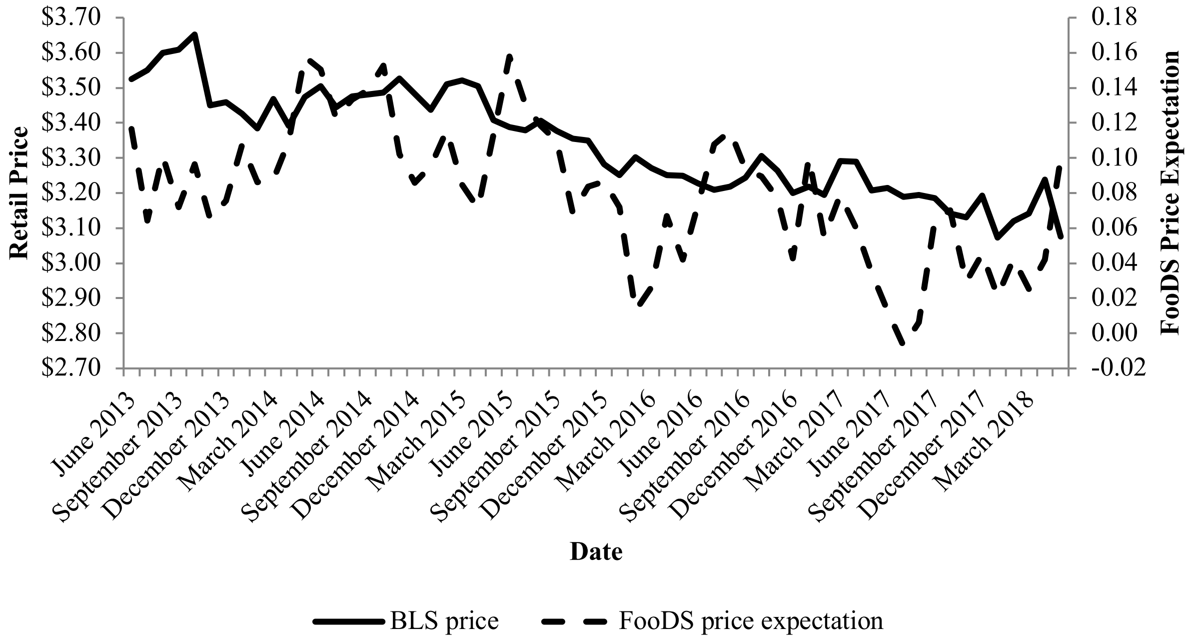
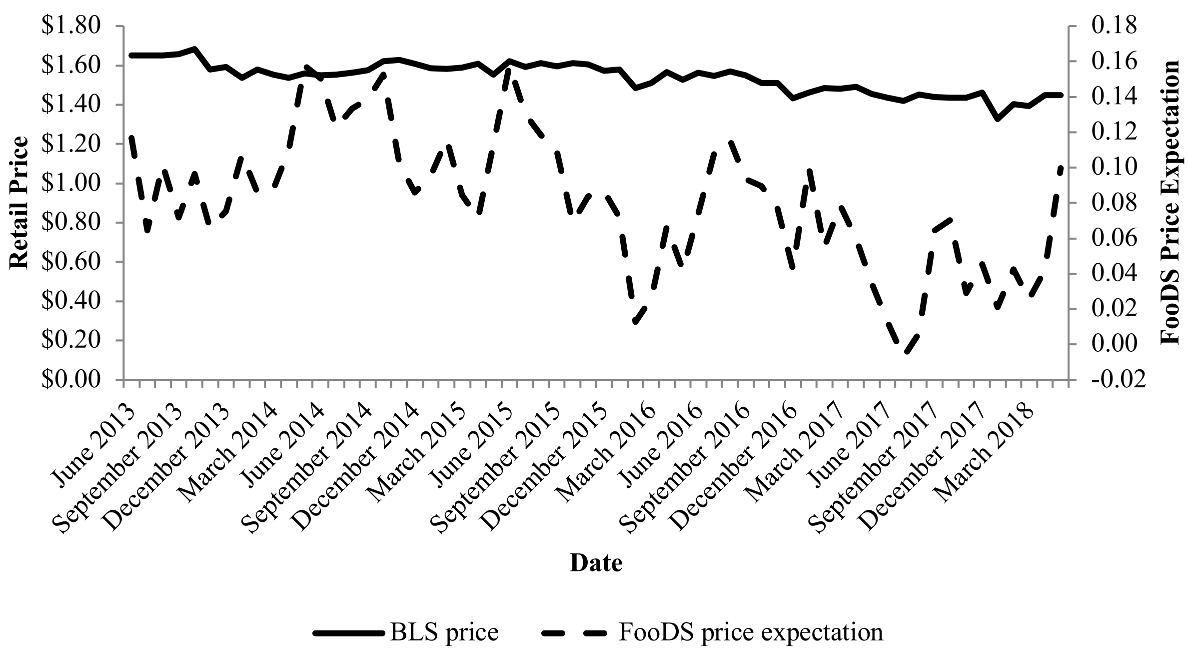


Figure 8. Chicken Wing BLS Prices and FooDS Price Expectations: June 2013–May 2018



price change(s) measured in FooDS for food product j at time t, M_i is a 0/1 monthly dummy variable (the month of December is dropped), and $\varepsilon_{j,t} \sim N(\mu_j, \sigma_{j,t}^2)$. BLS prices are specified at time t as a function of BLS prices two periods prior to the release date. This specification is adopted because the BLS does not release price data timely enough to use a one-period lag in real-world forecasting. While it would be possible to estimate a model with a one-period lag for BLS price changes, actual applied forecasts with this type of model would require forecasting 1 month ahead, and using this forecast to then forecast 2 months ahead to arrive at an actual forecast of the current period. Rather than adopting this approach, we chose the more practical method of estimating a model that has the data on hand needed to make the forecast of interest. The model in equation (2) uses current FooDS responses (e.g., June) to estimate current BLS prices (also June).

Table 1. Correlations between Same-Period BLS Prices and Survey-Based Expected Prices

Item	Correlation
Ground beef	0.277**
Beef steak	−0.116
Pork chop	0.718***
Deli ham	0.661***
Chicken breast	0.572***
Chicken wing	0.624***

Notes: Double and triple asterisks (**,***) represent significance at the 0.05 and 0.01 levels, respectively.

Before conducting any hypothesis tests regarding model specification, we first check to determine whether the linear relationship specified in equation (2) is mean-reverting. Engle and Granger (1987) discuss the decreased power of traditional Dickey–Fuller tests when multiple regressors are used in OLS regressions. For this reason, we use the Engle–Granger cointegration test, in which a Monte Carlo simulation is conducted to determine the critical value of test statistics. If data are not cointegrated, we take the first difference of BLS prices (i.e., price changes) and achieve cointegration.

After data in all models are cointegrated, we conduct diagnostic tests for autocorrelation and heteroskedasticity. By redefining the error terms and variances as $\varepsilon_{j,t} = \rho_j \varepsilon_{j,t-1} + v_{j,t}$ and $\sigma_{j,t}^2 = \delta_0 + \delta_{1,j} Z_{j,t}$, we test for the presence of autocorrelation and heteroskedasticity with the following hypotheses:

$$H_{01}: \rho_j = 0 \; vs. H_{a1}: \rho_j \neq 0, \text{ and}$$

$$H_{02}: \delta_{1,j} = 0 \; vs. H_{a2}: \delta_{1,j} \neq 0.$$

We use Durbin–Watson tests to test for the presence of autocorrelation and White's test for the presence of heteroskedasticity. If autocorrelation is present, we estimate autoregressive parameters; if heteroskedasticity is present, homoskedasticity is achieved through maximum likelihood estimation. Additionally, we conduct a joint hypothesis test to determine whether seasonal effects are present for all meats. Once appropriate corrections have been made, we test the key hypothesis that price expectations are a leading indicator of BLS prices by exploring whether $\beta_{2,j} = 0$.

We are also interested in the predictive power of equation (2), which can easily be defined as a general model nesting two separate autoregressive models. These autoregressive models are

(3) $$BLSPrice_{j,t} = \alpha_{0,j} + \alpha_{1,j}BLSPrice_{j,t-2} + \sum_{i=1}^{11} \varphi_{i,j}M_i + \varepsilon_{j,t}$$

(4) $$BLSPrice_{j,t} = \gamma_{0,j} + \gamma_{1,j}PE_{j,t} + \sum_{i=1}^{11} \varphi_{i,j}M_i + \varepsilon_{j,t}.$$

Because these models are not special cases of one another, an orthodox test can be conducted with equation (2) to determine which of equations (2) through (4) is the most appropriate, and accurate, forecast model. Specifically, the following hypotheses are tested independently:

$H_{03}\colon \beta_{1,j} = 0\ vs.\ H_{a3}\colon \beta_{1,j} \neq 0$, and

$H_{04}\colon \beta_{2,j} = 0\ vs.\ H_{a4}\colon \beta_{2,j} \neq 0.$

If H_{03} is rejected but we fail to reject H_{04}, then equation (3) will yield the most accurate forecast. Similarly, if results indicate failure to reject H_{03} but reject H_{04}, then equation (4) is the most appropriate forecast model. If both H_{03} and H_{04} are rejected, then lagged BLS prices (or price changes) and price expectations from FooDS contain unique information and equation (2) will yield the most accurate forecast. Lastly, if we fail to reject both H_{03} and H_{04}, BLS prices and price expectations from FooDS contain the same information. In this case, equations (3) and (4) should yield similar forecast results.

Results

We calculated the correlation between BLS prices and FooDS variables to explore the same-period linear relationships between the variables. As shown in Table 1, a statistically significant positive correlation exists for all meat price measures, excluding beef steak. The correlation between beef steak BLS price change and FooDS price expectations is negative but not statistically significant.

Cointegration, Model Specification, and Orthodox Tests

Table 2 contains estimates from equation (2) as well as test statistics and associated statistical significance measures used to determine whether variables are cointegrated. It is important to note we failed to reject the hypothesis of no cointegration when estimating ground beef prices. As a result, we take the first difference of ground beef BLS prices and estimate respective price changes using the first difference of BLS prices lagged two periods and FooDS price expectations. All other meat prices are estimated in levels.

Table 2. Relationship between BLS Prices and FooDS Price Expectations: Equation (2)

Date	Beef Steak[a]	Ground Beef[b]	Chicken Breast[a]	Chicken Wing[a]	Pork Chop[a]	Ham[a]
β_0, constant	1.453***	−0.068	0.284	0.358***	3.286***	2.179
	(0.461)	(0.044)	(0.168)	(0.109)	(0.579)	(1.123)
β_1, BLS price lagged two periods	0.784***	-	0.889***	0.724***	0.053	0.441
	(0.060)	-	(0.053)	(0.071)	(0.156)	(0.266)
β_1, first difference of BLS price	-	−0.146	-	-	-	-
lagged two periods	-	(0.173)	-	-	-	-
β_2, FooDS price expectation	0.080	0.317	0.400	0.545***	0.592	0.260
	(0.386)	(0.229)	(0.230)	(0.139)	(0.391)	(0.412)
φ_1, January	0.032	0.005	−0.112	−0.028	−0.087***	0.017
	(0.038)	(0.025)	(0.022)	(0.022)	(0.032)	(0.052)
φ_2, February	0.141**	0.044	0.048**	0.003	−0.077	0.089
	(0.053)	(0.030)	(0.022)	(0.022)	(0.043)	(0.070)
φ_3, March	0.259***	0.043	0.113***	0.029	−0.047	0.115
	(0.050)	(0.033)	(0.022)	(0.022)	(0.053)	(0.073)
φ_4, April	0.324***	0.042	0.083***	0.044	−0.004	−0.003
	(0.045)	(0.035)	(0.022)	(0.022)	(0.058)	(0.064)
φ_5, May	0.250***	−0.015	−0.007	0.011	−0.001	0.049
	(0.049)	(0.036)	(0.022)	(0.022)	(0.059)	(0.066)
φ_6, June	0.230***	0.026	0.012	0.007	−0.002	0.136
	(0.056)	(0.038)	(0.025)	(0.023)	(0.059)	(0.088)
φ_7, July	0.188***	0.001	0.016	0.018	0.042	0.136
	(0.051)	(0.037)	(0.024)	(0.023)	(0.058)	(0.075)
φ_8, August	0.163	0.042	0.052**	0.028	0.064	0.166**
	(0.046)	(0.037)	(0.023)	(0.022)	(0.055)	(0.064)
φ_9, September	0.148***	0.031	0.072***	0.029	0.066	0.199***
	(0.050)	(0.033)	(0.023)	(0.022)	(0.050)	(0.064)
φ_{10}, October	0.086	−0.010	0.062***	0.024	0.035	0.178***
	(0.053)	(0.032)	(0.023)	(0.022)	(0.043)	(0.059)
φ_{11}, November	0.038	0.027	0.037	0.023	0.016	0.052
	(0.038)	(0.026)	(0.022)	(0.021)	(0.031)	(0.041)
Autocorrelation coefficients						
$\rho_{j,t-1}$	−0.890***	−0.533***	-	-	−0.968***	−0.857***
	(0.131)	(0.146)	-	-	(0.038)	(0.154)
$\rho_{j,t-2}$	0.647***	-	-	-	-	0.413
	(0.155)	-	-	-	-	(0.231)
$\rho_{j,t-3}$	−0.411***	-	-	-	-	−0.418**
	(0.125)	-	-	-	-	(0.172)
$\rho_{j,t-12}$	0.372***	-	-	-	-	-
	(0.083)	-	-	-	-	-
Diagnostic statistics						
Engle–Granger cointegration test	−4.373***	−5.140***	−5.791***	−5.668***	−5.178	−4.221***
Durbin–Watson test[c]	0.923***	1.253***	1.648	1.569	1.043***	1.062***
White's test[c]	50.740***	38.590***	44.100***	46.420**	39.050***	31.390**
$\varphi_1 = \varphi_2 = \cdots = \varphi_{10} = \varphi_{11} = 0$	6.160***	1.500	6.390***	1.470	1.210	2.520**
R^2	0.872	0.299	0.942	0.847	0.276	0.482

Notes: Double and triple asterisks (**,***) represent significance at the 0.05 and 0.01 levels, respectively. Numbers in parentheses are standard errors. *F*-value test statistics are shown for the joint hypothesis autocorrelation tests.
[a] Models are estimated in levels ($N = 58$).
[b] Model estimating price changes. In other words, the dependent variable(s) are in first-difference form ($N = 57$).
[c] Test conducted prior to maximum likelihood stepwise autoregression estimation.

Durbin–Watson tests indicate that positive autocorrelation is present in models estimating beef- and pork-related prices but absent when estimating chicken breast and wing prices. Failing to correct for positive autocorrelation would result in smaller error variance estimates; as a result, confidence intervals would be too small and true null hypotheses would be rejected with a higher probability than the stated significance. In addition, we reject the null hypothesis of no heteroskedasticity for all meat price estimation models. As a result, $\delta_{1,j}$ is statistically different from 0 in all models. We correct for autocorrelation and heteroskedasticity using maximum likelihood stepwise autoregression estimation, resulting in the recovery of all efficiency properties.

Results in Table 2 indicate that β_1 and β_2 are statistically different from 0 when estimating chicken wing prices. That is, we reject H_{03} and H_{04} for chicken wing and BLS prices and FooDS chicken price expectations are both considered leading indicators. $H_{03}$is rejected when estimating beef steak and chicken breast, whereas we fail to reject H_{04}. This means that previous beef steak and chicken breast BLS prices are leading indicators of current (and future) beef steak and chicken breast prices but associated FooDS price expectations are not. Additionally, we fail to reject H_{03} and H_{04} for ground beef, pork chop, and ham price estimates. That is, ground beef, pork chop, and ham FooDS price expectation(s) and lagged BLS prices (differences) contain the same information, and forecasts from equations (3) and (4) will yield similar estimates. In short, equation (2) is the most appropriate for estimating chicken wing prices, equation (3) is most appropriate for estimating beef steak and chicken breast prices, and either equation (3) or equation (4) can be used to estimate ground beef, pork chop, and ham prices.

Table 3 contains results associated with beef steak, ground beef, chicken breast, pork chop, and ham price estimates using equation (3), and Table 4 contains results associated with ground beef, pork chop, and ham price estimates using equation (4). Both equations indicate that seasonal variation is present in ham prices, and equation (3) indicates that beef steak and chicken breast prices are seasonal. Although orthodox tests indicate lagged BLS price changes and FooDS beef price expectations contain the same information, different effects are captured by respective parameters. For example, for every \$1 increase in ground beef prices (e.g., $BLS_{ground\ beef,July}$), retail ground beef prices ($BLSPrice_{beef\ steak,September}$) are expected to decrease by an average of \$0.11. The opposite relationship is observed between retail ground beef price changes and FooDS beef price expectations through equation (4); for every one unit increase in consumers' beef price expectations (e.g., $PE_{beef,July}$), retail ground beef prices ($BLSPrice_{ground\ beef,July}$) are expected to increase by an average of \$0.27. Interestingly, FooDS pork price expectations and lagged pork chop and deli ham prices are both found to have positive relationships with respective prices.

Conclusions

Analysis of study results indicates that U.S. consumers' chicken price expectations obtained through a consumer survey (FooDS) are leading indicators of chicken wing prices in the United States. Increased accuracy of future price estimates not only affords retailers the ability to formulate appropriate marketing strategies at an earlier date, but also empowers them with confidence regarding procurement decisions. That is, accurate price forecasts allow retailers to determine the market equilibrium more confidently in terms of quantity demanded of each

Table 3. Relationship between BLS Prices and Lagged BLS Prices: Equation (3)

Date	Beef Steak[a]	Ground Beef[b]	Chicken Breast[a]	Pork Chop[a]	Ham[a]
β_0, constant	1.502***	−0.018	0.094	1.321**	2.241
	(0.436)	(0.027)	(0.130)	(0.612)	(1.123)
β_1, BLS price lagged two periods	0.779***	-	0.953***	0.623***	0.431
	(0.059)	-	(0.038)	(0.172)	(0.266)
β_1, first difference of BLS price lagged	-	−0.112	-	-	-
two periods	-	(0.170)	-	-	-
φ_1, January	0.032	0.007	−0.004	−0.057	0.019
	(0.038)	(0.025)	(0.022)	(0.039)	(0.050)
φ_2, February	0.140**	0.043	0.049**	−0.051	0.085
	(0.053)	(0.031)	(0.022)	(0.057)	(0.069)
φ_3, March	0.257***	0.042	0.117***	0.025	0.112
	(0.050)	(0.034)	(0.022)	(0.058)	(0.072)
φ_4, April	0.324***	0.045	0.087***	0.084	0.0001
	(0.045)	(0.036)	(0.022)	(0.053)	(0.063)
φ_5, May	0.251***	−0.009	0.002	0.078	0.053
	(0.048)	(0.037)	(0.022)	(0.056)	(0.065)
φ_6, June	0.233***	0.036	0.027	0.041	0.138
	(0.055)	(0.038)	(0.023)	(0.060)	(0.086)
φ_7, July	0.189***	0.004	0.030	0.074	0.138
	(0.051)	(0.038)	(0.023)	(0.055)	(0.074)
φ_8, August	0.166***	0.047	0.066***	0.112**	0.171***
	(0.044)	(0.038)	(0.022)	(0.049)	(0.062)
φ_9, September	0.150***	0.037	0.087***	0.079	0.204***
	(0.049)	(0.034)	(0.022)	(0.054)	(0.062)
φ_{10}, October	0.087	−0.007	0.074***	0.029	0.183***
	(0.053)	(0.032)	(0.022)	(0.056)	(0.057)
φ_{11}, November	0.037	0.021	0.041	−0.005	0.052
	(0.038)	(0.026)	(0.022)	(0.039)	(0.040)
Autocorrelation coefficients					
$\rho_{j,t-1}$	−0.897***	−0.576***	-	−1.094***	−0.870***
	(0.128)	(0.137)	-	(0.132)	(0.152)
$\rho_{j,t-2}$	0.651***	-	-	0.747***	0.398
	(0.154)	-	-	(0.187)	(0.236)
$\rho_{j,t-3}$	−0.423***	-	-	−0.564***	−0.405**
	(0.121)	-	-	(0.131)	(0.181)
$\rho_{j,t-12}$	0.364***	-	-	-	-
	(0.080)	-	-	-	-
Diagnostic statistics					
$\varphi_1 = \varphi_2 = \cdots = \varphi_{10} = \varphi_{11} = 0$	6.280***	1.460	6.450***	1.520	2.640**
R^2	0.865	0.277	0.940	0.527	0.467

Notes: Double and triple asterisks (**,***) represent significance at the 0.05 and 0.01 levels, respectively. Numbers in parentheses are standard errors.
[a] Models are estimated in levels ($N = 58$).
[b] Model is estimating price changes. In other words, the dependent variable is in first difference form ($N = 57$).

Table 4. Relationship between BLS Prices and FooDS Price Expectations: Equation (4)

Date	Ground Beef[a]	Pork Chop[b]	Ham[b]
β_0, constant	−0.057	3.450***	4.048***
	(0.040)	(0.238)	(0.119)
β_2, FooDS price expectation	0.273	0.526	0.147
	(0.207)	(0.378)	(0.423)
φ_1, January	0.001	−0.089***	−0.031
	(0.025)	(0.031)	(0.035)
φ_2, February	0.042	−0.082	0.019
	(0.030)	(0.041)	(0.046)
φ_3, March	0.041	−0.058	0.034
	(0.032)	(0.048)	(0.053)
φ_4, April	0.036	−0.015	−0.061
	(0.033)	(0.052)	(0.058)
φ_5, May	−0.020	−0.012	−0.001
	(0.034)	(0.055)	(0.061)
φ_6, June	0.027	−0.013	0.046
	(0.035)	(0.056)	(0.062)
φ_7, July	0.012	0.048	0.058
	(0.033)	(0.055)	(0.061)
φ_8, August	0.040	0.068	0.114
	(0.033)	(0.053)	(0.059)
φ_9, September	0.028	0.072	0.151***
	(0.032)	(0.048)	(0.054)
φ_{10}, October	−0.018	0.041	0.159***
	(0.030)	(0.042)	(0.047)
φ_{11}, November	0.020	0.019	0.049
	(0.025)	(0.030)	(0.034)
Autocorrelation coefficient			
$\rho_{j,t-1}$	−0.465**	−0.973***	−0.921***
	(0.136)	(0.030)	(0.053)
Diagnostic statistics			
$\varphi_1 = \varphi_2 = \cdots = \varphi_{10} = \varphi_{11} = 0$	1.450	1.480	2.680***
R^2	0.277	0.288	0.392

Notes: Double and triple asterisks (**,***) represent significance at the 0.05 and 0.01 levels, respectively. Numbers in parentheses are standard errors.
[a] Model is estimating price changes. In other words, the dependent variable is in first difference form ($N = 59$).
[b] Models are estimated in levels ($N = 60$).

product at the retail level. This prevents retailers from procuring more of a product than will be demanded by consumers, ultimately resulting in the loss of potential profit from procurement costs not covered by overestimated sales. Accurate forecasts of future retail prices should also reduce asymmetric price information.

Although results suggest there is some explanatory power in the aggregation of (FooDS) survey responses, there are some (difficult to handle) issues that might restrict forecast performance. Changes in the survey itself might be beneficial. The main problem with the survey pertains to the timing of administration. That is, the administration of FooDS occurs at a different time than when BLS price data are *released*. Due to the longevity of the survey, imposing drastic changes to FooDS would pose larger problems than any associated with this study. As a result, we sought out alternative solutions. Disaggregated, weekly prices were obtained from the Agricultural Marketing Service (AMS) and used as a proxy for lagged BLS prices; results are similar to those discussed above.[4]

In addition, the distinction between measurements reported by FooDS and the BLS should be considered. For instance, the wording of the questions asked in FooDS used to construct price expectations can be interpreted as consumers' expectations regarding beef, pork, and chicken prices in the next 2 weeks relative to the previous 2 weeks. Therefore, because the survey is administered in the middle of each month, price expectation measurements are interpreted as consumers' expected (monthly) price changes. Although asked differently in FooDS, respondents are asked comparable questions to those in the highly regarded and closely followed Conference Board's Consumer Confidence Index Survey and the Michigan Survey of Consumers administered by the University of Michigan. On the other hand, the BLS reports average retail prices rather than price changes.

While economic theory is typically void of anomalies, there are instances in which deviations from commonly accepted principles arise. Specific to the study at hand, Baucells and Hwang (2017) note five prominent anomalies in which decision making deviates from classical economic rationality: i) sunk-cost effects (Thaler, 1980; Arkes and Blumer, 1985), ii) payment depreciation (Gourville and Soman, 1998), iii) reluctance to trade (Thaler, 1985; Novemsky and Kahneman, 2005), iv) preference for up-front payment (Prelec and Loewenstein, 1998), and v) flat-rate bias (Della Vigna and Malmendier, 2006; Lambrecht and Skiera, 2006). Anomalies such as these are not compatible with traditional discounted utility model(s) and have resulted in modifications of the rational model. Namely, Thaler (1985) recognizes the central role of reference-price comparisons and proposes a model in which consumers obtain transaction utility by comparing reference prices with actual prices to explain anomalies i) and iii). Koszegi and Rabin (2006) propose a model in which reference prices form and adapt by a process of anticipation. This model explains anomalies i), iii), and v). Because purchase decisions are made by consumers with reference prices in mind, quantity of products demanded sets the retail market equilibrium prices. Moreover, deviations from classical economic rationale, now supported by updated theories, provide insight into why consumer expectations about future prices (derived from reference prices) provide more accurate price forecasts than lagged (realized) prices alone.

[4] Results associated with models incorporating AMS retail price data are in the appendix.

Perhaps knowledge gained from this study, as well as various demand studies, will enable researchers to develop more accurate price estimation models. For instance, Piggott and Marsh (2010) discuss the possibility of demand models specifying prices as a function of quantities. This is motivated by the perishable nature of many foods now consumed and, consequently, limited storage, and the biological lag inherent in the production of most food products and byproducts sold in the retail setting. Because of the biological lag, many food products are essentially fixed in quantity in the short run (Christensen and Manser, 1977; Huang, 1988). This model specification, grounded in economic theory, suggests food quantities are exogenous (supply is inelastic), and prices must adjust to establish a market equilibrium. This specification of demand model(s) and others similar to it are often estimated as a complete system of demand in which not only the quantity of good i affects equilibrium prices for good i, but the quantity of $n - 1$ complements and substitutes does as well. In turn, this allows for the estimation of elasticity measurements to determine the effect of complements and substitutes on the prices of each food. In other words, the literature has built on the economic theory of cross-price and cross-quantity relationships. Future research should not limit econometric models seeking to estimate (future) prices to exogenous variables directly related to endogenous variables. Instead, exogenous variables shown to have indirect effects on endogenous variables in question should also be considered.

Often, the topic of external validity arises when researchers implement primary data in their analyses. While researchers exercise extreme caution in the methods used to collect and analyze primary data, this study supports the notion that external validity is associated with information collected through experiments and surveys. In the same vein, external validity is not always associated with primary data collection, as observed through results associated with ground beef, pork chop, and deli ham price estimations.

Results presented in this study verify findings by Thaler (1985) and Koszegi and Rabin (2006) that consumers use reference prices to dictate purchasing decisions. However, we show that there is merit in using aggregate price expectations to forecast future meat prices through econometric modeling. As alluded to earlier, it seems that piecing together knowledge provided by the study at hand and studies in the demand (e.g., Deaton and Muellbauer, 1980; Eales and Unnevehr; 1994), machine learning (e.g., Bryant, Bessler, and Haigh, 2009; Pearl, 2014), and price analysis (e.g., Thaler 1985; Koszegi and Rabin, 2006) literatures will help future researchers as they attempt to accurately forecast prices. Moreover, although advances in technology and increased access to information have yielded instrumental variables not previously available, inadequate data or inappropriate alternatives often forces researchers to settle for less appropriate data generating process specifications or abandon research projects when unavoidable econometric problems arise and no viable solution is available. Because prices are often used to evaluate market structures and competition, estimate demand, determine project feasibility, or determine the most profitable production practices, future research might benefit from the use of aggregate price expectations as instrumental variables in lieu of realized prices.

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Appendix

AMS Retail Prices

The USDA Agriculture Marketing Service (AMS) publishes average U.S. retail meat prices on a weekly basis. Table A1 shows AMS retail items averaged each week to determine weekly AMS beef steak, ground beef, pork chop, deli ham, chicken breast, and chicken wing retail prices. Because FooDS is administered on the 10th of each month (unless the 10th falls on a weekend), we use AMS retail prices reported on or before the 10th of each month (from June 2013–May 2018). Figures A1–A6 show BLS and AMS prices and associated FooDS price expectations.

Table A1. AMS Retail Item Definitions

Food Product	AMS–Defined Retail Item(S)
Beef steak	Ground beef 70%–79%, Ground beef 80%–89%, Ground beef 90% or more
Ground beef	Bone-in ribeye steak, boneless ribeye steak, T-bone steak, porterhouse steak, filet mignon, bone-in strip steak, boneless New York strip steak, sirloin steak, boneless sirloin steak, sirloin tip steak, boneless top sirloin steak, top round steak, bottom round steak, eye of round steak, rump steak, chuck/shoulder/arm steak, flat iron steak, flank steak, minute/cube steaks, tri-tip, skirt steak
Pork chop	Rib end chops bone-in, sirloin chops bone-in, center cut chops bone-in, assorted chops bone-in, rib chops boneless, sirloin chops boneless, center cut chops boneless, smoked chops
Deli ham	Deli ham
Chicken breast	Boneless/skinless marinated breast, boneless/skinless thin-sliced breast, boneless/skinless IQF breast, boneless/skinless regular pack breast, boneless/skinless organic breast, boneless/skinless specialty breast, boneless/skinless value pack breast
Chicken wing	Fried/baked bone-in wings, fried/baked boneless wings, party wings IQF, specialty whole wings, conventional whole wings, conventional whole wings IQF

Figure A1. Uncooked Beef Steak BLS, AMS, and FooDS Price Expectations: June 2013–May 2018

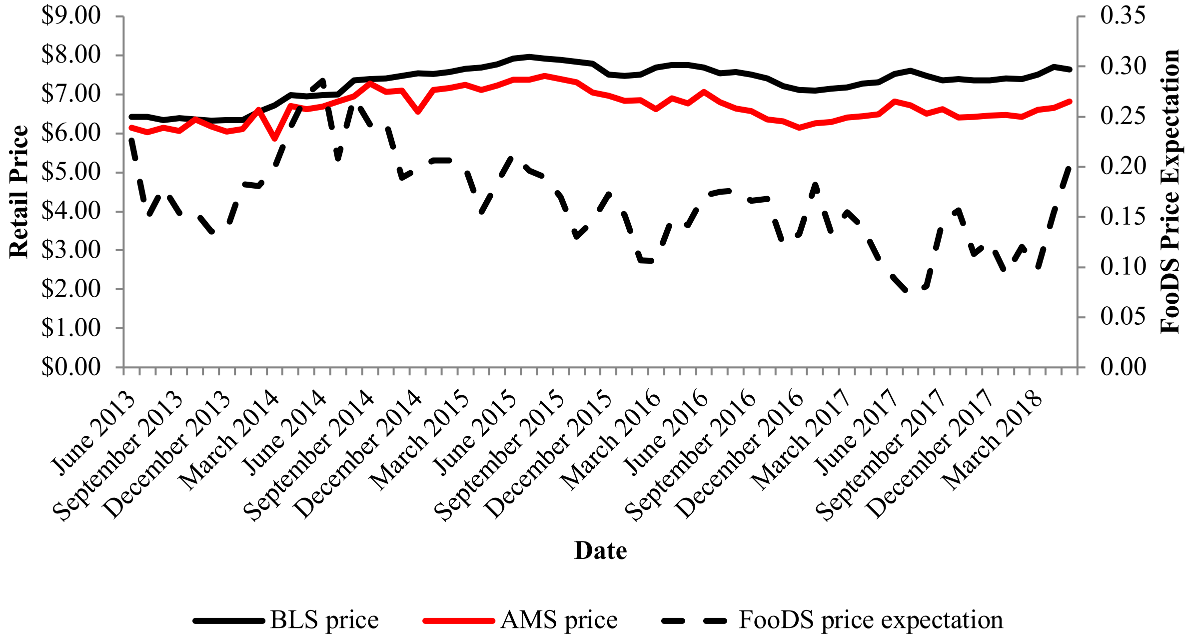


Figure A2. Uncooked Ground Beef BLS, AMS, and FooDS Price Expectations: June 2013–May 2018

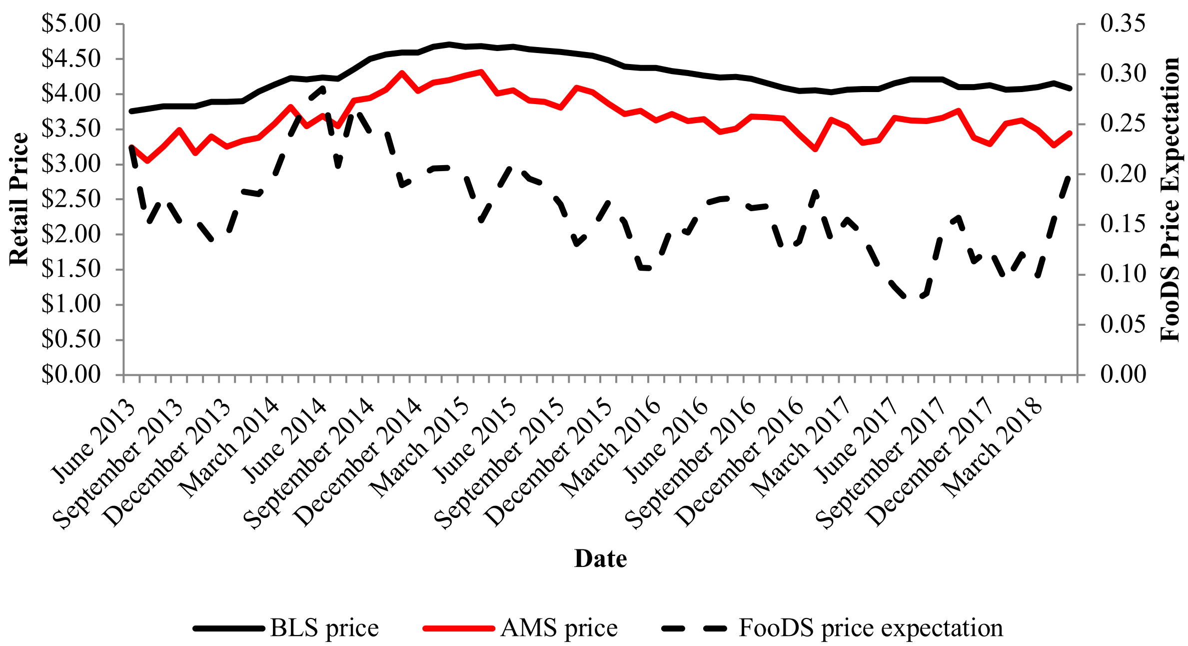


Figure A3. Pork Chop BLS, AMS, and FooDS Price Expectations: June 2013–May 2018

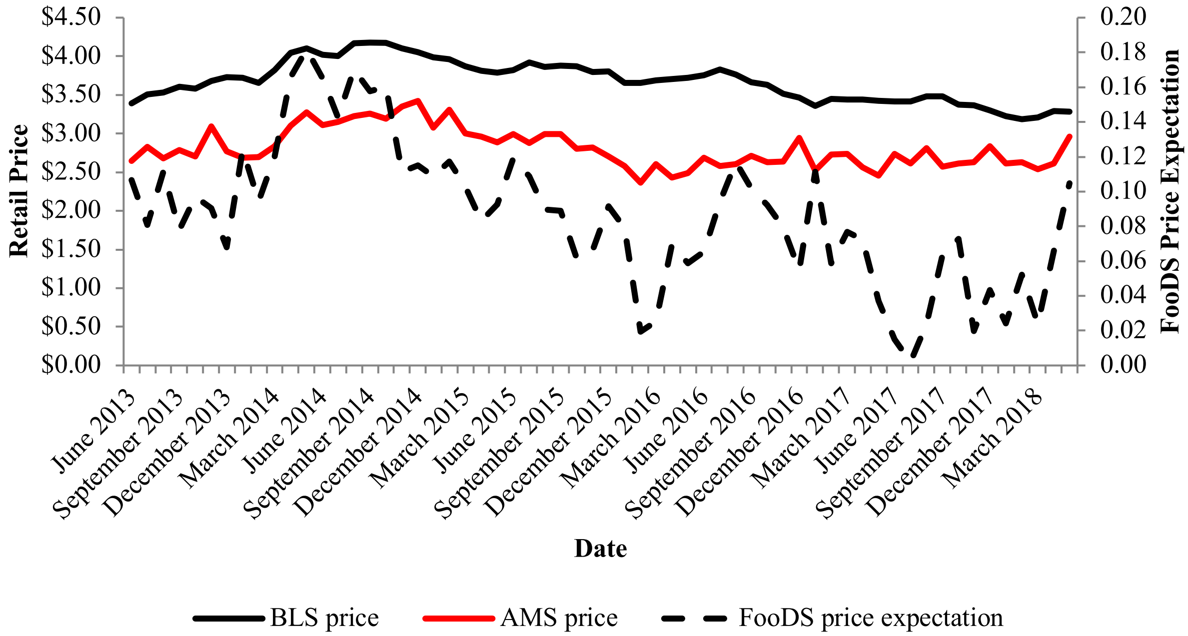


Figure A4. Deli Ham BLS, AMS, and FooDS Price Expectations: June 2013–May 2018

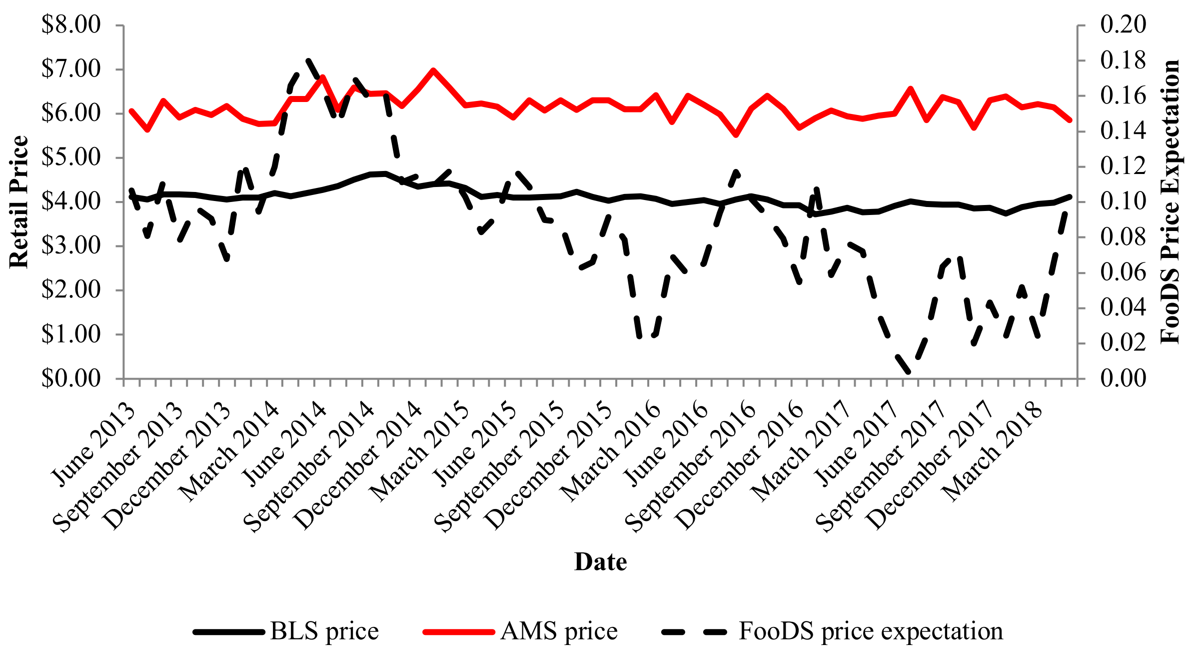


Figure A5. Chicken Breast BLS, AMS, and FooDS Price Expectations: June 2013–May 2018

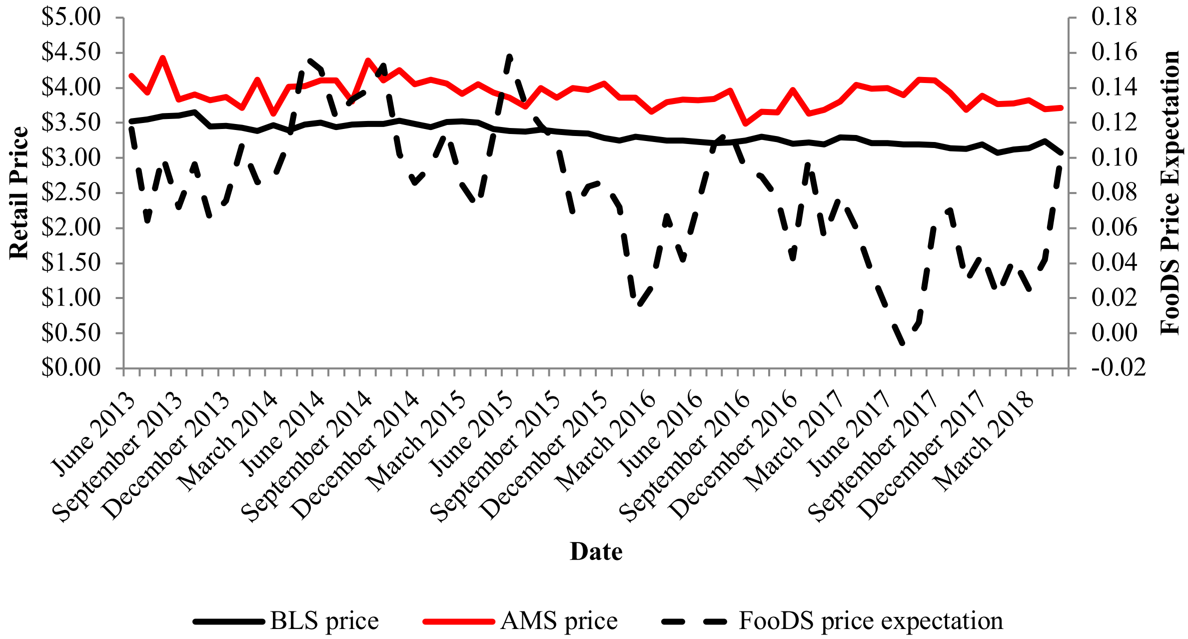
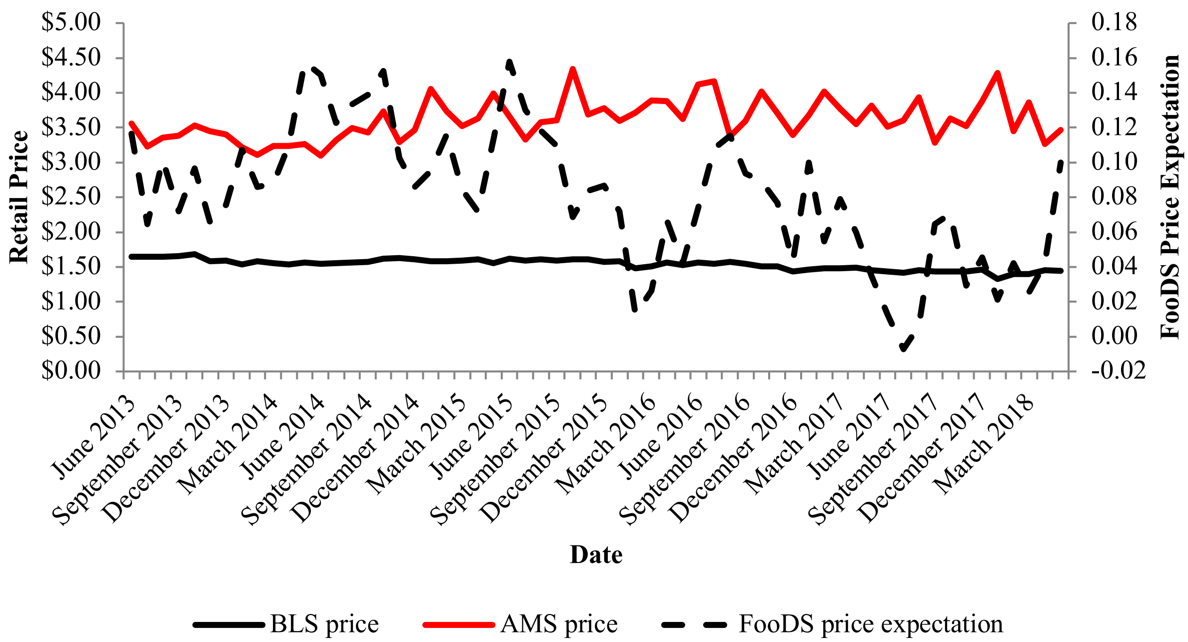


Figure A6. Chicken Wing BLS, AMS, and FooDS Price Expectations: June 2013–May 2018



To determine whether AMS prices are more appropriate leading indicators than FooDS price expectations, we conduct an orthodox test using the following model specification:

(A1) $$BLSPrice_{j,t} = \beta_{0,j} + \beta_{1,j}AMSPrice_{j,t} + \beta_{2,j}PE_{j,t} + \sum_{i=1}^{11}\varphi_{i,j}M_i + \varepsilon_{j,t}$$

because, like equation (2), we can define equation (A1) as a general model nesting two separate autoregressive models. These autoregressive models are

(A2) $$BLSPrice_{j,t} = \gamma_{0,j} + \gamma_{1,j}AMSPrice_{j,t} + \sum_{i=1}^{11}\varphi_{i,j}M_i + \epsilon_{j,t}$$

(A3) $$BLSPrice_{j,t} = \alpha_{0,j} + \alpha_{2,j}PE_{j,t} + \sum_{i=1}^{11}\varphi_{i,j}M_i + v_{j,t}$$

where all variables are as previously defined and $AMSPrice_{j,t}$ represents the AMS retail price of good j at time t. After ensuring stationarity, accounting for and correcting autocorrelation and heteroskedasticity, and checking for seasonality, we conduct an orthodox test in which the following hypotheses are tested independently:

$H_{05}: \beta_{1,j} = 0 \; vs. H_{a5}: \beta_{1,j} \neq 0$, and

$H_{06}: \beta_{2,j} = 0 \; vs. H_{a6}: \beta_{2,j} \neq 0$.

Results are presented in the same manner as those regarding the relationship between BLS prices and FooDS price expectations. Table A2 indicates that all variables in all models estimating prices in levels are cointegrated, excluding pork chop. Thus, we take the first difference of BLS and AMS pork chop prices to ensure estimates associated with data are mean-reverting. Results indicate that positive autocorrelation is present in all meat price estimation models, except for pork chop, and heteroskedasticity is an issue for all equations. In turn, we estimate these models with maximum likelihood stepwise autoregression. Results in Table A2 indicate rejection of H_{06} when estimating chicken wing prices but failure to reject H_{05}. This suggests that FooDS chicken price expectations are leading indicators of chicken wing prices, while AMS chicken wing prices are not leading indicators. Furthermore, when estimating beef steak, ground beef, chicken breast, and ham prices along with pork chop price changes, we fail to reject both H_{05} and H_{06}. In other words, AMS prices and FooDS price expectations contain similar information. Table A3 shows estimates associated with equation (A2) and Table A4 shows estimates associated with equation (A3), when necessary.

Table A2. Relationship between BLS Prices, FooDS Price Expectations, and AMS Prices: Equation (A1)

Date	Beef Steak[a]	Ground Beef[a]	Chicken Breast[a]	Chicken Wing[a]	Pork Chop[b]	Ham[a]
β_0, constant	6.114***	4.011***	3.212***	1.498***	−0.034	4.047***
	(0.767)	(0.183)	(0.184)	(0.092)	(0.038)	(0.223)
β_1, AMS price	0.130	0.042	0.022	0.0004	-	0.0003
	(0.073)	(0.038)	(0.033)	(0.022)	-	(0.029)
β_1, first difference of AMS price	-	-	-	-	0.058	-
	-	-	-	-	(0.047)	-
β_2, FooDS price expectation	−0.241	0.074	0.208	0.537***	0.147	0.147
	(0.501)	(0.208)	(0.287)	(0.187)	(0.265)	(0.432)
φ_1, January	0.0001	−0.014	−0.032	−0.040**	−0.054	−0.031
	(0.047)	(0.019)	(0.026)	(0.016)	(0.047)	(0.035)
φ_2, February	0.038	0.009	−0.001	−0.019	0.017	0.019
	(0.061)	(0.025)	(0.034)	(0.022)	(0.046)	(0.048)
φ_3, March	0.098	0.019	0.040	−0.017	0.051	0.034
	(0.070)	(0.029)	(0.040)	(0.025)	(0.046)	(0.054)
φ_4, April	0.205**	0.040	0.042	0.007	0.075**	−0.061
	(0.077)	(0.031)	(0.043)	(0.027)	(0.037)	(0.059)
φ_5, May	0.165	0.003	−0.007	−0.023	0.028	−0.001
	(0.084)	(0.034)	(0.046)	(0.029)	(0.046)	(0.062)
φ_6, June	0.217**	0.020	−0.001	−0.004	0.009	0.050
	(0.087)	(0.035)	(0.047)	(0.029)	(0.048)	(0.063)
φ_7, July	0.204**	0.024	−0.008	−0.003	0.081	0.058
	(0.082)	(0.033)	(0.045)	(0.029)	(0.046)	(0.062)
φ_8, August	0.203**	0.044	0.022	0.012	0.042	0.114
	(0.080)	(0.031)	(0.043)	(0.028)	(0.037)	(0.060)
φ_9, September	0.177**	0.061**	0.033	0.007	0.013	0.151***
	(0.072)	(0.029)	(0.041)	(0.026)	(0.046)	(0.055)
φ_{10}, October	0.124	0.022	0.048	0.018	−0.015	0.159***
	(0.062)	(0.025)	(0.035)	(0.022)	(0.046)	(0.035)
φ_{11}, November	0.046	0.016	0.012	0.014	−0.011	0.049
	(0.048)	(0.019)	(0.025)	(0.016)	(0.046)	(0.035)
Autocorrelation coefficients						
$\rho_{j,t-1}$	−0.987***	−1.113***	−0.953***	−0.883***	-	−0.921***
	(0.021)	(0.035)	(0.052)	(0.071)	-	(0.054)
$\rho_{j,t-6}$	-	0.162***	-	-	-	-
	-	(0.034)	-	-	-	-
Diagnostic statistics						
Engle–Granger cointegration test	−5.472***	−5.054***	−4.655***	−4.566***	−6.648	−4.476**
Durbin–Watson test[c]	0.876***	1.207***	0.438***	0.481***	1.648	0.917***
White's test[c]	40.960***	31.120***	38.910***	39.350***	44.730***	39.920***
$\varphi_1 = \varphi_2 = \cdots = \varphi_{10} = \varphi_{11} = 0$	1.280	1.340	1.190	1.340	1.890	2.620**
R^2	0.332	0.280	0.240	0.343	0.354	0.392

Notes: Double and triple asterisks (**,***) represent significance at the 0.05 and 0.01 levels, respectively. Numbers in parentheses are standard errors. F-value test statistics are shown for the joint hypothesis autocorrelation tests.
[a] Model(s) are estimated in levels (N=60).
[b] Model estimating price changes. In other words, the dependent variable(s) are in first difference form ($N = 59$).
[c] Test conducted prior to maximum likelihood stepwise autoregression estimation.

Table A3. Relationship between BLS Prices and AMS Prices: Equation (A2)

Date	**Beef Steak**[a]	**Ground Beef**[a]	**Chicken Breast**[a]	**Pork Chop**[b]	**Ham**[a]
β_0, constant	6.128***	4.022***	3.195***	−0.023	4.075***
	(0.772)	(0.178)	(0.224)	(0.032)	(0.216)
β_1, AMS price	0.124	0.044	0.032	-	−0.002
	(0.071)	(0.037)	(0.038)	-	(0.029)
β_1, first difference of AMS price	-	-	-	0.062	-
	-	-	-	(0.046)	-
φ_1, January	−0.004	−0.013	−0.028	−0.051	−0.029
	(0.046)	(0.019)	(0.027)	(0.047)	(0.035)
φ_2, February	0.038	0.009	−0.001	0.016	0.017
	(0.061)	(0.025)	(0.028)	(0.046)	(0.048)
φ_3, March	0.099	0.018	0.038	0.050	0.032
	(0.069)	(0.028)	(0.031)	(0.047)	(0.055)
φ_4, April	0.202**	0.040	0.043	0.078**	−0.059
	(0.076)	(0.031)	(0.033)	(0.036)	(0.060)
φ_5, May	0.161	0.004	−0.002	0.031	0.001
	(0.083)	(0.033)	(0.035)	(0.046)	(0.062)
φ_6, June	0.209**	0.022	0.012	0.011	0.049
	(0.084)	(0.034)	(0.035)	(0.048)	(0.063)
φ_7, July	0.204**	0.024	−0.003	0.083	0.060
	(0.081)	(0.033)	(0.034)	(0.046)	(0.063)
φ_8, August	0.199**	0.045	0.030	0.045	0.118
	(0.079)	(0.030)	(0.033)	(0.036)	(0.060)
φ_9, September	0.173**	0.063**	0.041	0.017	0.155***
	(0.071)	(0.028)	(0.032)	(0.046)	(0.055)
φ_{10}, October	0.121	0.024	0.056**	−0.011	0.162***
	(0.061)	(0.024)	(0.027)	(0.046)	(0.047)
φ_{11}, November	0.051	0.015	0.012	−0.011	0.048
	(0.046)	(0.019)	(0.026)	(0.046)	(0.035)
Autocorrelation coefficients					
$\rho_{j,t-1}$	−0.988***	−1.113***	−0.581***	-	−0.936***
	(0.021)	(0.034)	(0.150)	-	(0.111)
$\rho_{j,t-2}$	-	-	−0.393**	-	-
	-	-	(0.152)	-	-
$\rho_{j,t-3}$	-	-	-	-	0.014
	-	-	-	-	(0.112)
$\rho_{j,t-6}$	-	0.163***	-	-	-
	-	(0.033)	-	-	-
Diagnostic statistics				-	
$\varphi_1 = \varphi_2 = \cdots = \varphi_{10} = \varphi_{11} = 0$	1.280	1.380	1.630	1.970	2.620**
R^2	0.328	0.279	0.295	0.351	0.391

Notes: Double and triple asterisks (**,***) represent significance at the 0.05 and 0.01 levels, respectively. Numbers in parentheses are standard errors.

[a] Models are estimated in levels ($N = 60$).

[b] Model estimating price changes. In other words, the dependent variable(s) are in first difference form ($N = 59$).

Table A4. Relationship between BLS Prices and FooDS Price Expectations: Equation (A3)

Date	Beef Steak[a]	Ground Beef[a]	Chicken Breast[a]	Chicken Wing[a]	Pork Chop[b]	Ham[a]
β_0, constant	6.908***	3.974***	3.300***	1.499***	−0.049	4.048***
	(0.675)	(0.272)	(0.137)	(0.042)	(0.028)	(0.119)
β_2, FooDS price	−0.067	0.198	0.220	0.536***	0.322	0.147
expectation	(0.503)	(0.266)	(0.285)	(0.181)	(0.236)	(0.423)
φ_1, January	−0.027	−0.019	−0.037	−0.040**	−0.069**	−0.031
	(0.046)	(0.024)	(0.025)	(0.016)	(0.030)	(0.035)
φ_2, February	0.017	0.004	−0.006	−0.019	0.030	0.019
	(0.061)	(0.032)	(0.034)	(0.021)	(0.030)	(0.046)
φ_3, March	0.112	0.023	0.038	−0.017	0.042	0.034
	(0.071)	(0.038)	(0.039)	(0.025)	(0.030)	(0.053)
φ_4, April	0.220***	0.038	0.039	0.007	0.060**	−0.061
	(0.078)	(0.041)	(0.043)	(0.027)	(0.026)	(0.058)
φ_5, May	0.206**	−0.0001	−0.010	−0.023	0.024	−0.001
	(0.083)	(0.044)	(0.045)	(0.028)	(0.030)	(0.061)
φ_6, June	0.256***	0.013	−0.002	−0.004	0.022	0.046
	(0.086)	(0.045)	(0.046)	(0.029)	(0.032)	(0.062)
φ_7, July	0.237***	0.016	−0.008	−0.003	0.071**	0.058
	(0.081)	(0.043)	(0.045)	(0.028)	(0.030)	(0.061)
φ_8, August	0.242	0.039	0.021	0.012	0.038	0.114
	(0.079)	(0.042)	(0.043)	(0.027)	(0.027)	(0.059)
φ_9, September	0.200***	0.054	0.028	0.007	0.008	0.151***
	(0.072)	(0.038)	(0.040)	(0.025)	(0.031)	(0.054)
φ_{10}, October	0.148**	0.022	0.045	0.018	−0.010	0.159***
	(0.062)	(0.033)	(0.034)	(0.022)	(0.031)	(0.047)
φ_{11}, November	0.076	0.023	0.013	0.014	−0.024	0.049
	(0.046)	(0.024)	(0.025)	(0.016)	(0.030)	(0.034)
Autocorrelation coefficients						
$\rho_{j,t-1}$	−0.988***	−0.985***	−0.952***	−0.884***	-	−0.921***
	(0.020)	(0.018)	(0.051)	(0.070)	-	(0.053)
Diagnostic statistics						
$\varphi_1 = \varphi_2 = \cdots = \varphi_{10} = \varphi_{11} = 0$	0.163	0.790	1.230	1.410	3.900***	2.680***
R^2	0.284	0.166	0.233	0.343	0.509	0.392

Notes: Double and triple asterisks (**,***) represent significance at the 0.05 and 0.01 levels, respectively. Numbers in parentheses are standard errors.

[a] Models are estimated in levels ($N = 60$).

[b] Model estimating price changes. In other words, the dependent variable(s) are in first difference form ($N = 59$).

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"There's No Place Like Home": Inquiry into Preferences for Local Foods

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Abstract

Using a nationally representative survey of U.S. consumers, we analyze demographics, food shopping behaviors, and stated preferences and use logistic regressions to further explore local food preferences and perceptions of farmers' markets. When asked the definition of "local," the largest percentage of respondents (28%) selected that local meant "in their county of residence." Respondents assigned various qualities to farmers' markets, including freshness, healthiness, tastiness, and locally produced. Having higher income, the presence of a child in the household,

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reading packaging information, shopping for local food at the supermarket, and closer definitions of local all increased the probability of shopping at the farmers' market.

Keywords: best–worst scaling, consumer perceptions, definition of local, farmers' market, food retail, local foods

***Locavore (noun lo·ca·vore \ ˈlō-kə-ˌvȯr \)** – A person whose diet consists only or principally of locally grown or produced food.*

– Oxford American Dictionary

The local food movement has been known "formally" since the 1950s. However, policies promoting local foods and the popularity of the "buy local" movement have been increasing recently (Winfree and Watson, 2017). The *Oxford American Dictionary* chose the word "locavore" as the 2007 word of the year, citing two reasons why local food consumption was on the rise: (i) an increase in consumer concerns for human impact on the environment and (ii) the role consumers believed eating local foods could play in living an environmentally friendly lifestyle (Oxford University Press, 2007). Despite the rise in popularity, the definition of local is still ambiguous and may differ among consumers (Thilmany McFadden, 2015). Beyond the definition of local, the reasons behind its rise in popularity are important to consider. The attributes that people find important or preferable and influence decisions to purchase local foods can be used in marketing, while the decisions of grocery retailers and restaurants can be reflected in the use of local foods in business promotion and outreach.

Many have tried to define the ambiguous term "local" using distance measures such as miles or geopolitical boundaries such as U.S. states or regions. The 2008 Food, Conservation, and Energy Act defined local foods as those produced within a 400-mile radius or within the boundaries of the state where the food was being sold (Low et al., 2015). From a consumer perspective, Onozaka, Nurse, and Thilmany McFadden (2010) found that over 70% of survey respondents defined local as coming from within a 50-mile radius and considered a 300-mile radius more likely to be regional than local. Foods labeled as "produced within the state" in grocery stores take advantage of the idea that some consumers prefer knowing the location in which products are produced. Nganje, Hughner, and Lee (2011) referred to the Arizona Grown certification as locally grown in their survey instrument and found that respondents were willing to pay more for locally produced spinach (defined as produced within the state) compared to locally produced carrots. Based on these results, it is unclear whether defining local as produced within the state aligns with respondents' definition of local or if they were demonstrating a preference for products grown within their state of residence.

Regardless, willingness to pay for the locality of production may be product-specific. For example, Nganje, Hughner, and Lee (2011) hypothesized that consumers associated within-state production with food safety and were willing to pay more for that attribute in spinach (than in carrots) due to recent food safety concerns related to spinach. The attributes and values consumers associate with their definition of local foods are, therefore, variable and complex.

Local food is often associated with farmers' markets, community supported agriculture (CSA), and direct buying (Zepeda and Leviten-Reid, 2004; Dunne et al., 2011). The general assumption is that those selling food at a farmers' market also live and grow the items near the farmers' market (Zepeda and Leviten-Reid, 2004). However, the rise in popularity of local products has meant that brick and mortar retailers also advertise the sale of local foods (Dunne et al., 2011). Additionally, many restaurants boast of serving food sourced locally, and the practice appeared on lists of restaurant trends for multiple years (Sharma, Moon and Strohbehn, 2014). An abundance of attention has been placed on various aspects of local food markets, including locally grown, locally produced, and even discussions about sourcing (Martinez, 2010). While none of these labels or claims are necessarily synonymous, consumers' perceptions of these statements deserve further study. When the farmer who actually produced (not just procured) the food is not physically available to answer questions regarding its production, the perceived definition of local food is an increasingly important marketing signal to consumers. Additionally, restaurants and brick and mortar retailers can use knowledge about the reasons why people seek out local foods to promote local wares without having the producer available to answer questions. Furthermore, it is possible that the attributes consumers associate with local foods can be met by nonlocal foods, such as environmentally friendly production practices, and retailers may choose to advertise non–locally produced food differently.

This analysis seeks to help close the gap in the literature by contributing to the definition of local, as seen or perceived by a nationally representative group of consumers, and to further understand the perceptions surrounding food (including local food) procurement both in the supermarket and in farmers' market settings. By analyzing demographics, food shopping behaviors, stated preferences, and the use of logistic regression focused on local food procurement, this work further explores local food preferences and perceptions of shopping at farmers' markets.

Methods

Survey Instrument

An online survey was launched on July 10, 2017, and closed on July 19, 2017. A total of 1,200 surveys were completed by U.S. household members during this data collection period. The survey was conducted using Qualtrics, and respondents were obtained through Lightspeed GMI, which maintains an opt-in panel. By using Qualtrics quotas, the survey was targeted to be nationally representative in terms of gender, age, income, region of residence, and education (U.S. Census Bureau, 2016). Questions were designed to help understand the relationship between households' demographic characteristics and their perceptions of local food. Regions of residence were as defined by the U.S. Census Bureau.[1] For all variables of interest, including shopping behaviors and preferences and household demographics, frequencies were calculated for categorical variables while means were calculated for continuous variables.

[1] Northeast (Connecticut, Maine, Massachusetts, New Hampshire, New Jersey, New York, Pennsylvania, Rhode Island, Vermont), Midwest (Indiana, Illinois, Iowa, Kansas, Michigan, Minnesota, Missouri, Nebraska, North Dakota, Ohio, South Dakota, Wisconsin), South (Alabama, Arkansas, Delaware, District of Columbia, Florida, Georgia, Kentucky, Louisiana, Maryland, Mississippi, North Carolina, Oklahoma, South Carolina, Tennessee, Texas, Virginia, West Virginia), and West (Alaska, Arizona, California, Colorado, Hawaii, Idaho, New Mexico, Montana, Nevada, Oregon, Utah, Washington, Wyoming).

Shopping Behavior and Perceptions of Local Food

In addition to demographic information, the study included whether the respondent was the primary food shopper, shopping frequency, weekly spending, availability of food retailers near their home, and other shopping questions focused on local foods. Regarding local foods, respondents were shown a variety of statements and asked to indicate how limiting the statement was in purchasing local foods. Additionally, respondents were asked their level of agreement with statements regarding local foods, such as how often they purchased local foods, shopping behavior, and the level of importance assigned to various reasons for purchasing local foods.

No single definition of local foods is universally accepted; thus we did not provide a definition to respondents, in order to avoid introducing bias among respondents from given information (Martinez, 2010). Rather, we assumed that respondents approached questions related to local foods similarly to how they would approach the local label in a shopping setting—with their own interpretation of the word *local.* Studying focus groups in Wisconsin, Zepeda and Leviten-Reid (2004) found that most respondents indicated a definition of local as an amount of time traveled by vehicle. A smaller group of respondents indicated the definition of local using a political boundary such as states or counties. Following Byrd, Widmar, and Wilcox (2017), we asked respondents to indicate their interpretation of local in terms of distance from their home. Respondents were presented with options to select from, including: i) my county of residence, ii) my county and neighboring counties, iii) 100 miles or less from my home, iv) my state of residence, v) the United States, vi) other, and vii) I don't know.

Logit Models

To further analyze the relationship between demographic characteristics and two specific shopping behaviors—purchasing local foods at the store and shopping at farmers' markets—we used two independent logit models to estimate the probability that a respondent would purchase local foods at the store or shop at a farmers' market. For the local foods model, the dependent variable took a value of 1 if the respondent shopped for local foods, and 0 otherwise. For the farmers' market model, the dependent variable took a value of 1 if the respondent shopped at the farmers' market, and 0 otherwise. All respondents were included in both models. For comparison purposes, the same independent variables, which included demographics and shopping behaviors, were used in both models, with one exception. Shopping at a farmers' market was included as an independent variable in the model of shopping for local foods at the store, and shopping for local foods at the store was included as an independent variable in the model of shopping at farmers' markets. The models allowed for (i) a flexible relationship between shopping at the farmers' market and shopping for local foods at the store, and (ii) the coefficient to be either negative or positive depending on the relationship between the independent and dependent variables. We hypothesized that respondents who shopped at farmers' markets were also likely to shop for local foods when making purchases at the store. Conversely, we hypothesized that those who shop for local foods when making purchases at the store were also likely to shop at farmers' markets. The coefficients of logit models are not directly interpretable, so we calculated marginal effects. The utility (V_{nj}) of either purchasing local foods at the store or shopping at farmers' markets takes the form

(1) $$V_{nj} = \beta' x_{nj} + e_{nj},$$

where x_{nj} is the vector of observed variables that relate to choice j for respondent n and e_{nj} is the unobserved error term (Train and Weeks, 2005). Observed variables for the model of respondents who shopped for local foods at the store were all dummy variables that took the value 1 (0 otherwise) and included female, age 55 or older, having a child in the household, usually or always reads information on food packaging before making purchasing decisions, looks at a display in a store to determine whether the food is local, shops at the farmers' market, definition of local food is within the county of residence, definition of local food is within 500 miles, definition of local is within the United States, resident of the Northeast, resident of the South, and resident of the Midwest. The observed variables for the model of farmers' market shoppers were identical to those in the model of those who shopped for local foods at the grocery store, with the exception of the inclusion of the variable that the respondent shopped for local food at the store and the exclusion of the variable that the respondent shopped at the farmers' market. The error term was assumed to be an independently and identically distributed Type I extreme value. Following Train and Weeks (2005), the logit probability (P_{ni}) for respondent n and attribute i becomes

(2) $$P_{ni} = \frac{e^{\beta' x_{ni}}}{\sum_j e^{\beta' x_{nj}}}.$$

Results and Discussion

Table 1 presents survey respondents demographic information and a comparison to U.S. Census Bureau data. There were 1,200 completed responses to the survey, and most categories were comparable to the population represented in the U.S. Census Bureau data, with the exception of region of residence, where there were 17% fewer respondents from the South and 17% more respondents from the Midwest, compared to U.S. Census targets. Other demographic information was derived from asking respondents to summarize eating behaviors with respect to vegetarian or vegan diets: 5% of respondents considered themselves vegetarian, while 4% considered themselves vegan. These results were similar to the findings of a Gallup Poll in which 4% of respondents were vegetarians and 2% of respondents were vegan (Gallup, 2012). 4% of respondents reported having a vegetarian household member, while 3% reported that a household member followed a vegan diet. The frequency of food shopping ranged from daily (6%) to monthly (8%), with the most frequent responses being weekly (43%) and twice weekly (26%).[2] Only 2% of respondents said that they did not know how much they spent in total on food each week, while 12% indicated they spent less than \$50 weekly, 29% selected \$50–\$99, 28% selected \$100–\$149, 15% selected \$150–199, 8% selected \$200–\$249, 4% selected \$250–\$299, and 2% selected \$300 or more. In a nationally representative survey of U.S citizens, Morgan et al. (2017) found that a high percentage of respondents (relative to other categories) spent \$51–\$100 (34%) and \$101–\$200 (30%) per week on food. Similarly, a higher percentage of respondents in this study selected \$50–\$99 or \$100–\$149 as the amount they spent weekly on food.

[2] "I don't know" was provided as an option but was not selected by any respondents; 6% of households indicated they shopped daily, 26% twice weekly, 43% weekly, 15% every other week, 8% monthly, and 2% never.

Table 1. Demographic Variables (N = 1,200)

Variable	Percentage of Respondents	Percentage of U.S. Census
Gender		
Male	49%	49%
Age		
18–24	10%	13%
25–34	18%	18%
35–44	17%	16%
45–54	18%	17%
55–65	17%	17%
65 +	20%	19%
Income		
$0–$24,999	23%	22%
$25,000–$49,999	25%	23%
$50,000–$74,999	18%	17%
$75,000–$99,999	12%	12%
> $100,000	21%	26%
Education		
Did not graduate from high school	3%	13%
Graduated from high school, did not attend college	26%	28%
Attended college, no degree earned	25%	21%
Associates or bachelor's degree earned	32%	27%
Graduate or professional degree earned	14%	12%
Region		
Northeast	18%	18%
South	38%	21%
Midwest	21%	38%
West	24%	24%

Perceptions of Local Food and Shopping Behavior Results

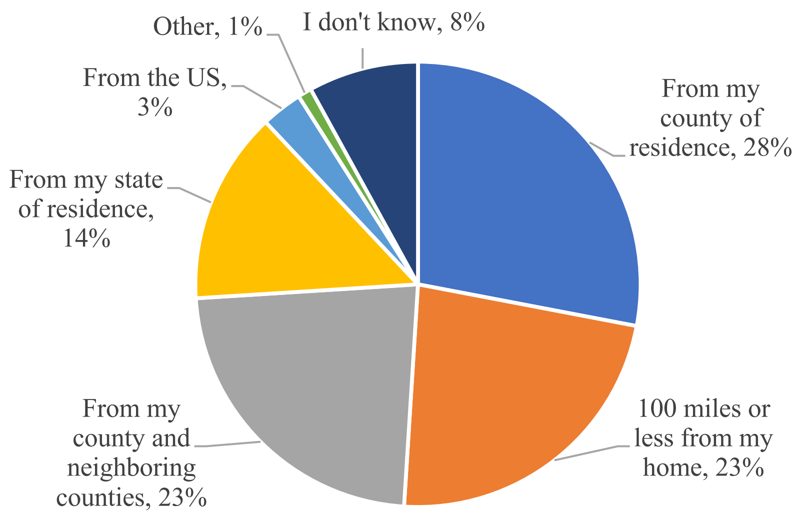
People form their perceptions of an issue based on their frame of reference, which is influenced by convictions, values, norms, knowledge, and interests (Te Velde, Aarts, and Van Woerkum, 2002). To better understand shopping practices within the sample, respondents were asked a series of questions about their food buying behavior. The majority of respondents (88%) indicated they were the primary food shopper in their households, and 63% indicated they purchased food from farmers' markets, roadside stands, and U-pick operations. Although the majority of respondents indicated they were the primary shopper, there is no way to verify this information. Even though the respondent may not truly be the primary shopper, they clearly believe that they either influence or execute food purchasing decisions for their household.

Respondents were asked about the food shopping location closest to their home to develop an understanding of the options present in the respondents' marketplaces. The shopping places least frequently selected as closest to the respondents' homes were community supported agriculture (CSAs) (1%), farm/farm stand (3%), community or home garden (3%), specialty/gift store (1%), natural food store (3%), and other (2%). The majority of respondents indicated that the closest food shopping location was a traditional supermarket (67%). Those making weekly shopping trips may be more likely to choose a farmers' market, considering an increased length of driving may be more easily accomplished when only shopping weekly compared to daily. This is further supported considering that 63% of respondents reported purchasing from a farmers' market, roadside stand, or U-pick operation, even though only 3% of respondents had those options closest to their home. In total, 68% of respondents indicated they purchased food labeled as "local" or "locally produced" in a grocery store, while 10% indicated they did not purchase such items, and 22% indicated that they did not know whether they did. Beyond the grocery store, 57% of respondents indicated they tended toward options not normally found at home when traveling. This desire for unique products when traveling and dining out may be useful information for those who plan and design restaurant menus and special advertising.

Respondents were asked additional shopping behavior questions related to the information they read on the food they purchased. A higher percentage of respondents indicated they always (21%), usually (31%), or sometimes (30%) read information on food packaging when making purchasing decisions compared to those who indicated rarely (13%) or never (6%). Respondents indicated checking for specific information about food origin less frequently than they reported looking at packaging. In total, 5% of respondents reported they always checked food origin, while 14% said they did so most of the time, 16% said about half the time, 16% said less than half the time, 24% said rarely, 19% said never, and 6% reported that they did not know. Many production attributes such as food origin and other production practices are credence attributes that cannot be directly discerned without reading label information. If consumers want to purchase locally produced items, the labels indicating that information need to be easy for the consumer to find, since few respondents indicated they actively look for information on food origin.

When asked to select their definition of local from a list of provided options, 28% of respondents indicated that local meant from their county of residence (Figure 1). In a nationally representative survey, Byrd, Widmar, and Wilcox (2017) asked respondents about their definition of local, offering options of 10, 20, 50, or 100 miles, and within the state. Given the options, respondents more frequently selected options that were closer to their homes: 75% of respondents selected less than 50 miles as local and 58% selected less than 20 miles. Onozaka, Nurse, and Thilmany McFadden (2010) found that most respondents labeled food from within the state as regional rather than local. In our study, 14% of respondents chose their state of residence as the definition of local. As a definition of local, only the United States had fewer respondents (not including "other" and "I don't know"). Given that counties vary in size, it is unclear which is closer, "100 miles or less from my home" or "my county of residence." However, in general, more people selected closer options as their definition of local as opposed to their state and the United States.

Figure 1. Respondents' Definitions of Local Food ($N = 1{,}200$)



Despite only 3% of respondents indicating a farm/farm stand was the closest shopping place to their home, and 7% indicating a farmers' market was closest to their home, 63% of respondents had previously purchased from a farmers' market, roadside stands, and U-pick operations. A large percentage of respondents (68%) indicated they purchased food in a grocery store that is labeled as "local" or "locally" produced; 50% of respondents had both purchased food from a farmers' market, roadside stand, or U-pick operation, and purchased food in a grocery store labeled as "local" or "locally" produced. Factors associated with purchasing local foods were presented to respondents and they were asked to indicate whether the factor was very limiting, moderately limiting, or not limiting to purchasing local food (Table 2). Unavailability and limited selection, seasonality, price, and inconvenient farmers' market days or times were selected as very limiting by 22%, 27%, 23%, and 19% of respondents, respectively.

Respondents were also asked to indicate which attributes were better at a farmers' market compared to the supermarket. They were given the options of "yes," "sometimes," and "no" (Table 2). A high percentage of respondents indicated farmers' markets ranked higher in terms of freshness (55%), healthiness (39%), tastiness (43%), and locally produced (50%). Respondents were asked to indicate, in terms of "strongly disagree" to "strongly agree," their level of agreement regarding local food statements including "local food is more expensive than other food," "local food should be organic," "local food tastes better," and other statements as listed in Table 3. Across all statements, a high percentage of respondents indicated they neither agreed nor disagreed; however, a higher percentage of respondents selected agreement over disagreement. Local vegetables and fruit were purchased "weekly or more often," more frequently than the other categories studied. Further research could evaluate whether this is a function of availability at farmers' market or consumer demand.

Respondents were asked to respond to various shopping statements with "yes," "sometimes," or "no" (Table 3). "No" and "sometimes" were selected by 32% and 30% of respondents for the statement "someone close to me consciously eats local foods." For the statements "someone close

Table 2. Respondents' Perceptions of Local Foods (N = 1,200)

Limiting Factors for Purchasing Local Foods	Very Limiting	Moderately Limiting	Not Limiting
Unavailability and limited selection	22%	38%	22%
Seasonality	27%	41%	17%
Uncertain of production location	12%	27%	37%
Price	23%	37%	27%
Farmers' market days or times are inconvenient	19%	34%	29%
Congestion/parking at farmers' market	13%	27%	41%
Time required for preparation of foods	9%	22%	51%
Lacking knowledge to prepare local foods	9%	21%	53%
Lacking transportation to market location	11%	17%	56%
Lacking storage capacity or refrigeration for large quantity purchases	13%	27%	45%
Variety	11%	33%	41%
Customer service	7%	22%	53%
Market location	16%	31%	38%
Market appearance	7%	25%	52%
Lack of regulation	9%	22%	49%
Food safety	13%	26%	45%
Preparation time	10%	21%	54%
Unattractive packaging	7%	19%	55%
Product quality	15%	27%	43%

Attributes Which Are Better at Farmers' Market than Supermarket	Yes	Sometimes	No
Freshness	55%	31%	4%
Healthiness	39%	36%	10%
Tastiness	43%	39%	6%
Locally produced	50%	32%	5%

Note: The option "I Don't Know" has been removed from the table for brevity. The percentage of respondents can be calculated by subtracting the percentages of the other options from 100%.

to me shops at farmers' markets" and "I find food at farmers' markets that cannot be founds at supermarkets," 33% and 43% of respondents (respectively) selected "sometimes." "No" was selected by 58%, 43%, and 58% of respondents (respectively) regarding the statements "I have my own personal garden," "I shop with family at the farmers' market," and "I shop with friends at the farmers' market."

Item attributes were also important to respondents. Respondents were asked to indicate on a Likert scale (from 1 = extremely important to 6 = not sure/don't know) the importance they attributed to each reason for purchasing local foods. The lowest mean response was for quality (1.75), indicating respondents found quality more important than the other reasons to purchase local foods

Table 3. Respondents' Beliefs regarding and Purchasing Behavior of Local Foods ($N = 1,200$)

Statement regarding Local Foods	Strongly Agree	Agree	Somewhat Agree	Neither Agree nor Disagree	Somewhat Disagree	Disagree	Strongly Disagree
Local food is more expensive than other food	10%	18%	24%	34%	9%	3%	2%
Local food should be organic	11%	17%	16%	39%	9%	5%	4%
Local food tastes better	13%	22%	23%	36%	3%	2%	1%
I like to know who produces the food I eat	13%	18%	23%	32%	8%	4%	2%
Purchasing local food is better for the environment	14%	25%	22%	33%	3%	2%	1%
Purchasing local food is more nutritious	11%	18%	22%	40%	4%	3%	1%
I try new foods when I shop at local food sources	10%	18%	23%	31%	10%	5%	3%
Shopping for local food is more enjoyable	12%	20%	20%	37%	5%	6%	2%

How Often Local Foods Are Purchased	More than Once a Week	Once a Week	Once a Month	Once Every 2 Months	3–5 Times a Year	Once a Year
Vegetables	10%	29%	21%	8%	15%	17%
Fruits	9%	27%	21%	8%	17%	18%
Honey	4%	4%	11%	8%	13%	60%
Meat	6%	19%	15%	6%	9%	45%
Seafood	4%	10%	13%	6%	4%	63%
Baked Goods	5%	19%	19%	8%	13%	36%
Water and other Beverages	9%	16%	11%	4%	5%	55%

Statement regarding Shopping Behaviors	Yes	Sometimes	No	I Don't Know
Someone close to me consciously eats local foods	20%	30%	32%	18%
Someone close to me shops at farmers' markets	27%	33%	26%	14%
I have my own personal garden	24%	14%	58%	4%
I shop with family at the farmers' market	20%	33%	43%	4%
I shop with friends at the farmers' market	13%	25%	58%	4%
I find food at farmers' market that cannot be found at supermarket	20%	43%	20%	17%

(Table 4). Zepeda and Leviten-Reid (2004) found that among reasons for shopping at farmers' markets, participants most frequently cited freshness and flavor. The second lowest mean response was for "more nutritious" (2.32), again indicating respondents found that nutrition was a more important reason for purchasing local foods than most other reasons. "Meeting/knowing the producer" had the largest mean response (3.69), which indicated this was the least important reason to purchase local foods. Other less important categories were "organically produced" (3.16) and "lessens environmental impact" (2.87). Similarly, using a Likert scale from 1 (strongly agree) to 5 (strongly disagree), respondents in the study conducted by Adams and Adams (2011) had a mean score of 4.17 in response to the statement "buying local produce can help support farm workers." This mean response was second (indicating disagreement) only to the statement "the production of local fruits and vegetables is great for the environment" (4.40) (Adams and Adams).

Logit Model Results

We used a logit model to better understand the relationship between respondents who shopped for local foods at the store, demographics, and shopping behavior (Table 5). Gender was not a statistically significant explanatory factor in shopping for local foods at the store. Respondents age 55 and older were 5% more likely (probabilistically) to shop for local foods at the store compared to younger respondents. If respondents usually or always read the information on food packaging when making a purchasing decision, they were 15% more likely to shop for local foods at the store. Beyond just reading information, if the respondent specifically looked at a display in the store to determine whether the food was local, they were 24% more likely to shop for local foods at the store. If the respondent shopped at the farmers' market, the probability that they shopped for local foods at the store increased by 26%. Respondents' definition of local foods was also a statistically significant predictor of shopping for local foods at the store. If the respondent defined local as within 500 miles of their home, the probability of shopping for local foods at the store increased by 11%. If they defined local as their state of residence, the probability of shopping for local at the store increased by 10%.

Similarly, we used a logit model to determine the relationship between demographics, shopping behavior, and shopping at the farmers' market (Table 5). Having an income over $50,000 increased the probability of shopping at the farmers' market by 6%. Having a child in the household increased the probability of shopping at the farmers' market by 8%. If the respondent usually or always read information on food packaging when making purchasing decisions, the probability of shopping at the farmers' market increased by 8%. Further, if a respondent looks at store displays to determine whether food is local, the probability that they shop at the farmers' market increased by 14%. If the respondent shopped for local food at the store, their probability of shopping at the farmers' market increased by 29%. However, having a definition of local that is within the county of residence increased the probability of shopping at the farmers' market by 10%. The probability of shopping at the farmers' market decreased by 9% if the respondent defined local as within their state of residence and by 22% if the respondent defined local as within the United States. Being a resident of the Northeast increased the probability of shopping at the farmers' market by 9%.

Interestingly, gender was also not a statistically significant explanatory variable for shopping at farmers' markets. Age was a statistically significant predictor of shopping for local foods at the store, but not for shopping at the farmers' market. In a national survey, Zepeda and Li (2006) found

Table 4. Importance of Purchasing Local Foods (N = 1,200)

	Extremely Important (1)	**Very Important (2)**	**Moderately Important (3)**	**Slightly Important (4)**	**Not at All Important (5)**	**Not Sure/Don't Know (6)**	**Mean Response**
Reasons to Purchase Local Foods	Percentage of Respondents						
Lessens environment impact	16%	27%	27%	18%	10%	3%	2.87[a]
Meeting/knowing the producer	9%	16%	16%	22%	31%	6%	3.69[b]
More nutritious	27%	35%	25%	9%	3%	2%	2.32[c]
Organically produced	16%	20%	23%	17%	21%	3%	3.16_d
Quality	47%	39%	10%	3%	0%	1%	1.75[e]
Price compared to non-local	22%	33%	28%	10%	4%	2%	2.49[f,g]
Product variety	20%	35%	30%	10%	3%	1%	2.45[f]
Supports local agriculture	20%	33%	27%	14%	4%	2%	2.58[g,h]
Supports local economy	21%	32%	26%	15%	3%	3%	2.55[g,h]
Sustainability	19%	31%	29%	11%	7%	3%	2.65[h]

Note: Within the table, matching letters indicate the mean response for those reasons to purchase local foods are not statistically different. For example, both price compared to non-local and product variety have an f, indicating they are not statistically different. However, product variety and supports local agriculture do not have matching letters, which indicates they are statistically different.

Table 5. Logit Model of Respondents Shop for Local Foods at the Store and Respondents Shop at the Farmers' Market ($N = 1,200$)

	Respondents Shop for Local Foods at the Store				Respondents Shop at the Farmers' Market			
Variable	**Coeff.**	**Std. Err.**	***p*-value**	**Marginal Effect**	**Coeff.**	**Std. Err.**	***p*-value**	**Marginal Effect**
Female	0.22	0.14	0.115	0.04	-0.16	0.13	0.216	-0.04
Age 55 or older	0.27	0.16	0.085	0.05	0.22	0.15	0.142	0.05
Income above $50,000	0.18	0.14	0.189	0.04	0.28	0.13	0.035	0.06
Respondent has a child in the household	0.26	0.18	0.147	0.05	0.34	0.17	0.044	0.08
Respondent usually/always reads information of food packaging in making purchasing decisions	0.75	0.14	<0.001	0.15	0.37	0.14	0.008	0.08
Respondent looks at a display in a store to determine if the food is local	1.21	0.25	<0.001	0.24	0.62	0.20	0.002	0.14
Respondent shops at the farmers' market	1.28	0.14	<0.001	0.26	–	–	–	–
Respondent shops for local food at the store	–	–	–	–	1.29	0.14	0.000	0.29
Respondent defines local as within the county of residence	0.29	0.18	0.103	0.06	0.46	0.17	0.008	0.10
Respondent defines local as within 500 miles	0.56	0.19	0.004	0.11	0.12	0.18	0.502	0.03
Respondent defines local as within their state of residence	0.48	0.22	0.029	0.10	-0.38	0.20	0.06	-0.09
Respondent defines local as within the U.S.	0.48	0.43	0.264	0.10	-0.98	0.39	0.013	-0.22
Resident of the Northeast	-0.04	0.22	0.847	-0.01	0.39	0.21	0.063	0.09
Resident of the South	-0.22	0.18	0.239	-0.04	-0.02	0.17	0.922	-0.00
Resident of the Midwest	-0.28	0.21	0.175	-0.06	0.32	0.20	0.101	0.07
Constant	-1.00	0.23	<0.001		-0.99	0.22	<0.001	

that most demographics—including gender, age, education, race, and religion—were not statistically significant indicators of local purchases. Conversely, having an income above $50,000 was a statistically significant predictor of shopping at the farmers' market. The role of income in explaining local buying may not be surprising, considering a higher percentage of respondents indicated price was a very limiting factor when shopping for local foods. Concern for price significantly decreased the probability of purchasing local foods. Additionally, Thilmany McFadden (2015) indicated that local foods were often associated with higher prices, which some customers were willing to pay, depending on the channels they commonly used to purchase produce.

Having a child in the household increased the probability the respondent shops at the farmers' market but not that they shop for local foods at the grocery store. Winfree and Watson (2017) found that farmers' markets are associated with increased social capital and amenities within communities that have farmers' markets. This increase in social capital and amenities could be desirable for families with children, increasing the frequency of visits to farmers' markets by families with children. Sallis and Glanz (2006) found that people who have access to safe places such as walkable neighborhoods and local markets that offer healthy food are more likely to be active and eat healthful foods. Several studies show the impact of gardening on children, including indicators such as increasing the consumption of vegetables and improving other life skills (Bir et al., 2017; Davis and Brann, 2017; Miller, 2007; Nimmo and Hallett, 2008; Robinson and Zajicek, 2005). It is possible that similar effects could be found when children participate in farmers' markets, and further research could explore this idea.

Unsurprisingly, shopping at a farmers' market increased the probability of shopping for local foods at the store and shopping for local foods at the store increased the probability of shopping at a farmers' market, indicating that consumer concern for local food transcends shopping location. Respondents' definition of local affects the probability that they shop for local foods at the store and the probability that they shop at farmers' markets. Defining local food as that produced within 500 miles or within the state of residence increased the probability that the respondent shopped for local food at the store. For shopping at the farmers' market, defining local as within the county of residence led to a positive increase in the probability of shopping at the farmers' market. However, as the definition of local became broader, the probability of shopping at the farmers' market decreased. If the respondent had a very broad view of local food, they probably believe most of the food they consume is local and do not feel the need to frequent a farmers' market.

Conclusion

The term local is not easily defined, and the interpretation of local varies among consumers. More often, people believe the definition of local to be smaller than within the entire state, when compared to a broader interpretation of local that encompasses country of origin. This finding corresponds with those of Byrd, Widmar, and Wilcox (2017) and Onozaka, Nurse, and Thilmany McFadden (2010), who also found that respondents chose the closer option as their definition of local. The surge of campaigns promoting food items and products produced within the state is further supported by the finding that many consumers consider local as within the state for at least some products, such as the Arizona grown campaign discussed by Nganje, Hughner, and Lee (2011). Although most consumers did not have a farmers' market as the closest option for food shopping, many consumers still shopped at farmers' markets. The enjoyment of shopping at farmers' markets, or the positive attributes many respondents associated with items purchased at farmers' markets, seems to be enough for consumers to overcome distance inconveniences. Additionally, consumers more frequently selected their shopping frequency as weekly, which may reduce the distance inconveniences associated with shopping locales.

Respondents also assigned many positive qualities to food from local sources, including freshness, healthiness, tastiness, and locally produced, similar to the positive attributes respondents ascribe to farmers' markets and local sources in other studies (Zepeda and Leviten-Reid, 2004; Adams and Adams, 2011). Factors that were considered very limiting with respect to local foods were selection, seasonality, and inconvenient market days or times. The attributes associated with local foods, such as quality and nutrition, may not be limited to local foods. If retailers selling nonlocal foods can demonstrate the quality and nutritional value of their food, they may be able to increase sales. Surprisingly, attributes often closely associated with local foods, such as "organically produced" and "lessens environmental impact," were not as important to respondents.

This research contributes to the definition of local (foods) and attempts to shed light on shopping behaviors related to local food beliefs and/or preferences. Fundamentally, respondents who had more tightly defined interpretations of local were more likely to shop at farmers' markets. Further research regarding the distance from farmers' markets that people believe the products to be produced may increase the understanding of the relationship between the definition of local and farmers' market shopping behavior. Additionally, respondents with preferences for local foods often purchased them from both brick and mortar stores and farmers' markets. Surprisingly, respondents were willing to drive to farmers' markets even though they were not the closest grocery option.

Although the desire to purchase local foods can be met by brick and mortar stores, farmers' markets appear to provide additional value to consumers, beyond the products themselves. Intuition would point to meeting/knowing a producer as a reason for the popularity of farmers' markets, but this was found to be the least important reason to purchase local foods. More research could be done to evaluate consumer shopping time and preferences for farmers' markets beyond frequency, and this information could be used to better tailor farmers' market hours of operation. Respondents with higher income, children, and those who read packaging information were more likely to shop at farmers' markets. Although reading package information is likely attributed to greater interest in credence attributes, the connection between farmers' markets and children is less clear. Further research into reasons for frequenting farmers' markets with children, including incorporating child-friendly activities or child-friendly shopping environments may aid in informing food marketplaces of the future.

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Eliciting Consumer Preference and Willingness to Pay for Mushrooms: A Latent Class Approach

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Abstract

As consumer demand for food labeling becomes increasingly important, producers and retailers can include various labeling to attract new customers. This study investigates Connecticut consumers' preferences and willingness to pay for mushrooms marketed with various labels using a latent class approach to identify classes within the market. Results reveal three market segments (price/GMO-label, locally/organically grown, and traditional mushroom varieties). Overall, only a third of consumers valued the "locally grown" or "organic" labels, so charging a premium for these labels might alienate a majority of consumers. Finally, GMO labeled mushrooms are discounted, but the non-GMO label receives little value.

Keywords: choice experiment, food labeling, latent class model

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Introduction

In 2016, the United States was the third largest producer of mushrooms in the world (839 million pounds),[1] behind China (15.5 billion pounds) and Italy (1.4 billion pounds) (Food and Agriculture Organization of the United Nations, 2016). The U.S. mushroom industry ranked fourth among vegetables and other crops' cash receipts in 2016, after potatoes, lettuce, and tomatoes (U.S. Department of Agriculture, 2018a). Per capita mushroom availability increased 15% from 2006–2007 to 2016–2017 (U.S. Department of Agriculture, 2018a). Currently, mushroom demand is near its highest-ever level (2.93 lb. per capita in 2016–2017), but it has stagnated over the last 5 years, hovering between 2.7 to 3 lb. per capita (U.S. Department of Agriculture, 2018b). Most of the demand is met with domestic production; however, imports have increased continuously over the past decade, making up 13% of per capita use in 2016–2017 compared to only 9% in 2000–2007. The increase in the share of imports on per capita use amounts to potentially over 41 million lb., or over $54 million in lost sales by domestic firms (calculated using data from U.S. Department of Agriculture, 2017).

The loss in sales to imports is not due to loss of production, as U.S. mushroom production has increased by 18% since 2006–2007. Rather, increased imports are the result of mushroom demand outstripping supply. However, as demand stagnates and production levels off, the market should return to intense competition for customers as large production areas throughout the world strive to increase sales within the U.S. market. For this reason, U.S. producers and retailers need to identify effective marketing strategies (e.g., locally grown, organic, and genetically modified organism [GMO] free labeling] as well as mushroom varieties that consumers value. As noted by *The Packer* (2017), sales of exotic varieties continue to increase.

Within the U.S. mushroom industry, the *Agaricus* category (e.g., "white button" and brown mushrooms like "cremini" and "portabella") represented 97% of sales by volume in 2016–2017, an increase of 16% since 2010 (U.S. Department of Agriculture, 2017). Increasing demand can be attributed to a number of factors, including new promotions, increased use by restaurants, and different product varieties (*The Packer,* 2016). In the United States, shiitake mushrooms have been identified as the third most preferred mushroom after white button (*Agaricus*) and portabella (brown *Agaricus*) in the retail, wholesale, and food service industry (Onianwa, Wesson, and Wheelock, 2000; Augostini, 2002; Technomic, 2005). Specialty mushrooms, such as shiitake and oyster, have seen sales increase by 67% since 2010 (U.S. Department of Agriculture, 2017). As demand has grown faster than supply, prices have risen by 48% for specialty and only 10% for *Agaricus* mushrooms. The volume of sales, and price in particular, for shiitake has increased by 74% and 41%, respectively (U.S. Department of Agriculture, 2017). Furthermore, specialty mushrooms were on average three times the price of Agaricus ($3.78/lb. compared to $1.25/lb. in 2016–2017) (U.S. Department of Agriculture, 2017). This price difference might be explained by production processes (e.g., the need for controlled room) and the length of time required to grow specialty versus *Agaricus* or due to specialty mushrooms being seen as a higher-end product, thereby garnering a price premium.

[1] The Food and Agriculture Organization of the United Nations categorizes all varieties of mushroom and truffle production.

This study investigates Connecticut consumers' preferences and willingness to pay (WTP) for various mushroom types using a latent class approach to identify market segments. Given the potential for increased mushrooms production in Connecticut, this study examines the drivers of white button, brown, and specialty mushroom demand by looking at consumers' preferences for various product attributes, such as growing region, organic certification, and presence of genetic modification. Furthermore, we compare consumer preference for popular *Agaricus* mushrooms with the specialty shiitake mushroom. With respect to industry contribution, we present marketing implications that highlight how producers and retailers can tailor their marketing strategies to capture heterogeneous consumers within the market. Further, consumer valuation of a GMO label and whether a class exists that would not have negative preference for this production practice is discussed.

Several studies have examined issues within the global mushroom market. Gold, Cernusca, and Godsey (2008) used a nationwide survey of shiitake mushroom producers and provided detailed production information (revenue, longevity, type of products, start-up costs) as well as marketing strategies (branding, communication, retail outlet). Regarding marketing research, Gold, Cernusca, and Godsey (2008) outlined the production side, while Mattila, Suonpää, and Piironen (2000) described the nutritional and medicinal benefits. However, only a few studies have examined determinants of mushroom demand (Augostini, 2002; Lucier, Allshouse, and Lin, 2003), and even fewer studies have evaluated demand for specialty mushrooms (Onianwa, Wesson, and Wheelock, 2000; Gold, Cernusca, and Godsey, 2008). Outside of varietal preference, no study has examined the role of marketing strategies, such as labeling (e.g., locally grown, organic and GMO-free) on consumer preference for mushrooms even, though certain types of labeling has been shown to have increasing popularity among some U.S. consumers (Thilmany, Bond, and Bond, 2008; Adams and Salois, 2010; James, Rickard, and Rossman, 2009; Yue and Tong, 2009; Bernard and Bernard, 2010; Onozaka and McFadden, 2011; Onken, Bernard and Pesek, 2011; Campbell et al., 2014).

Materials and Methods

In an online survey administered in June/July 2015, 760 Connecticut consumers answered questions about their purchasing habits of specialty vegetables and mushrooms, including a choice experiment on several vegetables and mushrooms. The overarching goal of the project was to better understand Connecticut consumers' perceptions and valuations of various labels across several vegetables and mushrooms. Respondents were from the online panel of Global Market Insite, Inc. (GMI) (Lightspeed Research, Warren, NJ). Potential respondents from GMI's database were randomly sent an invitation to participate in the survey. Respondents that agreed to participate, were 18 years or older, had purchased fresh vegetables or mushrooms during the last year completed the survey, and resided in Connecticut were allowed to participate in the survey.

After meeting all requirements, respondents were randomly assigned to a vegetable or mushroom choice experiment. This paper focuses on respondents randomly selected into the mushroom choice experiment. The survey was administered to Connecticut residents for several reasons, notably due to the funding agency's interest in the Connecticut market. Furthermore, unlike many other states, Connecticut strictly defines local as "produced within the state or 10 miles from the point of purchase" (Connecticut Department of Agriculture, 2018).

A total of 200 consumers were randomly selected to complete the mushroom choice experiment, with 145 providing complete responses. The survey sample was representative of the Connecticut population with respect to age, race, household income, and persons per household (Table 1). Further, our sample matched the dispersion of residents throughout the state, with 80% of our sample being urban/suburban compared to U.S. census estimates of 88% (U.S. Census Bureau, 2012). Women were oversampled, which is unsurprising given that it has been reported that women are the primary household shoppers (Private Label Manufacturers Association, 2013). A caveat to our analysis is that our sample appears to be representative to the Connecticut population, but there is no way to 100% ensure it is representative. Based on the fact that our sample

Table 1. Descriptive Statistics of the Explanatory Variables Used in the Latent Class Model

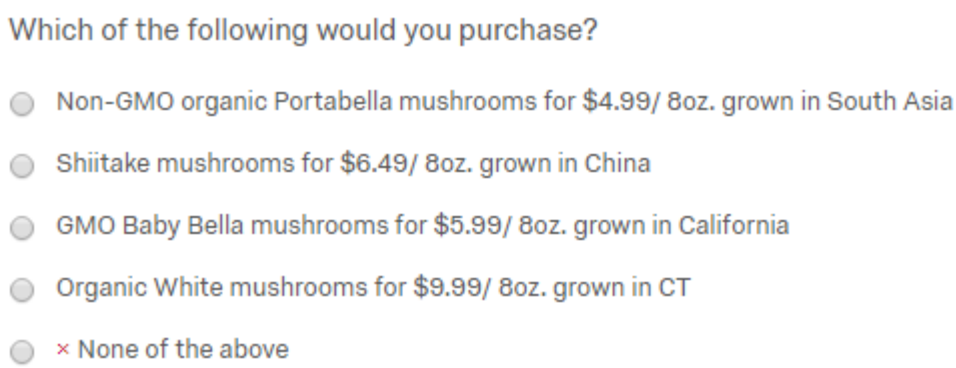
	Sample		Connecticut
Variable	**Mean**	**St. Deviation**	**Mean**
Mean income ($)	72,390	49,356	–
Median ($)	73,083		71,755[a]
Mean age	51.3	15.3	–
Median	51		41[a]
Children per household	1.30	0.49	–
Adults per household	2.17	0.90	–
Male	0.36	0.48	0.51
Caucasian	0.85	0.36	0.80
Location			
Metro	0.21	0.41	0.88[b]
Suburban	0.59	0.49	–
Rural	0.20	0.40	0.12
Food Neophobia Scale (FNS)	28.6	10.8	–
Mushroom experience			
Portabella	0.76	0.43	–
Shiitake	0.60	0.49	–
GMO Questions			
GMOs Safe (1 = yes)	0.15	0.36	–
GMO Issues (1 = long-term health issues)	0.25	0.43	–
No. of respondents	145		
No. of obs. (145 respondents × 10 sets × 5 products)	7,250		

[a] Mean age is not provided, so we provide the median Connecticut age provided by the U.S. Census Bureau (2012); however, the median age includes residents under 18 years of age, which is not directly comparable to our sample. The number of children/adults per household in Connecticut could not be found; however, average persons per household in Connecticut was 2.56 in 2012–2016 (U.S. Census Bureau, 2018). Income is inflation adjusted to 2016 dollars (U.S. Census Bureau, 2018).
[b] The U.S. Census Bureau includes urban and suburban together.

demographics are similar to the Connecticut population demographics, we believe that our results are generalizable to all Connecticut residents. Further, our results are generalizable to the U.S. population to the extent that Connecticut respondents in our sample share similar beliefs as the U.S. population.

Before beginning the choice experiment, each respondent was told to act as though they were in a real purchase situation and reminded to keep their budget constraint in mind. Respondents were then told that each product they evaluated would be an 8 oz. container of mushrooms. Each respondent was presented with ten choice sets consisting of four choices and an option to choose "none of the above." The choice sets and products with each choice set were randomized between respondents to help limit respondent fatigue. The optimal number of choice sets was determined based on the D-efficiency criterion (Kuhfeld, 2010). Each product within a choice set was specified as an 8 oz. package of mushrooms with varying attributes presented in the form of text describing the attributes comprising the product (Figure 1).

Figure 1. Example of a Choice Set Used in the Survey



The attributes included in the choice experiment included mushroom variety, price, origin, production type, and information on GMO content (Table 2). Attributes (and attribute levels) were chosen based on observations of mushroom packaging in retail stores throughout Connecticut as well as past literature on vegetables. Notably, in retail stores, price, origin, organic, and variety are generally provided to consumers. GMO was included due to the increasing focus on GMO labeling throughout the United States and the potential for GMOs to be introduced in mushrooms.

Table 2. Attributes and Levels Included in the Choice Experiment

Price ($)	Mushroom type	Label	Location produced	Production type
4.99	Portabella	GMO	Connecticut	Organic
5.99	Baby bella	Non-GMO	California	Not organic
6.99	Shiitake	No label	United States	
7.99	White mushroom		South Asia	
9.99			China	

Four mushroom varieties were included in the choice design, including white mushrooms, portabellas, baby bellas, and the specialty shiitake mushrooms. Prices varied within a range of \$4.99 to \$9.99 per 8 oz. package to incorporate the dispersion of prices found in various Connectict grocery stores at the time of the survey. Mushroom origin specified the location of production, including Connecticut, California, United States, China, and South Asia. The "Connecticut" label was the local label (as defined by Connecticut law). Use of the "California" and "United States" labels represented domestic products, while "China" and "South Asia" represented imported products. China was included due to the size of their production volume, while South Asia was included given their increasing volume of production. California was chosen given their production volume and their reputation for being a major agricultural producer.

Organic and GMO labeling are becoming increasingly important. In 2015, organic and non-GMO food sales outpaced overall store sales at Whole Foods by 54% (Schweizer, 2015). U.S. organic food sales topped \$47 billion in 2017, was up 6.4% from 2016 (Organic Trade Association, 2018). In 2016–2017, certified organic sales of all mushrooms represented 8% of total mushroom sales (U.S. Department of Agriculture, 2017). Reasons for purchasing organic generally focus on environmental and safety concerns (Ritson and Oughton, 2007; Essoussi and Zahaf, 2008), with numerous studies finding that consumers are willing to pay a premium for organically produced foods (Batte et al., 2007; Campbell et al., 2010). To capture consumer preference and WTP for organic, we included an organically grown label or provided no information. We did not provide any other information about the definitions of organic, as most retail stores do not provide this type of information.

Currently, there are no USDA-approved GMO mushroom varieties available on the market, though mushrooms that have been gene edited are moving toward the consumer market (Waltz, 2016). Even though no GMO-approved mushroom varieties are currently available, there has been a move by states to mandate GMO labeling of foods and businesses to utilize non-GMO labeling to ensure consumer awareness regarding their product. For instance, several states in the United States have passed laws requiring specific labeling restrictions on genetically modified (GM) foods, including Connecticut (in 2013), Maine (in 2013), and Vermont (in 2014). However, in 2016 the United States passed the National Bioengineered Food Disclosure Law establishing a U.S. standard for labeling GMO products while also nullifying the state laws (Jaffe, 2017). Past studies have reported that consumer WTP declines when a food is labeled as genetically modified (Huffman et al., 2003; Loureiro and Hine 2004; Hu, Veeman, and Adamowicz, 2005; Lusk et al., 2005; Dannenberg, 2009; Lewis, Grebitus, and Nayga, 2016; McFadden and Lusk, 2017) and that mandatory GM labeling can act as a market barrier, preventing GM products from reaching supermarket shelves (Carter and Gruère, 2003). To evaluate consumer preference and WTP for GMOs, we utilized labeled mushrooms in the study as GMO, non-GMO, or no information was provided. We did not provide any other information about the definitions of GMO, as most retail stores do not provide this type of information.

Econometric Model

To account for potential heterogeneity in consumer taste and preferences, we used a Latent Class Model (LCM) to analyze our survey data (Boxall and Adamowicz, 2002; Greene and Hensher, 2003). The LCM postulates that individual behavior depends on observable attributes and on latent heterogeneity that varies with factors that are unobserved by the analyst (Greene and Hensher, 2003). In LCMs, the population of respondents is divided into a set number of classes, or groups, with varying preferences such that, although groups are different from each other, all members of the same group share the same parameters. We used Bayesian Information Criteria (BIC) to determine the number of consumer groups (Table 3). The unobserved heterogeneity is then captured by these latent classes in the population, which are associated with different parameter vectors in the model.

Table 3. Summary of Latent Class Models up to Five Classes

Classes	LL[a](K)	BIC[b]	CAIC[c]
2	−1447.54	3084.20	3122.20
3	−1382.50	3083.51	3147.51
4	−1324.03	3095.97	3185.97
5	−1270.91	3119.13	3235.13

Note: Estimation is based on 7,250 choices from $N = 145$ survey participants.
[a] LL is the log-likelihood values at the convergence. K is the number of parameters.
[b] BIC is Bayesian Information Criteria, calculated as $-2 \times \text{LL} + [K \times \ln(N)]$.
[c] CAIC is Consistent Akaike Information Criteria, calculated as $-2 \times \text{LL} + [\ln(N) + 1] \times K$.

The LCM is based on Random Utility theory, in which consumer i's utility, conditional on class s, from choosing product j can be presented by

$$(1) \qquad U_{ij|s} = X_j \beta_s + \epsilon_{ij|s},$$

where X_j represents the vector of product attributes [e.g., mushroom varieties, production location, production technology used (organic and GMO), and price]; β_s represents class-specific taste and preferences, and $\epsilon_{ij|s}$ is the error term that is conditionally *i.i.d.* extreme value type 1 within class. The unconditional probability that consumer i is sorted in class s based on socio-demographic characteristics is given by

$$(2) \qquad P_{is} = \frac{\exp(\theta_s Z_i)}{\sum_s \exp(\theta_s Z_i)},$$

where Z_i represents the socidemographic characteristics of consumer i and θ_s is a parameter vector that determines the probability of class membership. After a consumer i is assigned to their most probable class, the probability of consumer i choosing product j is found by

$$(3) \qquad P_{ij|s} = \frac{\exp(\mu_s X_j \beta_s)}{\sum_s \exp(\mu_s X_j \beta_s)},$$

where μ_s is the scale parameter for class s and is normalized to 1. Finally, the joint probability of a consumer i in class s choosing product j is given by

$$(4) \qquad P_{ijs} = P_{ij|s} \times P_{is} = \frac{\exp(\mu_s X_j \beta_s)}{\sum_s \exp(\mu_s X_j \beta_s)} \times \frac{\exp(\theta_s Z_i)}{\sum_s \exp(\theta_s Z_i)}.$$

Equation 4 is used to estimate the class-specific utility and class probability parameters using maximum likelihood estimation method. Previous studies have shown that race, sex, income, age and household composition are important determinants of mushroom consumption (Lucier, Allshouse, and Lin, 2003; Jiang et al., 2017; Boin and Nunes, 2018). In our model, in addition to the above-mentioned factors, the class membership equation includes living areas (metro, suburban, and rural), an index of food neophobia, previous purchasing behavior for shiitake and portabella mushrooms, and safety and health perceptions of GMO products. Food neophobia is defined as a "reluctance to eat" unfamiliar foods (Dovey et al., 2008). Pliner and Hobden (1992) developed a Food Neophobia Scale (FNS) consisting of a survey of five positive and five negative statements regarding food consumption. Participants respond to the 10 questions on a seven-point Likert scale ranging from "strongly disagree" to "strongly agree." A lower score on the FNS represents low neophobia, implying those participants are more likely to try new food and food technology. Regarding the purchasing behavior, participants were asked whether and how frequently they bought portabella or shiitake mushrooms. Participants were also asked about their perceptions regarding GMO products, whether the participants considered GMO to be safe, and whether GMO caused long-term health issues.

LCM coefficients were used to calculate consumer WTP for each group:

$$WTP_j = -\left(\frac{\beta_j}{\beta_{price}}\right), \tag{5}$$

where β_j is the estimated coefficient for each attribute j and β_p is the estimated coefficient for the price attribute. We used the delta method in STATA to obtain 95% confidence intervals for the WTP estimates.

Results and Discussion

Regarding respondents' mushroom purchasing behavior, it is worth highlighting the lack of familiarity with shiitake mushrooms. About 40% of the respondents had never purchased shiitake mushrooms, compared to only 24% for portabella mushrooms (Table 1). Among those who had purchased shiitake at least once, about 67% shopped at large chain grocery stores, while only a small fraction, about 12%, shopped at a farmers' market. Of the shiitake purchases, almost 56% were produced locally, and 27% were imported from East Asia. Potential consumers of shiitake (about 11% of our sample) were interested in purchasing but had never purchased, due to "not being able to purchase locally grown" as their main concern for not buying shiitake mushrooms. Consumers were also concerned about shiitake being "too expensive."

Results from latent class analysis reveal three classes with varying preferences in the market for the four types of mushrooms. From Table 4, we see that all the classes have significant and negative coefficients associated with the "none" option, which reflects the fact that a respondent experienced an increase in utility level from making a product choice other than the "none" option. Consistent with economic theory, we find negative coefficients with respect to the "price" attribute. The attribute is significant for all three classes. A negative and significant coefficient indicates that the respondents prefer a lower price for their products to a higher price.

Table 4. Latent Class Model Results

	Class 1 Price and GMO Sensitive Class		Class 2 Labeling Oriented Class		Class 3 Traditional Mushroom Buyer Class	
% share	34.70%		37.20%		28.10%	
Parameter estimates						
Baby bella	0.347	(1.04)	−0.214	(−0.85)	0.568**	(2.72)
Portabella	−0.127	(−0.31)	−0.190	(−0.79)	0.505*	(2.45)
Shiitake	−0.454	(−1.21)	−0.254	(−0.95)	−0.003	(−0.02)
GMO	−0.921**	(−2.84)	−1.431***	(−4.54)	0.007	(0.03)
Non-GMO	−1.109*	(−2.33)	−0.234	(−1.01)	0.042	(0.24)
Connecticut	0.168	(0.50)	0.959***	(4.93)	−0.107	(−0.54)
South Asia	−1.183**	(−2.78)	−2.224***	(−5.44)	−0.999***	(−4.05)
China	−2.792***	(−4.21)	−2.877***	(−5.95)	−0.637**	(−2.89)
California	−0.751**	(−2.84)	−0.621**	(−2.71)	−0.221	(−1.18)
Organic	0.038	(0.13)	0.726***	(3.55)	0.069	(0.38)
Price	−1.538***	(−7.88)	−0.515***	(−6.22)	−0.399***	(−6.83)
None option	−8.953***	(−6.81)	−5.270***	(−6.75)	−5.487***	(−7.52)
Class membership equation						
Age	0.048***	(3.29)	0.019	(1.31)		
Male	−0.952	(−1.69)	−0.497	(−0.85)		
White	−0.041	(−0.06)	−0.574	(−0.87)		
Household adults	0.273	(0.99)	−0.201	(−0.69)		
Household kids	0.020	(0.03)	−0.614	(−0.99)		
Metro	0.195	(0.23)	0.118	(0.12)		
Suburban	−0.667	(−1.16)	−0.051	(−0.09)		
Income	0.000	(0.86)	0.000	(1.62)		
FNS	−0.024	(−1.17)	−0.048*	(−2.32)		
GMO perceived as safe	0.408	(0.60)	−0.802	(−1.05)		
GMO causes long term health issues	0.280	(0.45)	0.389	(0.63)		
Experience with shiitake	−0.485	(−0.82)	1.467*	(2.25)		
Experience with portabella	0.072	(0.10)	−1.835**	(−2.58)		
Constant	−1.673	(−1.44)	2.405*	(2.18)		

Notes: Single, double, and triple asterisks (*, **, ***) indicate significance at the 10%, 5%, and 1% level, respectively. Numbers in parentheses are *t*-statistics.

Latent Class One: Price and GMO Sensitive Class

Latent class one makes up 34.7% of the sample. The magnitude of class one's price coefficient implies that this class is more price sensitive than classse two and three. Consumers in class one showed no preference across mushroom varieties. Interestingly, class one consumers did not have a preference for locally labeled (i.e., Connecticut grown) mushrooms compared to mushrooms marketed with a generic label of "produced in the U.S." However, this group of consumers showed a significant negative preference toward products imported from China and Southeast Asia as well as mushrooms grown in California. The disutility is higher for imported labels compared to the

California label. This group of consumers was also sensitive to the GMO label in their purchase decisions, as indicated by the negative and significant coefficients for both the GMO and non-GMO labeled mushrooms. This result is important given GMO mushrooms are moving toward being available on the consumer market (Waltz, 2016) and new labeling requirements for GMO foods. Class one consumers showed no preference toward organically produced mushrooms. With respect to the class membership equation, class one tended to be made up of older consumers and have fewer male household members compared to class three (Table 4).

Latent Class Two: Labeling Oriented Class

Latent class two includes 37.2% of the sample (Table 4). Class two consumers are distinguished from the other classes by the positive and significant coefficient for the “Connecticut” attribute, implying that this group has a direct preference for locally grown products. Consumers in class two prefer Connecticut-grown mushrooms compared to those grown elsewhere, consistent with other studies that used stated preference methods to estimate the WTP for locally grown food (Brown, 2003; Giraud, Bond, and Bond, 2005; Thilmany, Bond, and Bond, 2008; Carpio and Isengildina-Massa, 2009; Yue and Tong, 2009; Grebitus, Lusk, and Nayga, 2013). Among the origins, South Asia and China were the least preferred, followed by California. Consumers in class two preferred an organically grown label compared to no label. Similar to class one consumers, class two consumers also showed a negative preference toward a GMO label compared to the baseline of “no label” product, and the magnitude of the coefficient associated with the GMO label is higher than that of class one. With respect to the mushroom varieties, class two consumers also did not show any preference toward any specific variety, similar to class one consumers.

Demographically, class two has a lower FNS score compared to class three, implying that class two consumers are relatively more willing to try new food products and food technologies. This group also has more experience purchasing shiitake mushrooms and less experience purchasing portabella mushrooms compared to class three consumers. Overall, it is worth stressing that although some of the consumers did have previous purchasing experience of shiitake mushrooms, they showed no preference toward shiitake mushrooms compared to traditional white button or brown mushrooms.

Latent Class 3: Traditional Mushroom Buyer Class

Latent class three consists of 28.1% of our sample. Consumers in class three showed a preference toward purchasing portabella and baby bella mushrooms compared to the baseline product (the white button variety). Similar to the other two classes, class three consumers also showed a dislike for imported mushrooms. Overall, class three consumers’ purchase decisions were not influenced by production methods, be they organic or GMO. Demographically, this group of consumers are younger and have more male household members than class one consumers. Class three consumers have more purchasing experience with portabella mushrooms and less experience with shiitake mushrooms compared to class two consumers. This group also has higher income compared to class two members, which is borderline significant (p-value = 0.105). Class three consumers have a higher FNS score compared to class two consumers, consistent with the fact that class three consumers showed a significant preference toward more traditional mushroom varieties like baby bella and portabella. We also find a negative preference for shiitake mushrooms for class three, but the coefficient is not statistically significant.

Willingness to Pay

Table 5 presents the mean WTP estimates for each class. Only class three consumers are willing to pay a premium of $1.42 and $1.27 per 8 oz. package for baby bella and portabella mushrooms, respectively. Regarding the GMO attributes, consumers of both classes one and two discounted mushrooms with an explicit GMO label, $0.60 for class 1 and $2.78 for class two. This discount differential could indicate that more class one consumers perceive GMO to be safe and not cause long-term health effects, although those factors were not statistically significant in the class membership equation. Among production method attributes, only class two consumers are willing to pay a premium of $1.40 for mushrooms with an “organic” label.

Regarding origin attributes, class two consumers are willing to pay a premium of $1.86 for an 8 oz. package of mushrooms grown in Connecticut. Consumers of all classes discounted mushrooms grown outside Connecticut. For example, for class one consumers the retailers need to discount the price by $0.48–$1.81 for mushrooms produced in California, South Asia, and China. The discount is higher for class two and class three consumers, $1.20–$5.58 for class 2 and $0.55–$2.50 for class three.

Conclusions

It is important for producers and retailers to identify their consumer base to make critical production and marketing decisions. We elicited consumer WTP for various labels that could be used to market and to sell mushrooms in the United States, including organic, local, and non-GMO labels. Based on the results of this study, stakeholders in the mushroom industry can adapt their marketing strategies to capture heterogeneous consumers at farmers’ markets, restaurants, gourmet groceries, and other specialized outlets.

We find three distinct classes in the market for popular *Agaricus* and specialty mushrooms among Connecticut consumers of mushrooms. Consumers of class two (“label-oriented class”), about 37.2% of the sample, are willing to pay a significant premium for organic and local (Connecticut-grown) labeled products, with the latter bringing in a higher premium in our results. This finding is consistent with previous studies, in which a “local” label was worth more than an “organic” label to consumers (Hu, Woods, and Bastin, 2009; Yue and Tong, 2009; Costanigro et al., 2011; Hu et al., 2011; Onozaka and McFadden, 2011). Consumers of all three classes showed an indirect preference for local (Connecticut-grown) products in terms of not being willing to pay a higher price for imported products or mushrooms grown in California. Consumers of classes one and two showed a negative preference for an explicit GMO label. This finding is important as it shows that, despite USDA approval of GM foods, many U.S. consumers still want their produce to be free of any GMO content. Overall, our results show that if mushrooms were appropriately labeled either “locally grown” or “organic,” producers and retailers could increase their mark-up for a select group of consumers. Notably, mushroom producers and retailers that targeting our label-oriented class should focus on promoting their mushrooms as locally grown given the preference for local mushrooms. With respect to firms preemptively labeling mushrooms as non-GMO, we find that

Table 5. Willingness-to-Pay Estimates from the Latent Class Model Results.

	Class 1	**(CI)**	**Class 2**	**(CI)**	**Class 3**	**(CI)**
Baby Bella	0.226	(−0.206, 0.692)	−0.415	(−1.415, 0.581)	1.426**	(0.361, 2.767)
Portabella	−0.082	(−0.554, 0.508)	−0.368	(−1.256, 0.594)	1.268**	(0.234, 2.502)
Shiitake	−0.295	(−0.721, 0.172)	−0.494	(−1.527, 0.516)	−0.009	(−1.057, 1.144)
GMO	−0.599***	(−1.007, −0.184)	−2.777***	(−4.294, −1.599)	0.016	(−0.878, 1.152)
Non-GMO	−0.721***	(−1.162, −0.126)	−0.454	(−1.147, 0.535)	0.105	(−0.686, 1.071)
Connecticut	0.109	(−0.329, 0.486)	1.861***	(1.090, 3.245)	−0.270	(−1.317, 0.768)
South Asia	−0.769**	(−1.486, −0.197)	−4.317***	(−6.292, −2.812)	−2.505***	(−3.897, −1.187)
China	−1.815	(−2.509, −1.116)	−5.585***	(−7.545, −4.050)	−1.597***	(−2.892, −0.514)
California	−0.488***	(−0.851, −0.142)	−1.206***	(−2.083, −0.347)	−0.555	(−1.450, 0.394)
Organic	0.025	(−0.349, 0.342)	1.408***	(0.621, 2.546)	0.173	(−0.652, 1.109)

Notes: CI = confidence interval. *, **, ***Significant at the 0.1, 0.05, and 0.01 levels, respectively.

there was little advantage compared to no information being provided about the product. This finding indicates that producers and retailers should not concentrate on GMO-related labels, as consumers most likely assume no label means non-GMO.

We also find that Connecticut consumers do not have a preference for specialty mushrooms, like shiitake, compared to more traditional mushrooms. According to our study, producers and retailers selling shiitake mushrooms, and perhaps other specialty mushrooms, should focus their efforts on locally grown and organic (class two) consumers to receive price premiums, which tended to have lower FNS scores and more experience with shiitake mushrooms. Further, class three (traditional mushroom buyers) should most likely be avoided, as they prefer baby bella and portabella mushrooms. Class two (price and GMO sensitive) may offer a market for shiitake mushrooms, but educational efforts are most likely needed given this class has less experience with shiitake mushrooms.

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Produce Buyer Quality Requirements to Form an Eastern Broccoli Industry

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Abstract

We used an online survey to examine the broccoli quality requirements of East Coast wholesale and retail buyers. Buyers exhibit strong preferences for broccoli attributes such as dark green color, small bead size, and uniform heads. Buyers demand the same high quality standards for both locally grown and West Coast–grown broccoli. Natural food resellers are more open to different product conditions in local broccoli. They could be the most approachable buyers for broccoli grown in the East Coast. These results could serve as the basis for future research regarding produce buyers' preferences for locally grown produce.

Keywords: broccoli, buyer preferences, local food, logit regression

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Introduction

Fresh broccoli is one of the major fresh vegetable crops, with a utilized production of 22 million cwt in 2016, valued at $838 million, similar to that of cabbage (U.S. Department of Agriculture, 2017). Although broccoli consumption is widespread throughout the United States, more than 85% of production occurs in California (U.S. Department of Agriculture, 2017; Atallah, Gómez, and Björkman, 2014). According to the U.S. Department of Agriculture (2015),

> The ongoing drought in California is likely to have a major impact on the State's agricultural production. Long-term moisture deficits across most of the State remain at near record levels. Because California is a major producer in the fruit, vegetable, tree nut, and dairy sectors, the drought has potential implications for U.S. supplies and prices of affected products this year and beyond.

Monterey County, which accounts for 40% of total U.S. broccoli production (Le Strange et al., 2010), has also been one of the hardest hit areas by the drought (U.S. Department of Agriculture, 2015), creating concerns about supply reliability due to unexpected production disruptions in California from droughts and floods and supply chain disruptions due to the long length of the supply chain.

To diversify broccoli supplies, the USDA funded the East Coast Broccoli Project to support the production and marketing of high-quality East Coast–grown broccoli as a supplement to West Coast supplies. The project encompasses the development of broccoli strains suitable for the East Coast climate, farmer recruitment, and infrastructure development to establish an East Coast broccoli industry (Björkman, 2011).

Strain development is fundamental to establishing the East Coast broccoli supply. Nearly all broccoli strains were developed to mature under California conditions and cannot be grown in most areas of the East Coast (Björkman, 2011). Weather conditions particular to the East Coast provide an exceptional problem for strain development: Hot, humid East Coast summers can cause structural abnormalities, including deformities that prevent the development of high-quality broccoli heads (Björkman and Pearson, 1998). Heads develop poorly when temperatures during bud development routinely exceed 30ºC, causing uneven bud growth, which produces uneven bead size and uneven heads (Björkman and Pearson). We tested whether buyers would accept local, East Coast broccoli varieties, which do not have the bud and head uniformity and other quality traits exhibited by California-grown broccoli.

The new, Eastern-grown strains have been tested with consumers and demonstrated potential for price premiums in the East Coast market (Fan et al., 2015). Demand for locally grown food is increasing, driven not only by rising concerns about transportation costs and sustainability (Björkman, 2011) but also by perceptions of increased freshness and other quality factors and social factors (such as helping local farmers and local communities). Research on other fruit and vegetable products has found higher consumer demand and increased WTP for local produce (Carpio and Isengildina-Massa, 2009; Meas et al., 2015; Thilmany McFadden, 2015).

Given strong consumer demand, the key to promoting Eastern broccoli lies in expanding production as well as marketing new products. Direct marketing channels, such as farmers' markets, are historically important channels for local produce, but research has shown that the growth of direct marketing channels has plateaued. Most of the sales growth of local produce is from intermediated grocery channels (Low et al., 2015; Thilmany McFadden, 2015; Richards et al., 2017). To build a scalable industry, Eastern-grown broccoli needs to go beyond direct marketing channels and approach intermediated grocery retailers, such as supermarkets (King, Gómez, and DiGiacomo, 2010). Although large supermarket distribution systems typically prefer to source from a few, large-scale suppliers to minimize cost, several national and regional supermarket chains have successfully sourced and marketed local food produced during local production seasons (King, Gómez, and DiGiacomo). Supermarkets can use local foods to create a sense of connection between consumers and local producers and build a more intimate relationship with local consumers (King, Gómez, and DiGiacomo). With expanded Eastern broccoli production and a well-coordinated regional supply chain, opportunity exists for an Eastern-broccoli industry to increase the supply to large-scale supermarkets and achieve economies of scale.

It is worth investigating preferences of produce buyers from large intermediaries, the gatekeepers to the grocery store shelves, and better understand their quality requirements for local broccoli. We conducted an online survey to shed light on produce buyers' willingness to pay a premium and their quality requirements for locally grown broccoli compared to nonlocal broccoli. We also explored buyers' most preferred product conditions for various product attributes. We explored whether certain types of buyers would have different quality standards or behaviors. Despite the small sample size, the results could be a useful basis to structure future hypotheses on produce buyers' preferences because the buyers we reached procured produce for companies representing about 50% of the grocery market on the East Coast.

Literature Review

Many researchers have gauged local produce marketing success by surveying consumers. Darby et al. (2006) found that consumers were willing to pay up to $1.17 more per carton for locally grown strawberries. Loureiro and Hine (2002) discovered that although consumers were willing to pay more for locally grown potatoes in Colorado, that premium was linked to higher product quality. In South Carolina, consumers indicated willingness to pay an average premium of 27% for produce grown in-state, despite many not being able to detect quality differences (Carpio and Isengildina-Massa, 2009). Meas et al. (2015) found that consumers in Ohio and Kentucky would pay premiums for blackberry jam identified by more specific geographical designations, such as substate regions and the Ohio Valley, indicating a preference for a clearer definition of "local" produce.

Various studies have demonstrated that consumers tend to associate "locally grown" with higher product quality and social contribution. Carpio and Isengildina-Massa (2009) found that consumers' main reason for choosing local produce was to support local farmers and the local economy. In a study by Onozaka, Nurse, and Thilmany McFadden (2010), survey participants indicated "proven health factors," "supporting local economy," "farmers receiving fair share of economic returns," and "maintaining local farmland" as the top four criteria used in their selection process. Consumers also considered locally grown produce to be superior in terms of freshness, eating quality, food safety, and nutritional value. Darby et al. (2006) found a substantial increase in willingness to pay (WTP) for local produce among consumers because of freshness, taste, a direct connection to food sources, nutrition, food safety, and support for local businesses and the regional economy. Gracia, de Magistris, and Nayga (2012) showed that social influence factors affect WTP for local food among women.

Despite studies showing consumer preferences for locally grown produce, the few studies on buyer preferences focus on buyers at traditional wholesale firms serving institutional customers. Hughes, Crissy, and Boys (2014) showed that wholesalers serving institutional customers tended to avoid handling local food due to the additional costs involved. Rimal and Onyango (2013) found that although there was buyer interest in local food in wholesale organizations serving institutional customers, attributes such as price, freshness, quality, and availability were considered more important decision drivers. Becot et al. (2014) found that Vermont school food directors, while encouraged to buy foods locally, were often limited by their budgets and regulatory edicts barring them from using geographical preferences as part of the bidding process (Becot et al.). The study suggested that institutional buyers were unlikely to be a source of price premiums (Becot et al.). Emerging local food system wholesalers are attempting to increase supply of locally procured products to institutions, but they are still a minority (Hughes, Crissy, and Boys).

Because few researchers have investigated large-scale retailers and wholesalers selling to the retail market, buyers' preferences for local produce—broccoli in particular—from these organizations are unknown. Whether East Coast broccoli can be a viable supplement to California broccoli supplies cannot be determined. Our contribution to the literature is to fill this gap by using primary research to determine buyer preferences for locally grown broccoli and provide guidance to Eastern broccoli growers in terms of both product standard and marketing channel prioritization.

Data

Primary data were collected through an online survey of major broccoli buyers in the East Coast market. The initial survey questions were developed by Phillip Coles, who has 35 years of experience in the produce industry, and Thomas Björkman, an expert in plant breeding who is developing broccoli strains for the East Coast climate. Once the survey questions were compiled, they were reviewed by two produce buyers, one from a large wholesaler and another from a regional grocery retailer. A variety of buyers from national and regional supermarket chains, supercenters, and produce wholesalers were selected and asked about their requirements, preferences, and practices related to broccoli purchases. Buyers were identified through personal contacts and social platforms such as LinkedIn® and represented roughly half the grocery retailing industry by sales (Lerman, 2014; McKitterick, 2015; SN Supermarket News, 2015). The survey was distributed to 49 buyers, of whom 27 responded (55%). The survey was conducted between November 2014 and February 2015 using Qualtrics. No remuneration was provided, and respondents could skip questions if they wished. Although this resulted in some missing values in the data, sufficient data were collected for most of the questions. Response rates were similar regardless of merchant type, size, or function (Table 1).

In the study, we defined "local" broccoli as broccoli produced in the same state as retailed. There is no universally accepted definition for "local" produce. The U.S. Congress defined local food in

Table 1. Produce Merchants Who Were Sent the Survey and Those Who Responded Represented by Type, Size, and Function

	Buyers Sent the Survey		**Respondents**	
	No. of Buyers (*N*)	**Response Rate (%)**	**No. of Buyers (*N*)**	**Percentage by Category (%)**
By type				
Natural food	19	52.6	10	37.0
Conventional	30	56.7	17	63.0
By size				
Local	13	61.5	8	29.6
Regional	25	52.0	13	48.2
National	11	54.5	6	22.2
By function				
Wholesalers	14	64.3	9	33.3
Supermarkets	31	48.4	15	55.6
Supercenters	4	75.0	3	11.1
Total	49	55.1	27	100.0

the 2008 Food, Conservation, and Energy Act as "'locally or regionally produced agricultural food product' if the total distance traveled is less than 400 miles from its origin, or within the State in which it is produced" (Martinez et al., 2010). Meanwhile, consumers have varying opinions on what constitutes the term "local." We chose our definition because it is part of the definition provided by the U.S. Congress, it is considered more easily definable and understood (Loureiro and Hine, 2002), and, more importantly, preliminary discussions with several buyers indicated that this was an accepted and often used definition among produce buyers.

In the first part of the survey, we asked questions regarding buyers' purchasing practices and attitudes (e.g., whether they have procured any local produce and marketed them as "local" and whether they consider "local" to be a positive product feature that could command a higher selling price). In the second part of the survey, we asked buyers to assess local and nonlocal broccoli with respect to different product attributes based on photographs of broccoli with various product conditions. Figure 1 depicts one example for three colors of broccoli.

The pictures were shown to the buyers without any descriptive terms. After seeing the photographs, buyers decided whether the condition in each picture was "preferred," "acceptable" or "unacceptable" under two scenarios, nonlocal and local. The assessment was repeated for six product attributes (color, bead size, head uniformity, stem length, maturity, and bead uniformity). Identical pictures were used for both nonlocal and local scenarios to discern whether buyers may be more forgiving toward locally produced broccoli in their quality requirements.

Figure 1. Broccoli Pictures Showing Different Colors

Dark green Light green Purple

Methodology

We first investigated the answers to the behavioral and attitudinal questions and cross-cut the data by merchant type, size, and functions to understand the overall situation as well as any heterogeneity across groups. Following that, we explored how different product conditions affect the probability of product acceptance or preference from a buyer's perspective. We considered six product attributes (color, bead size, head uniformity, stem length, maturity, and bead uniformity) and ran two regressions for each product attribute. Separate regressions were run for each product attribute because we had asked in the questionnaire for the assessment separately for each product attribute. There was no interaction between product attributes.

For each product attribute, we used one product condition as the outside option and looked at the change in probability of acceptance or preference given a change in product condition from the outside option. A random-effect logit model was used considering the binary nature of the dependent variables. Logistic distribution of the error terms was assumed. Individual random effect was included due to the correlation between the assessments of different product conditions from the same individual.

Mathematically, for each attribute *i* (*i* = color, bead size, head uniformity, stem length, maturity, and bead uniformity), we have:

$$(1) \qquad Preferred_j = \alpha_0 + \alpha_1 Local_j + \alpha_2 Natural\_Food_j + \boldsymbol{\beta_i} V\boldsymbol{alue\_Attribute}_i + \varepsilon_{1j},$$

$$(2) \qquad Acceptable_j = \gamma_0 + \gamma_1 Local_j + \gamma_2 Natural\_Food_j + \boldsymbol{\delta_i} \boldsymbol{Value\_Attribute}_i + \varepsilon_{2j},$$

where subscript *j* refers to one assessment case regarding the product attribute. The variables *Preferred*, *Acceptable*, *Local*, and *Natural_Food* are binary variables, which take a value of 0 or 1, and $\boldsymbol{Value\_Attribute}_i$ is a column vector responding to product conditions. The number of elements in the vector is equal to the number of product conditions minus 1 (because one product condition was excluded as the outside option). The row corresponding to the product condition in the specific assessment case takes a value 1, and the other rows take a value of 0. $\boldsymbol{\beta_i}$ and $\boldsymbol{\delta_i}$ are row vectors of parameter estimates corresponding to the product conditions in the column vector $\boldsymbol{Value\_Attribute}_i$. The parameter estimates in $\boldsymbol{\beta_i}$ and $\boldsymbol{\delta_i}$ are the natural logs of the odds ratio for acceptance or preference under one product condition compared to the outside option. Based on the industry norm on product quality, we chose the least preferred product conditions as the outside option for each product attribute. Therefore, we expect to see an increase in probability of acceptance or preference when we change from the outside option to another product condition. In other words, we expect the parameter estimates in $\boldsymbol{\beta_i}$ and $\boldsymbol{\delta_i}$ to be positive. Stata 14.2 was used to conduct the regressions. Table 2 lists the variables used in the model and their definitions.

Table 2. Variables and Definitions

Variables	Definition
Dependent variables (for each product attribute: maturity, bead size, head uniformity, stem length, color, bead uniformity):	
Preferred	1 if "preferred," 0 otherwise, for each attribute *i*
Acceptable	1 if "preferred" or "acceptable," 0 otherwise, for each attribute *i*
Independent Variables:	
Local	1 if broccoli is produced within the state where it is retailed; 0 otherwise
Natural Food	1 if buyer represents a natural food reseller; 0 otherwise
Product Attributes	
Maturity	
Optimal maturity	1 if yes, 0 otherwise
Over mature	1 if yes, 0 otherwise
Very over mature	1 if yes, 0 otherwise (excluded dummy)
Bead size	
Small	1 if bead size is small, 0 otherwise
Medium	1 if bead size is medium, 0 if otherwise
Large	1 if bead size is large, 0 if otherwise (excluded dummy)
Head uniformity	
Very uniform	1 if broccoli head is very uniform, 0 otherwise
Uniform	1 if broccoli head is uniform, 0 otherwise
Nonuniform	1 if broccoli head is not uniform, 0 otherwise (excluded dummy)
Stem length	
Flush cut stem	1 if broccoli stem is cut flush, 0 otherwise
Short stem	1 if broccoli stem is short, 0 otherwise
Medium stem	1 if broccoli stem is medium, 0 otherwise
Long stem	1 if broccoli stem is long, 0 otherwise
Extra-long stem	1 if broccoli stem is extra-long, 0 otherwise (excluded dummy)
Color	
Dark green	1 if broccoli head is dark green, 0 otherwise
Light green	1 if broccoli head is light green, 0 otherwise
Purple	1 if broccoli head is purple, 0 otherwise (excluded dummy)
Bead uniformity	
Very uniform	1 if broccoli beads are very uniform, 0 otherwise
Uniform	1 if broccoli beads are uniform, 0 otherwise
Nonuniform	1 if broccoli beads are not uniform, 0 otherwise (excluded dummy)

The dependent variable is based on the buyers' assessments of the six product attributes. The raw data—entered as "preferred," "acceptable," or "unacceptable"—were processed into two binary variables, *Preferred* and *Acceptable* (Table 2).

The explanatory variables on product conditions were generated by associating each photo with one descriptor; for example, in Figure 1, the three conditions are tagged as dark green, light green, or purple in color. These product descriptions entered the equation as the binary variable $\textbf{\textit{Value\_Attribute}}_i$, which takes a value of 0 or 1. One of the product conditions was excluded as the outside option.

Product origin and reseller type were also included as dummy variables. The variable *Local* was used to identify the potential difference in the quality requirements from the buyers for the local and nonlocal products. The question of interest is whether buyers have lower quality requirements for the local products. We included *Natural_Food* to capture potential heterogeneity in quality requirements between the natural food resellers and the other conventional resellers. We focused on this specific reseller type based on our examination of the behavioral and attitudinal questions.

Results

After exploring the answers to the behavioral and attitudinal questions, we found the majority of the buyers had procured local produce before, and almost all of them considered "local" to be a positive feature. When they procured local produce, they typically marketed it as "local." Locally grown is marketed by providing sections devoted to "local" in the produce section, shelf talkers identifying products as local, identifying local farmers with photos and displays telling their stories. Retailers at times have special events and tastings showcasing locally grown products (Granderson, 2016). Although only 23% of buyers believed local produce could command higher selling prices, most of them nevertheless wanted to have East Cost broccoli available and would prefer East Coast broccoli, all else equal. Table 3 summarizes the statistics.

Discussions with buyers while finalizing the survey, and with contacts who helped identify buyers from smaller organizations, revealed that larger organizations, regional and national resellers with distribution centers, tended to be more interested in additional broccoli supplies in case of supply disruptions and to increase price competition. Having sources closer to individual distribution centers gives them additional supply lines and alternatives. In the event of a shortage in California, West Coast distribution centers could continue to be supplied from California and East Coast facilities could source from East Coast suppliers. This also gives greater flexibility to Midwest facilities, which could be supplied from either coast depending on conditions.

Smaller and natural food resellers have one to a few stores and do not have distribution centers. They are typically in one metropolitan area, and those in our survey are all on the East Coast. They are more interested in minimizing the distance from their sources, and therefore prefer broccoli from other regions on the East Coast to California broccoli when local broccoli is not in season. We cross-cut the data by merchant type, size, and function. We discovered that significantly more natural food resellers believed that local produce could command a higher selling price.

Table 3. Respondents Who Answered "Yes" to the Behavioral and Attitudinal Questions, Total and Breakdown by Merchant Type

Practices or Attitudes	Overall (%, *N*)	Natural Food (%, *N*)	Conventional (%, *N*)	*p*-Value (Fisher's Exact)
Do you procure "local" produce?	74.1	70.0	76.5	1.000
Do you consider "local" a positive marketing feature?	92.3	100.0	87.5	0.508
Do you consider "local" a feature that commands higher price?	23.1	55.6	5.9	0.010***
If you purchased local broccoli in 2013, was it marketed as local?	87.0	100.0	80.0	0.526
Do you see an advantage to East Coast broccoli being available when "local" is out of season?	88.0	90.0	86.7	1.000
Other attributes being equal, would you prefer East Coast broccoli?	79.2	100.0	68.75	0.130

Note: Single, double, and triple asterisks (*, **, ***) denote estimates statistical significance at the 0.10, 0.05, and 0.01 level, respectively. Number of responses (*I*) varies due to missing values, percentages calculated based on available answers. The fourth question is based on the number of respondents who purchased local broccoli in 2013; two buyers who had not purchased were not included. Fisher's exact test is used for calculating *p*-values due to small sample size.

We obtained regression results on two dependent variables, *Preferred* and *Acceptable*, regarding the six product attributes.[1] Tables 4 and 5 illustrate the odds ratios estimated from equations (1) and (2). Table 4 signifies the likelihood that buyers prefer a product of a particular condition to the excluded option, and Table 5 indicates the odds that a buyer considers a product with that condition acceptable over the excluded condition.

In Table 4, no coefficient for local product origin is significant, indicating that buyers use the same quality standards across local and nonlocal products when selecting preferred products. Buyers from natural food sellers tend to be more tolerant of stem length, product color, and maturity. However, they are no different from buyers from conventional resellers when evaluating bead size or head uniformity. Buyers prefer a dark-green color, small bead size, uniform head, and short stem. The odds ratio for dark green is high, indicating a clear preference. No significant preference was found for product maturity.

When looking at the odds ratios for the buyers to accept a product condition, similar to the preferred case, we do not see significant coefficients for local products. Dark-green color, small bead size, uniform head, and short stem are again most likely to be accepted, but the buyers would also accept light green color, medium bead size, and flush cut stem, indicating higher tolerance. Dark green is still the most widely accepted color, followed by light green, while purple is almost

[1] We did not include the result on bead uniformity in the preferred case because none of the coefficients were significant.

universally unwanted, except for a few natural food store buyers. This results in extremely high odds ratios for dark green and light green colors. The coefficients for optimal maturity and over maturity are significant and close to each other, indicating similar acceptance levels for both conditions. Coefficients for head uniformity are significant in the acceptable case, showing strong preferences for very uniform and uniform head over nonuniform ones (Table 5).

Table 4. Regression Result on Preferred Product Conditions (Coefficients in Odds Ratios)

	(1) Preferred: Color	**(2) Preferred: Bead Size**	**(3) Preferred: Head Uniformity**	**(4) Preferred: Stem Length**	**(5) Preferred: Maturity**
Local	0.58	1.09	0.97	0.85	1.09
	(0.43)	(0.51)	(0.55)	(0.31)	(0.52)
Natural food reseller	10.69*	1.00	1.37	2.69***	2.81*
	(13.97)	(0.53)	(1.17)	(0.98)	(1.75)
Dark green	1,146.31***				
	(1,910.22)				
Light green	1.22				
	(1.20)				
Small bead size		19.19***			
		(15.53)			
Medium bead size		4.81*			
		(4.00)			
Very uniform head			15.66**		
			(18.85)		
Uniform head			29.80***		
			(35.71)		
Flush cut stem				1.83	
				(1.08)	
Short stem				3.10**	
				(1.75)	
Medium stem				1.33	
				(0.82)	
Long stem				1.26	
				(0.77)	
Optimal maturity					1.98
					(1.1)
Over mature					0.49
					(0.33)
No. of obs.	132	131	118	208	130

Note: Single, double, and triple asterisks (*, **, ***) denote estimates statistical significance at the 0.10, 0.05, and 0.01 level, respectively.

Table 5. Regression Result on Acceptable Product Conditions (Coefficients in Odds Ratios)

	(6) Acceptable: Color	(7) Acceptable: Bead Size	(8) Acceptable: Head Uniformity	(9) Acceptable: Stem Length	(10) Acceptable: Maturity	(11) Acceptable: Bead Uniformity
Local	0.27	0.91	0.98	1.08	1.19	0.35
	(0.47)	(0.51)	(0.61)	(0.36)	(0.54)	(0.54)
Natural food reseller	0.85[a]***	2.93	12.84	2.29	1.82	7.89
	(3.38)	(2.50)	(22.94)	(1.27)	(1.79)	(21.19)
Dark green ($\times 10^{15}$)	0.16***					
	(1.21)					
Light green ($\times 10^{10}$)	0.88***					
	(3.43)					
Small bead size		20.69***				
		(17.01)				
Medium bead size		20.20***				
		(16.64)				
Very uniform head			2.84			
			(2.17)			
Uniform head			3.89*			
			(3.05)			
Flush cut stem				2.96**		
				(1.53)		
Short stem				3.43**		
				(1.81)		
Medium stem				1.53		
				(0.75)		
Long stem				1.56		
				(0.76)		
Optimal maturity					2.71*	
					(1.54)	
Over mature					2.62*	
					(1.48)	
Very uniform bead ($\times 10^{20}$)						1.71***
						(8.87)
Uniform bead ($\times 10^{10}$)						2.89***
						(8.95)
No. of obs.	132	131	118	208	130	131

Note: Single, double, and triple asterisks (*, **, ***) denote estimates statistical significance at the 0.10, 0.05, and 0.01 level, respectively.
[a] Coefficient and standard deviation rescaled, in 10^9.

Overall, there is no difference in quality requirements regardless of whether broccoli is sourced locally; all buyers have the same quality requirements for both local and nonlocal broccoli. The hypothesis that the locally grown feature would be attractive enough to compensate for lower product quality is disproven. Buyers for natural food sellers tend to be more forgiving; they accept a wider range of product conditions. Broccoli buyers seem to be most selective with color, followed by bead size, bead uniformity, and head uniformity. Given the limitation of the sample size, some of these findings might be subject to the small-sample bias. However, they could be helpful to form hypotheses for future research on produce buyers' preferences.

Conclusion

In this study, we investigated fresh produce buyers' preferences regarding broccoli product attributes through a survey of buyers from major fresh produce merchants. The regressions show that they favor dark green color, uniform heads and beads, small bead size, and short stems. This result is consistent with both our expectations and industry norms for high-quality broccoli. The preference of dark green color is extremely strong, followed by small bead size and uniform heads. Results also suggest that natural food resellers tend to be more forgiving on quality. They are more willing to procure a wider range of broccoli conditions. We failed to detect any difference in quality requirements between local and nonlocal produce. Although most respondents indicated interest in local and East Coast broccoli, they demanded identical product quality, regardless of origin. The buyers would not compromise their quality standards for the additional value provided from local sourcing. Although natural food resellers are more tolerant with product maturity, color, and stem length, their modicum of forgiveness seems to be for all broccoli and is not affected by product origin.

This suggests that East Coast growers must first establish product quality competitiveness—especially regarding color, bead size, and head uniformity—to compete with the California broccoli. While these key product attributes depend a lot on the development of new varieties suitable for the region, stem length and maturity are relatively easier to manage and should be a quick win to augment product attractiveness. In particular, growers should ensure that broccoli has short stems and are not flush cut, as flush cuts are not only less desirable but also reduce product weight and thus yield. Flush cut stems, while acceptable, will lower quality and raise costs compared to short stems. For the new broccoli growers on the East Coast, natural food resellers could be a good starting point, given their more forgiving quality requirements overall. Moreover, as natural food resellers are typically smaller, growers could start with a smaller scale launch with them. As growers become more proficient and competent, able to meet the other quality parameters, they could scale up production and approach larger clients.

Given the small sample size in this study, we suggest using our findings as a directional analysis to inform future research. In addition, more research regarding retail buyers is needed to better understand this key role in the fresh produce supply chain. With a larger sample, other approaches (such as a choice experiment) could be used to better quantify the importance of different product attributes and the value of being able to meet product requirements.

Acknowledgment

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Appendix: Broccoli Buyer Questionnaire

1. "Local" Broccoli Procurement:

We would like to know about your "local" broccoli procurement. In particular:

Do you procure "local" broccoli (Defined as grown in the same state as retailed)? Yes___ No___

If you use a different definition of "local" for marketing, what is your definition?

____

Does "local" broccoli have any additional value for you:
- As a marketing feature (but no effect on pricing)? Yes___ No___
- As a feature that commands a higher selling price? Yes___ No___
- If it commands a higher price, what was the average $/box markup for local broccoli in the past year? ________

When local broccoli is in season, what percentage purchased in 2013 was considered local?
- 0 ❑ > 0-5 ❑ 5-20 ❑ 20-50 ❑ More than 50 ❑
- Was it marketed as local? Yes___ No___

Would your organization see an advantage to East Coast Broccoli being available when "local" (As defined by state) is out of season? Yes___ No___

If you have bought broccoli grown in the Eastern U.S. in the past, what have you seen as specific advantages and disadvantages:

	Advantage	Disadvantage	Varies
Cost	❑	❑	❑
Availability	❑	❑	❑
Consistency of availability	❑	❑	❑
Quality	❑	❑	❑
Consistency of quality	❑	❑	❑

All other attributes being equal, would you prefer to procure East Coast Broccoli? Yes___ No___

During 2013, approximately what percent of broccoli purchases was procured from the East Coast? __________

Five years earlier, during 2008, approximately what percent of the broccoli purchased was procured from the East Coast? __________

2. Quality requirements and pricing policies:

Do you have price quality penalties and premiums? Yes___ No___

If you answered yes, please provide the following information:
On what parameters: ____
Are they stated in written agreements? Yes___ No___
Would you be willing to share a sample agreement with us? Yes___ No___

We would like to understand your broccoli quality requirements and whether those requirements may be different for "local" broccoli. Please indicate your quality requirements for "non-local" and "local" broccoli. In addition, please indicate whether criteria shown in each photo is a preferred or acceptable requirement, or something that normally would be rejected:

External condition:

Non-local:
Grade: Fancy ❑ #1 ❑ #2 ❑ Do not use USDA grading ❑
Maximum % Damage tolerance: None ❑ up to 5% ❑ 5-20% ❑

Local:
Grade: Fancy ❑ #1 ❑ #2 ❑ Do not use USDA grading ❑
Maximum % Damage tolerance: None ❑ up to 5%❑ 5-20% ❑

Maturity:

Check preferred, acceptable or unacceptable under each photo for Non-local, then local broccoli

  

Non-local:			
preferred	❑	❑	❑
acceptable	❑	❑	❑
unacceptable	❑	❑	❑
Local:			
preferred	❑	❑	❑
acceptable	❑	❑	❑
unacceptable	❑	❑	❑

Color:

Check preferred, acceptable or unacceptable under each photo for Non-local, then local broccoli

  

Non-local:			
preferred	❑	❑	❑
acceptable	❑	❑	❑
unacceptable	❑	❑	❑
Local:			
preferred	❑	❑	❑
acceptable	❑	❑	❑
unacceptable	❑	❑	❑

Bead size:

Check preferred, acceptable or unacceptable under each photo for Non-local, then local broccoli

  

Non-local:			
preferred	❑	❑	❑
acceptable	❑	❑	❑
unacceptable	❑	❑	❑
Local:			
preferred	❑	❑	❑
acceptable	❑	❑	❑
unacceptable	❑	❑	❑

Head uniformity:

Check preferred, acceptable or unacceptable under each photo for Non-local, then local broccoli

Non-local:			
preferred	❑	❑	❑
acceptable	❑	❑	❑
unacceptable	❑	❑	❑
Local:			
preferred	❑	❑	❑
acceptable	❑	❑	❑
unacceptable	❑	❑	❑

Bead uniformity:

Check preferred, acceptable or unacceptable under each photo for Non-local, then local broccoli

Non-local:			
preferred	❑	❑	❑
acceptable	❑	❑	❑
unacceptable	❑	❑	❑
Local:			
preferred	❑	❑	❑
acceptable	❑	❑	❑
unacceptable	❑	❑	❑

Stem length:

Non-local:					
preferred	❑	❑	❑	❑	❑
acceptable	❑	❑	❑	❑	❑
unacceptable	❑	❑	❑	❑	❑
Local:					
preferred	❑	❑	❑	❑	❑
acceptable	❑	❑	❑	❑	❑
unacceptable	❑	❑	❑	❑	❑

3. Postharvest requirements:

We would like to know about your postharvest requirements for broccoli, including packaging, pre-cooling and storage. If you have no requirements for a particular category, please indicate 'none'.

Packaging:	Requirement	Preference	None
Outer cases:________________	❑	❑	❑
Selling unit: _______________	❑	❑	❑
Pack size: _________________	❑	❑	❑
Pre-cooling:			
Ice: 1-2 pounds	❑	❑	❑
Ice: 10-20 pounds	❑	❑	❑
Iceless:	❑	❑	❑
Storage:			
Temperature: _____________	❑	❑	❑
Shelf-life: ________________	❑	❑	❑

4. Seasonality, volumes, and sources:

We would like to ask you about the sources (state or region within state) and volumes of broccoli crowns over the last year (2013).

What were your total boxes of broccoli purchased in 2013? __________

Please provide information for your two main suppliers.

Season	*Supplier*	*Total volume (# of 21 lb. boxes)*	*Length of relationship?*	*Sources (country, state or region within state)*
Spring	1.			
	2.			
Summer	1.			
	2.			
Fall	1.			
	2.			
Winter	1.			
	2.			

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Food Label Use and Knowledge of Nutritional Facts on Sugars among Undergraduate Students

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Abstract

For several decades, research findings have linked sugar consumption to serious health problems including high cholesterol, heart disease, and kidney disease. However, due to the sugar lobby's influence, many of these findings were not publicized. It is also alleged that in 1967, the Sugar Research Foundation paid three Harvard scientists to distort their research results and suggest that fat, not sugar, was the problem in our diets.

Given Louisiana's rising obesity rate among young adults, our study's main objectives are to document undergraduates' food label use; to examine overall knowledge of labeling information on sugar; and to identify factors influencing performance on questions pertaining to Nutrition Facts labels and sugar. Data were collected from a sample of 402 undergraduate students and analyzed using descriptive statistics and the binomial logistic model. For the multivariate analyses, we hypothesized that label use would be influenced by age, gender, household income, and minutes exercised. Knowledge of sugar was hypothesized to be influenced by income, label use, and perceived health status.

Of the 402 respondents, 88% indicated that they never, rarely, or sometimes read labels. About 67% of respondents correctly answered a question about the types of sugars listed on Nutrition Facts labels. The four significant predictors of frequency of nutrition label use were age, gender, household income, and minutes exercised, as expected, while knowledge of sugar was statistically significantly influenced by household income, label use, and perceived health status, also as expected. Older students were 1.055 times more likely to read labels than younger students.

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Females, those who perceived their health to be poor, and those from lower-income households were less likely to read the Nutrition Facts labels. Students who exercised regularly were more likely to read labels. Students from lower-income households, infrequent label users, and those who perceived themselves to be unhealthy were less likely to correctly answer the question about sugar.

Healthcare costs and federal deficits have been rising steadily and are expected to continue their upward trajectory. Food scientists and nutritionists at our institution are using nutrition education to encourage students to adopt healthier lifestyles. Additionally, the Food and Drug Administration is planning to include %Daily Value of added sugars on Nutrition Facts labels beginning in 2021, in lieu of the "calories from fat" column.

Keywords: binomial logistic model, college students, food label use, health status, knowledge of sugar, multivariate analysis, nutrition facts labels

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Putting Food on the Blockchain: A Regulatory Overview

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Blockchain is currently being heralded as a multidimensional solution to inefficiencies in various sectors ranging from finance to agriculture. Blockchain presents an exciting opportunity to shift business interactions through smart contracts, distributed ledgers, improved transparency measures, and more secure data practices. The technology provides mechanisms for storing massive amounts of information, allowing for improved data analysis through collection of "big data," and its distributed nature allows for greater information sharing among stakeholders. In theory, blockchain offers a new conceptualization of farm-to-table and has the potential to transform an increasingly globalized agri-food industry. Notably, multiple blockchain "projects" seeking to optimize the agri-food industry have recently gained traction with partnerships like that of IBM and Maerk (utilizing Hyperledger, an open-source blockchain hosted by the Linux Foundation), which are employing the technology to strengthen traceability processes, bolster food safety measures, and increase consumer knowledge about food provenance.

The United States is grappling with policing the technology beyond its popular functionality as digital currency. While these projects seem promising, it is crucial to consider how the emerging technology will be regulated and how these regulations may interfere with the aims of ambitious projects. Examining both federal level and state-level legislation and regulation, this research adds to the existing body of literature on blockchain technology, which is heavily focused on evaluating the merits of different blockchain "platforms." The goal is to provide a better understanding of how regulatory measures may create obstacles to agri-food leveraging blockchain in lucrative ways and to determine whether the current U.S. legal approach to the emerging technology embodies a "hands-off" mentality. Moving forward, this research aims to monitor shifts in the regulatory environment to better understand how the technology will interact with regulation. Can a healthy balance of responsible regulation exist without threatening to stifle the ability of innovation to flourish and grow organically?

Keywords: blockchain, big data, decentralization, food provenance, distributed technology, supply chain data

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Looking at Economic and Noneconomic Drivers of Farm Diversification

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Crop diversification mitigates risk by spreading market volatility and increasing farm resiliency among fruit and vegetable (FAV) farmers. We estimated how economic and noneconomic factors affect crop diversification among FAV farmers. Economic factors included access to markets and land; noneconomic factors included farmers' beliefs and access to information from extension and farmers' networks. This study also investigated the effects of these factors at different degrees of diversification.

We hypothesized that farmers selling directly to consumers are more likely to diversify compared to those selling wholesale. We expected farmers with more land to specialize their crop mix due to economies of scale. We also anticipated that noneconomic factors—such as positive expectations about their farming system and access to information from support networks—could facilitate adoption of diversification strategies. Data was obtained from a 2012 web-based survey of FAV farmers sourced from the MarketMaker database (https://foodmarketmaker.com/). The analysis used responses from 1,532 farmers across 16 states.

We used an ordinary least square regression to determine the effects of economic and noneconomic factors on diversification. An instrumental variable (IV) approach (i.e., distance to markets in miles) controlled for unobserved factors that might drive farmers selling in local markets and adopting crop diversification to enhance the biodiversity of local food systems. A Durbin–Wu–Hausman endogeneity test indicated that the IV approach was not endogenous. Lastly, a quantile regression estimated the effect of factors on the distribution of crop diversification.

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Results indicate that selling locally increases diversification. Farmer–customer relationships in local markets allow feedback from end users, allowing farmers to adapt crops to meet demand. Crop diversity also contributes to a colorful supply of FAV in local markets, a key marketing strategy to attract customers. Reliance on other farmers for information decreases diversification. Certified organic farmers are more likely than conventional farmers to diversify. Factors that deter crop diversification include being in the Southern region (FL, GA, SC) and farming part-time.

The quantile regression categorized operations as specialized (1–4 crops), low (5–15 crops), medium (16–28 crops), and highly diversified (29–43 crops). Results indicate that selling to local markets positively influences crop diversification across all levels. Increasing farm acreage positively influences diversification for specialized farms but negatively influences highly diversified operations. Additionally, positive attitudes toward farming positively influence diversification, and obtaining information from other farmers negatively affects specialized operations.

Keywords: consumer, diversification, fruit, local markets, market, retail, specializations, vegetable

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An Overview of Small-Scale Commercial Hops Production in Virginia

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Virginia-grown hop varieties are USDA-developed, public-domain varieties. Southeastern hops are more susceptible to downy mildew and other fungal diseases, given shorter daylight spans and increased heat and humidity. Based on 31 responses to an annual producer survey, Seigle and Scoggins (2017) reported that Virginia acreage ranged from 10–22 acres. Virginia has a high number of craft breweries, motivated by a growing interest in craft beer. Direct marketing is an opportunity to add value through personalized service and strong buyer relationships. Given the large capital investment in a slow-growing perennial crop and marketing expenses, producers are encouraged to use planning tools to better identify and manage risk exposure. *User Notes for Small-Scale Virginia Commercial Hops Production Enterprise Budgets* are available to accompany Virginia hops enterprise budgets.

Washington state accounts for the majority of U.S. acres harvested (Figures 1 and 2) and command the highest prices (Figure 3). Overall, U.S. yields per acre (Figure 4) have increased.

Keywords: alternative enterprise, enterprise budgets, hops production, small scale, Southeastern specialty crops, Virginia

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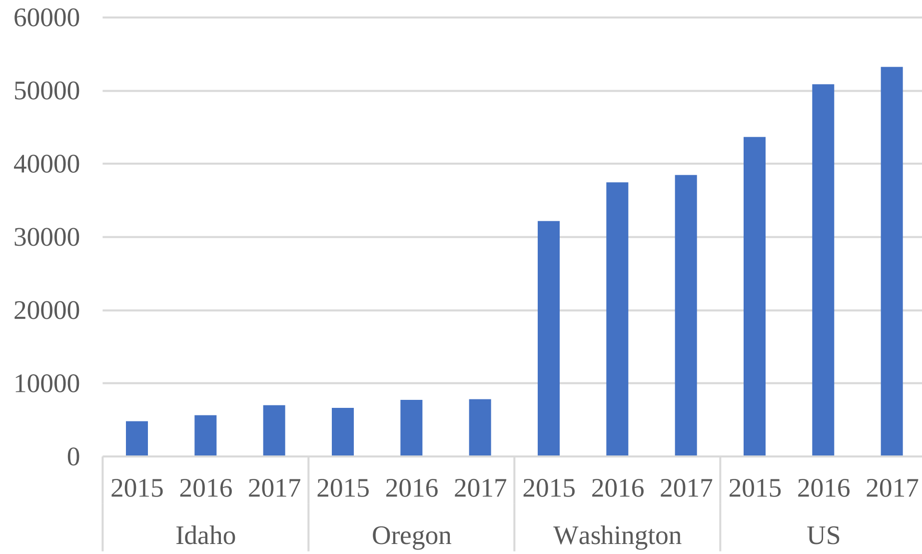
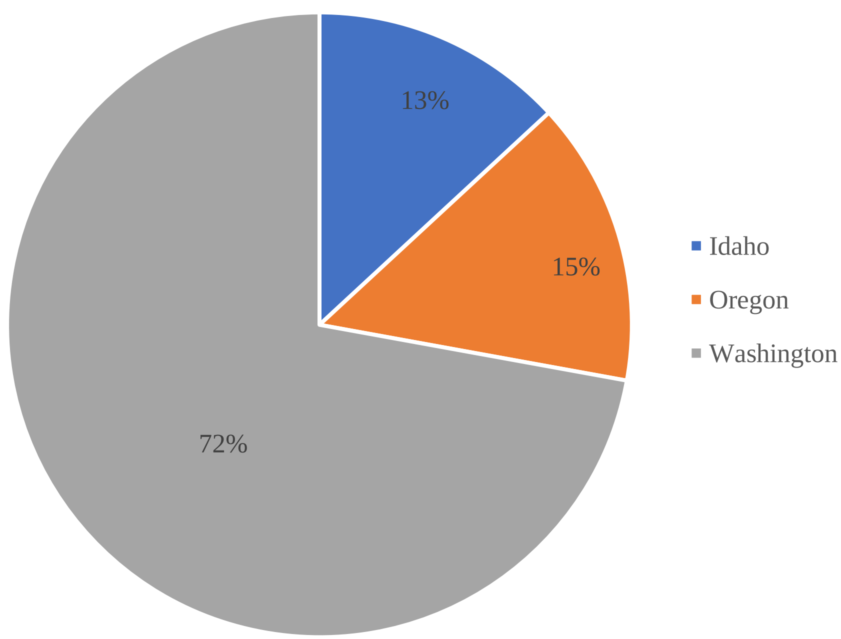
Figure 1. U.S. Hops Harvested (acres) by State, 2015–2017



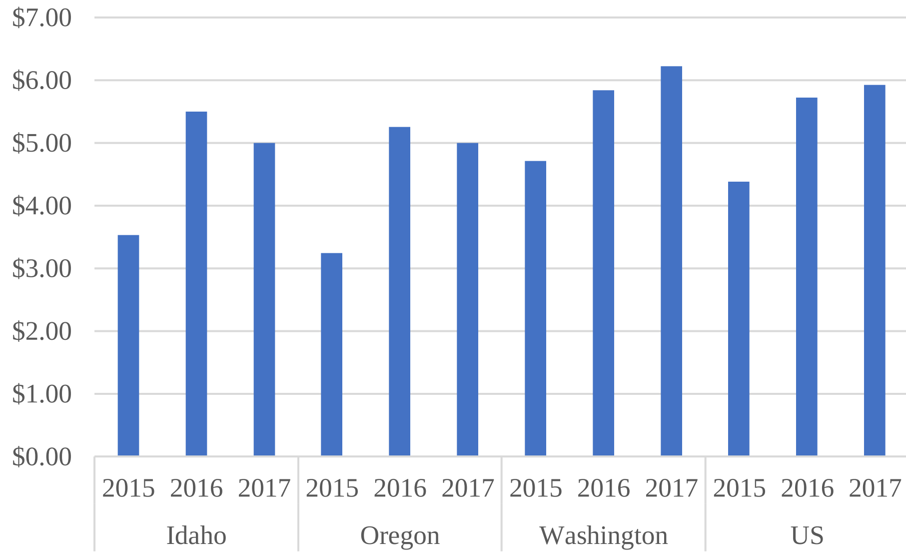
Source: U.S. Department of Agriculture (2017).

Figure 2. Share of U.S. Hops Harvested Acreage by State, 2017



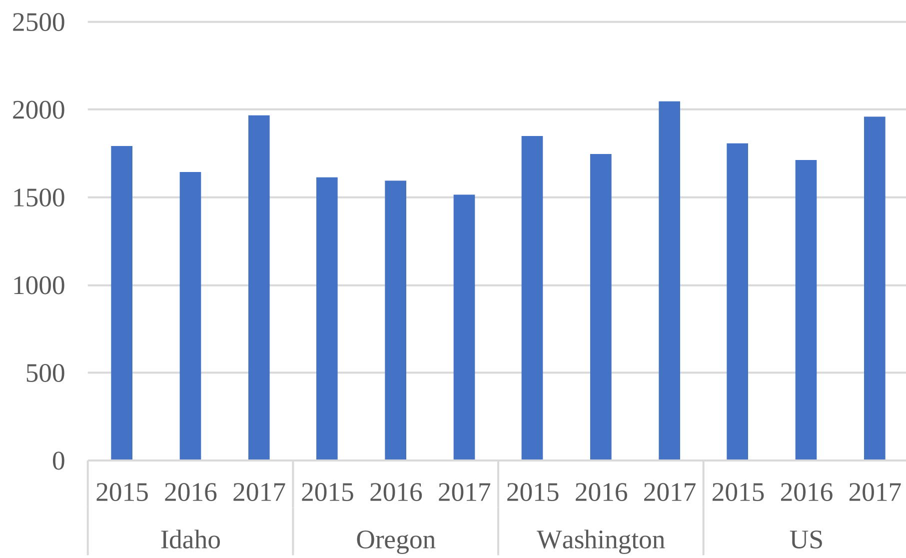
Source: U.S. Department of Agriculture (2017).

Figure 3. U.S. Hops Prices ($/lb) by State, 2015–2017



Source: U.S. Department of Agriculture (2017).

Figure 4. U.S. Hops Average Yield (lb/acre) by State, 2015–2017



Source: U.S. Department of Agriculture (2017).

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The Modern Farmers' Market: The Role of the "Anchor Vendor" in Technology Usage and Adoption

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Technology is an increasingly important force in the world today, pervading everyday life in a myriad of ways. This is no less true in the field of retail than elsewhere. However, farmers' markets—which have become increasingly prevalent in recent years, from 1,755 in 1994 to 8,669 in 2016 (USDA, 2016)—may represent an unusual case because of their cultural associations. Moreover, the nature of technology adoption in general often follows patterns similar to those in the fashion industry: After an initial surge in popularity, a new concept is abandoned with similar relative speed (Sun, 2013). This process may be driven by opinion leaders or, especially, prominent and influential "anchor vendors," who occupy a special position in the establishment of shared market spaces (Gatzlaff, Sirmans, and Diskin, 1994). To understand the role of technology in the context of the modern farmers' markets and what drives this role, this study seeks to quantitatively analyze a broad cross section of farmers' market vendors, not only to determine their technology usage but also to understand the drivers of this technology usage. Taking a cross-sectional approach, we categorize farmers' markets by vendor types and seek to understand both the characteristics of technology use and the sources of influence of this usage by vendor type. The results have implications for the theoretical understanding of the farmers' market context and how it compares with other retail contexts as well as for technology companies seeking to expand their services to include vendors at these increasingly prominent markets.

Keywords: farmers' market, technology adoption, entrepreneurship, vendor

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The Intersection of Social and Economic Value Creation in Social Entrepreneurship: A Comparative Case Study of Food Hubs

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Abstract

Food hubs have the potential to be a key driver of success among local and regional food supply chains. Although the number of food hubs in the United States has grown over the last decade, a dominant design for these types of organizations is still emerging. This study systematically analyzes four food hubs with different organizational structures from the perspective of the entrepreneurship processes by which they were formed. We find that food hubs are social enterprises aimed at creating social and economic value simultaneously, but the social value proposition differs by food hub type.

Keywords: comparative case study analysis, food hubs, local and regional food systems, social entrepreneurship

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Introduction

Over the last 2 decades, increasing demand for locally produced food among U.S. consumers has led to a reemphasis on local and regional food systems and the emergence of organizational innovations such as food hubs to coordinate these food systems. Food hubs have the potential to be a key driver of the success of local and regional food supply chains. Although the number of food hubs in the United States has grown over the last decade, a dominant design for these types of organizations is still emerging. If food hubs are to be sustainable, it is essential to further investigate the characteristics of these organizations and better understand the purpose of food hubs in the local and regional food systems. This, in turn, has underlying implications for strategy development for practitioners and policy makers. We propose that to understand food hub motivations and intentions, it is important to examine the entrepreneurial processes by which they are formed (i.e., "how" entrepreneurship is organized in food hubs). In particular, we explore the key similarities and differences among various types of food hubs from the perspective of entrepreneurship processes. We adapt the social entrepreneurship framework proposed by Austin, Stevenson, and Wei-Skillern (2006) to systematically analyze and compare four case study food hubs.

Literature Review

Food hubs are typically defined as organizations that actively manage the flow of food products from primarily local and regional producers to retailers, institutions (e.g., schools and hospitals), and foodservice companies (Barham et al., 2012). Although the number of food hubs has been growing, the purpose of food hubs is still debated in academic literature and among practitioners. The three major streams of research explaining the emergence and purpose of food hubs include

(i) food hubs as organizations that increase the market efficiency of the local and regional food systems (Day-Farnsworth and Morales, 2011; Diamond and Barham, 2012; Matson, Sullins, and Cook, 2013, Diamond et al., 2014),
(ii) food hubs as organizations aimed to create sustainable production and consumption culture of local foods (i.e., sustainability- and community-oriented organizations) (Blay-Palmer et al., 2013) or as market-driven organizations aimed to support values-based agri-food supply chains (i.e., bridging the gap between the small- and medium-sized producers and wholesale buyers) (Berti and Mulligan, 2016),
(iii) food hubs as organizations that combine purchasing and distribution functions with social mission goals (e.g., helping to grow regional food systems, increasing healthy food access, and having positive impacts on local economies in which food hubs operate) (Fischer et al., 2015).

Perhaps the divergence in these approaches regarding the purpose of food hubs in the food system, coupled with the heterogeneous business structures that also characterize these organizations, is one of the main reasons for the lack of clarity about whether food hubs pursue a social mission, monetary incentives, or both simultaneously. We argue that examining food hubs from a social entrepreneurship theoretical framework might provide further insights into the role of food hubs in the food system.

Social Entrepreneurship Framework

Social entrepreneurship is defined as "a process involving the innovative use and combination of resources to pursue opportunities to catalyze social change and/or address social needs" (Mair and Marti, 2006, p. 37). Austin, Stevenson, and Wei-Skillern (2006) propose an analytical framework, the Social Entrepreneurship Framework (SEF), to analyze social entrepreneurship process (Figure 1). The framework includes five key components: opportunity, people, capital resources, social-value proposition (SVP), and contextual forces. The principle premise of this framework is that the opportunity, people, and capital resource components of the framework "need to be related to and integrated by the core social-value proposition (SVP)" (p.16). As Austin, Stevenson, and Wei-Skillern argue, social enterprises are ventures that have an SVP at the core of their mission and strategy.

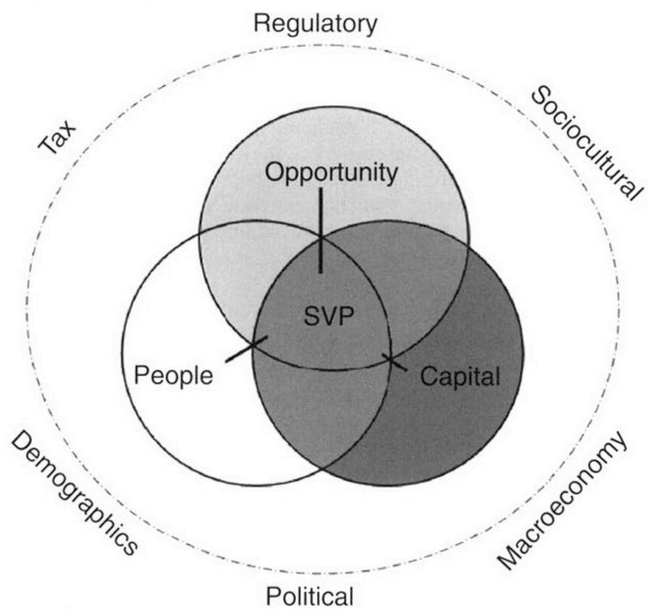

Figure 1. Social Entrepreneurship Framework
Notes: The social value proposition (SVP) refers to the distinctive mission of a social enterprise and the multifaceted nature of social value creation. People and capital refer to human and capital resources, respectively. The opportunity is defined as an activity that promises a better or desired state in the future. The context refers to factors (e.g., demographics, lifestyles, political, sociocultural factors, regulatory structure, political environment, etc.) that an entrepreneur has no control over (Austin, Stevenson, and Wei-Skillern, 2006).
Source: Austin, Stevenson, and Wei-Skillern (2006).

Methods

This study employs a multiple–case study research design (Yin, 2003) to conduct a comparative case study analysis of four Michigan food hubs. We employ a purposive sampling strategy to select four food hubs (A, B, C, D) with different organizational structures. The food hubs include a nonprofit organization (A), a for-profit organization (B), an organization that operates as one of the separate projects of a larger NGO (C), and an organization that is a partnership between two different entities (D). Semi-standardized interviews served as the main instrument for data collection. The interviews were conducted with food hub managers or founders in Summer and

Fall 2015 and verbatim transcribed. Supplementary secondary data were also collected through publicly available food hub websites. These data were used to construct case studies employing open and axial coding procedures (Creswell, 1998; Patton, 2002).

We also performed a comparative analysis of food hubs to identify key similarities and differences with regard to each dimension of the social entrepreneurship framework (see Table 1 for the operationalization of dimensions). We are specifically interested in the process of how the case study food hubs organize these processes rather than the numerical value of their financial resources per se.

Table 1. Operationalization of the Social Entrepreneurship Framework

Dimension	Operationalization
Opportunity and context	Foundation history and evolution path
Capital	Key funding sources critical for food hub establishment, survival and growth
People	Key individuals involved in the establishment of the food hubs
Social Value Proposition	Long-term mission and short-term goals

Results

Opportunity and Context

In comparing the nature of opportunities captured by the food hubs along with the contextual factors (Table 2), we found that food hubs first identified particular needs or issues faced by smaller farmers, local community members, and/or local and regional food systems (except for the for-profit food hub, which was first established as a small commercial operation and later restructured its organization model to focus on strengthening local and regional food systems through food safety and distribution). This was followed by identifying interested stakeholders or partners who were willing to contribute and network formation. This largely determined the resource pool available for starting a food hub. Finally, the food hubs were strategic about choosing a legal business structure for their initiatives, which were mainly for financial reasons rather than social mission. The intent was to start an entity that would have the capacity to generate enough revenue in the short-run to fund the operations.

We also found that at some point food hubs needed a brick-and-mortar building as a place to aggregate their products. Some of them acquired and renovated abandoned buildings by utilizing local community support.

Capital

In many ways, the acquisition of financial resources, survival, and growth were similar among the food hubs (Table 3). First, although food hubs generate revenues by charging fees to producer–suppliers for utilizing the food hub as a marketing channel, funds from philanthropic organizations and government programs have shown to be the most critical in the establishment and survival of these food hubs (except for food hub B). The funds were utilized to establish the

Table 2. Nature of Opportunities Captured by Case Study Food Hubs

Food Hub Name	First Established as	Nature of Opportunities Captured	Current Legal Business Status
A	Community garden organization	Local community building through gardening Youth involvement in farming/food production Improving food access	Nonprofit
B	Small commercial operation	Preserving family farms Maintaining farm identity throughout the supply chain Allowing growers to have part in decision making Food safety	For-profit
C	A separate project of a larger NGO	Local farmers and food processors' identified need that there was a gap between the demand for local food in the area and the way to get it to those who needed it	A separate project of a larger NGO
D	Partnership between two entities	Local farmers' challenges in trying to market their products to larger buyers such as restaurants Food safety	Partnership between two entities

Table 3. Major Funding Sources of Case Study Food Hubs

Food Hub Name	Funding Source
A	Foundation Nonprofit organizations Local community foundation Federal government programs
B	Private investments State program
C	Nonprofit organization
D	Federal government programs State department Privately held company University

food hub, build infrastructure for food hub initial operations, and pay food hub staff. Second, the food hubs have made strategic choices in terms of identifying and establishing diversified complementary funding sources along with a diversified customer base. Third, food hubs were strategic in using their funds in terms of choosing business structures.

Despite these similarities, we also found some key differences. The major fund providers for food hubs A, C, and D belong to two main categories: (i) organizations supporting local community development initiatives, and (ii) organizations supporting local/fair/healthy food initiatives. Food hub B was established and grown based on private investments (Table 3).

People

Some key similarities were identified in the key human resources involved in the establishment of the food hubs. First, the food hubs were founded by individuals who had already been working with local farmers or their local or regional community in general. Second, food hub investors and funders had strong commitments to local and regional food and community development initiatives. Third, the engagement of diverse food hub stakeholders was critical for food hub capacity building. Despite these similarities, food hubs differ in the number of people involved in their establishment.

The Social Value Proposition (SVP)

Comparing the long-term missions and short-term goals of all four food hubs, we identified two key similarities. First, the long-term missions of the case study food hubs are rooted in their social mission goals (Table 4). Short-term goals, on the other hand, revolve around building an

Table 4. Key Components of Long-Term Missions of Case Study Food Hubs

Food Hub Name	Long-Term Mission
A	• Support the existing farmers it sources the products from. • Build new farmers.
B	• Build a resilient and socially just food system.
C	• Help small- and medium-sized food growers and producers to rely on farming for their livelihood. • Help low-income families in local community to have access to healthy food. • Help meet the demand of institutions participating in "20% by 2020" initiative.
D	• Support farmers who want to scale up to serve markets beyond merely the farmers' market. • Help start school gardens. • Provide services in the area of food safety. • Partner with organizations to help with food access and health issues.

Table 5. Key Components of Short-Term Goals of Case Study Food Hubs

Food Hub Name	Short-Term Goals
A	• Generate more revenues to be able to pay salaries of food hub's key personnel. • Self-fund equipment or costs related to the food hub. • Be less dependent on philanthropic funding.
B	• Become an expert in area of food safety. • Become a company where individuals and organizations would be able and seek to contact for addressing various questions or issues.
C	• Generate more sales. • Help growers to build more of their capacity. • Have more occupants for the storage facility.
D	• Increase awareness within the region about the activities of the food hub and how the community members (e.g., farmers, consumers, etc.) can benefit from it.

economically viable enterprise through economic value creation (i.e., revenue) (Table 5). These results reinforce the theory of social entrepreneurship about the balance of social and economic value creation in a social enterprise.

The nature and scope of social value creation, however, differs by food hub type. In particular, long-term missions fall into one or more of the following categories: (i) helping small- and medium-sized producers—both existing and new—rely on farming for their livelihoods; (ii) improving access to healthy food in local communities; and/or (iii) building locally and regionally integrated resilient food systems by focusing on food safety.

These results reinforce the social entrepreneurship theory in terms of the multifaceted nature of SVP to catalyze social change or meet social needs.

Conclusion

The findings of our study show that food hubs are social enterprises aimed to simultaneously create social and economic value. Social value is created by addressing the needs of small- and medium-sized farmers to access larger markets, establishing scale-appropriate infrastructure and food safety procedures, improving healthy food access in local communities, preserving family farms, maintaining farm identity, and/or strengthening local and regional systems as a whole. Social mission is at the core of their strategy and decision making. Meanwhile, economic value is created in the form of revenues. Food hubs pursue revenue-creation strategies to build economically viable enterprises. Diversifying funding sources and strategies that align with food hubs' SVP are critical for food hub survival and growth.

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Untangling the Economic and Social Impediments to Producer Adoption of Organic Wheat

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Abstract

Consumer demand for organic products has grown rapidly in recent years, encouraging the development of a wide range of organic products. Demand for organic wheat products, such as breads and baked goods, currently exceeds supply. This study examines the economic and social impediments to producer adoption of organic wheat through an online survey of wheat producers in the western United States conducted in 2018. Results show that wheat producers are transitioning out of organic production due to pest control and profitability concerns. Current organic wheat producers were motivated to adopt organic methods by profit potential and personal values at the time of transition.

Keywords: grower adoption, organic, personal values, profit, wheat

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Introduction

Consumer demand for organic products has shown double-digit growth in recent years, encouraging the development of a wide range of organic goods. The percentage share of at-home organic food purchases in 2015 had more than doubled since 2005, to 5% of the total share; organic retail sales in the U.S. were $43.3 billion in 2015 (U.S. Department of Agriculture, 2017). Organic products can now be found in approximately three -quarters of conventional grocery stores, as major U.S. food retailers such as Walmart, Target, and Costco have expanded their selection of organic food offerings (U.S. Department of Agriculture, 2017). Consumer bypass conventionally produced foods due to concerns about health and the environment and are willing to pay premiums for organic foods. What was previously a lifestyle choice for a small number of consumers has become a common purchase for a majority of Americans, who now purchase organic items at least occasionally (Greene and Dimitri, 2002).

With the increasing demand for organic wheat flour for large customers such as restaurants and food manufacturing companies, Ardent Mills, a major North American supplier of flour, is now attempting to meet the demand with its Organic Initiative 2019 (Ardent Mills, 2015). The initiative will assist growers with adopting organic wheat and the associated concerns. Possible challenges for producers are frequently related to transition costs, weed and pest control, USDA organic certification compliancy, and production yields. (Ardent Mills, 2015).

Consumer demand for organic wheat current exceeds supply. U.S. organic wheat acres increased by only 10% in 2017, due primarily to struggling yields, especially in dryland systems (Koory, 2018). Organic winter wheat is primarily produced in the Northern Plains region; Montana and Wyoming, the top-producing states, together accounted for 15% of total organic wheat acres and experienced an expansion in wheat acreage of 22% in 2017 (Koory, 2018).

This article examines the economic and social impediments to producer organic wheat adoption through an online survey of wheat producers in the western United States conducted in 2018. Results show that wheat producers are transitioning out of organic production due pest control and profitability concerns. Current organic wheat producers were motivated to adopt organic methods by profit potential and personal values at the time of transition. Future research and policy should focus on improving organic wheat yields and overall profitability.

Literature Review

Previous research has identified significant barriers to producer adoption of organic farming methods, include lack of production knowledge, higher cost of inputs, transition costs, concerns regarding weed and pest control, potential volatility of organic premiums, access to markets, and perceived risk (Kallas, Serra, and Gil, 2010; Kuminoff and Wossink, 2010; Uematsu and Mishra, 2012; Lewis et al., 2011; Nelson et al., 2015; McBride et al., 2015). Despite increasing demand—and the fact that organic goods are one of the fastest growing food segments—researchers have found that producers are slower to adopt than expected. Previous organic adoption research spans many commodities, including grains, produce, dairy, and meat products across the globe. Table 1 summarizes findings from previous studies.

Table 1. Variable Effects on Organic Adoption

Variable	+/-	Variable	+/-
Farm size	-	Risk-averse producer	-
Family size	-	Perceived risk	-
Gender (female)	+	Environmental protection concerns	+
Education level	+	Organic policy incentives (government grants)	+
Age	-	Personal belief in organic lifestyle	+
Years of farming experience	-	Concern for health	+
Knowledge of organic farming	+	Believes organic produces better-quality product	+
Organic marketing concerns	-	Worried about organic product yields	-
Distance from processing services	-	Competition from other labels	-
Higher cost of inputs	-	Concerns about weed and pest control	-
Transition costs	-	Volatility of organic premiums	-

Source: Previous literature.

Adoption barriers are often overcome through educating growers on organic production methods, government grants (policy incentives), and the profit margins gained through organic premiums. Organic producers are more likely to be women, younger, and have a relatively higher income level, fewer years of farming experience, and smaller farms (Kallas, Serra, and Gil, 2010). Additional commonalities between organic growers are personal values such as an emphasis on an organic lifestyle, environmental protection concerns, and believing organic production methods produce higher quality products (Padel, 2008).

Survey Data

Data for this study were collected through an online survey using Qualtrics in September 2018. Wheat producers across fourteen western states were contacted and emailed the survey link by various farming and grain growers associations with which they were associated. A total of 111 responses were collected, 82 of which were fully completed and used in this analysis. Utah (30) and Colorado (20) had the highest response rates, and no responses were provided from producers in four states.

Survey questions covered topics relating to basic wheat producer sociodemographics, farm characteristics, history of production practices, trust in various information resources, and concerns about organic production and implementing new technologies on farms generally. Questions related to current farm irrigation strategies (if any), preferred information delivery methods, and knowledge needs were also included. Information on past wheat production practices (organic only, transitioned from conventional to organic, conventional only, etc.) were also obtained. These questions were used to clarify any changes made in the past, the reasons for the change, and producer rationale for not using organic methods. The survey questions were chosen based on findings from a review of literature and the goals of this study.

Results

Table 2 reports basic survey summary statistics. As shown, 26% of the respondents had relatively small farms of less than 150 acres. Another quarter had medium-sized farms with 151–700 wheat acres, and nearly half of the respondents produced wheat on 701 or more acres annually. Only 35% of respondents reported an annual income of less than $100,000, and nearly 30% grossed $500,000 or higher. Approximately 40% of respondents leased 60% or more of their farm land. Of the respondents, 8% were female, 94% sold through wholesale channels, and 11% were first-generation farmers. The survey was primarily answered by older producers. Over three-quarters of respondents indicated that they would take on risk to increase profits, while almost 80% of the participants carried federal crop insurance.

Table 2. Sample Summary Statistics

Variable	Obs.	Mean	Std. Dev.	Min	Max
Small farm size (≤ 150 acres)	80	0.26	0.44	0	1
Large % of acres leased (≥ 60% of total)	82	0.40	0.49	0	1
Small gross income (< $100 k)	66	0.35	0.48	0	1
Sell directly to retailer (yes = 1)	70	0.06	0.23	0	1
Female (yes = 1)	66	0.08	0.27	0	1
Age group	66	3.05	1.16	1	4
First-generation farmer (yes = 1)	66	0.11	0.31	0	1
Take risk for profit (yes = 1)	66	0.77	0.42	0	1

Of the total survey respondents, 64 producers (78%) used only conventional methods in 2017 (Figure 1); the remainder, or 22%, were organic producers, including complete or partial adopters. Of the 18 organic producers, 9 were certified. Two respondents currently using conventionally methods had started using organic methods and later switched to conventional. Four respondents had grown both organic and nonorganic wheat but now produce only conventional. Of the organic producers, two began with conventional methods.

We asked respondents to rank their preferred information provider related to production/marketing practices on a scale of 1 (most preferred) to 8 (least preferred. Respondents ranked Cooperative Extension workshops/field days as their most preferred source of information (Table 3). Running trials on their farm/land, Cooperative Extension publications and video, and observing trials on other farms were also highly ranked. The least preferred method for information was production/financial assessment tools. Respondents were also asked to rank information sources in terms of their level of trust in that source on a scale of 1 (most trusted) to 8 (least trusted). The most trustworthy sources are university research and neighboring growers (Table 4). The least trusted are federal agencies.

Respondents were asked to indicate their most commonly used resources (Figure 2). Soil testing and magazines were the most commonly used resources. Approximately half of participants used Extension workshops/field days and Extension publications/websites. One-third of respondents used USDA publications; consultants were used with similar frequency. Only around one-quarter of respondents reported using videos and apps as a source of information.

Figure 1. Production Methods Used ($N = 82$)

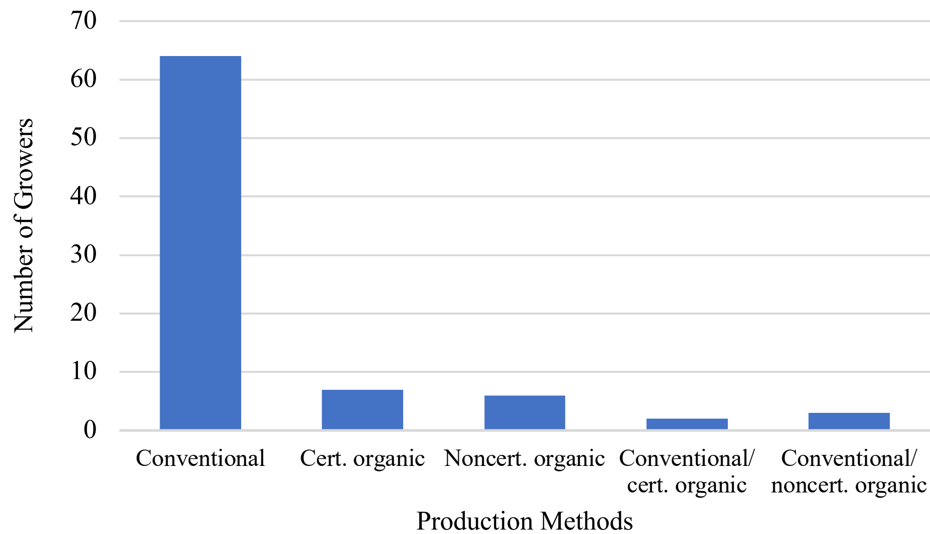


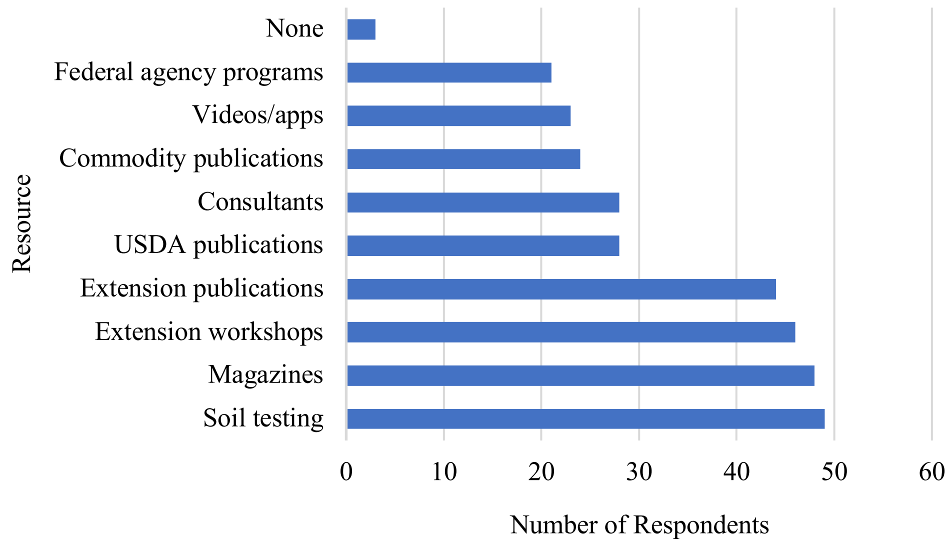
Table 3. Ranking of Preferred Information Providers ($N = 82$)

Rank of Preferred Method for Receiving Information or Tools (1 = Most Preferred)	Mode of Responses
Coop. extension publications/videos	2
Coop. extension field days/workshops	1
Production/financial assessment tools	7
On-site consultant	4
Commodity association	3
Trial on personal land	1
Trial on other farms	2

Table 4. Ranking of Trusted Information Sources ($N = 82$)

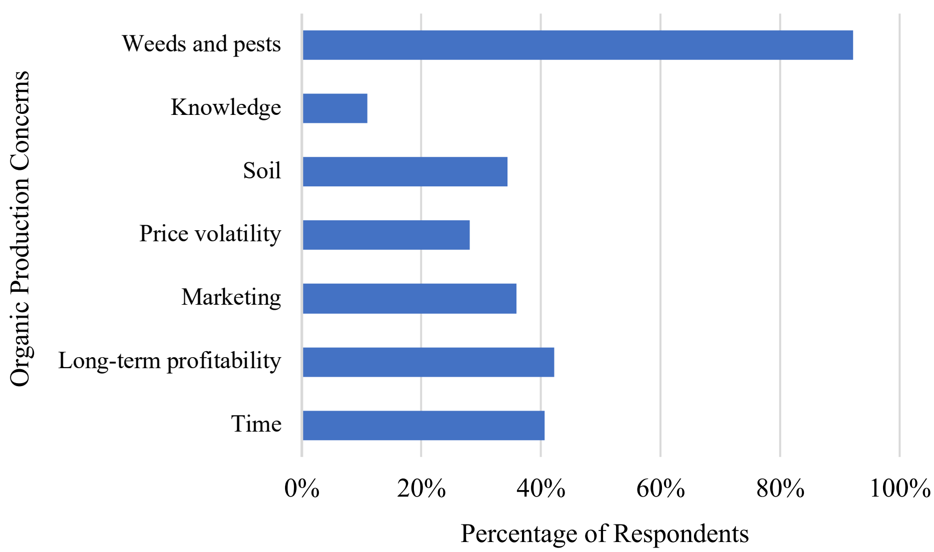
Rank of Trust in Information Source (1 = Most Trusted)	Mode of Responses
University	1
Neighbor	1
Extension resources	3
Product companies	4
Consultant	5
Commodity association	5
Federal loans/programs	7

Figure 2. Resource Use ($N = 65$)



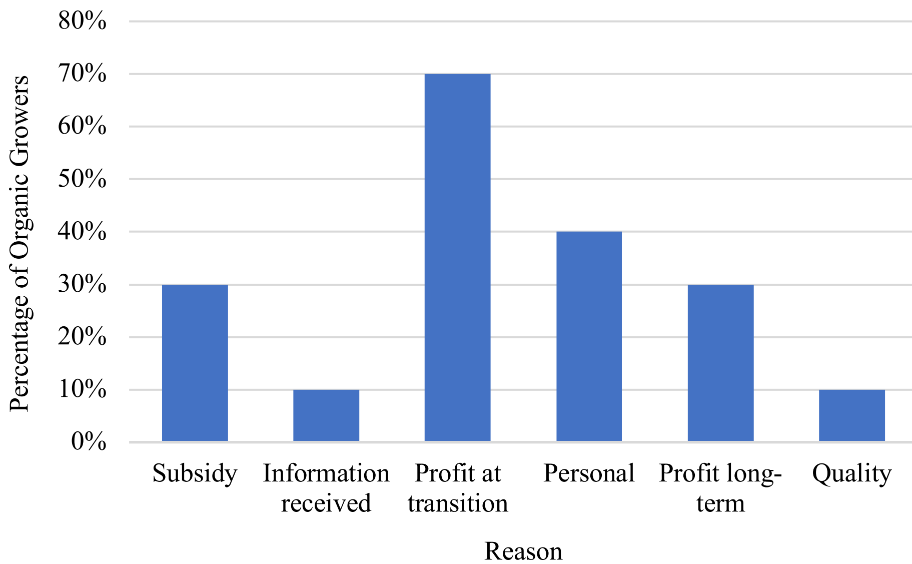
When asked about their concerns regarding organic farming (Figure 3), the most common response was weed and pest control (92%), followed by concern for long-term profitability in organic farming (42%), time required to certify (41%), marketing (36%), and soil impacts (34%). Only 28% of growers were concerned about the actual volatility of organic premiums. Additional concerns included the hassle of protecting organic products from exposure to chemicals, especially upon delivery and storage, and impact on neighboring farms.

Figure 3. Concerns Regarding Organic Production ($N = 66$)



Ten organic growers (both certified or not) responded to the question regarding motives for organic adoption (Figure 4). The most common response was profit opportunity at the time of transition (70%), followed by personal beliefs/values (40%). Additional reasons include continually rising input costs and the need for a more efficient way to kill herbicide-resistant weeds in conventional systems. Contrary to much of the previous literature, adoption based on information received was the least common response chosen on average. The availability of a subsidy was also a significant reason for adoption, but less than expected profit in the long- and short-term.

Figure 4. Motivations for Organic Adoption (*N* = 10)



Conclusions

This article examines the economic and social impediments to producer organic wheat adoption through an online survey of 82 wheat producers in the western United States. Despite strong growth in nationwide demand for organic wheat products, results show that wheat producers are transitioning out of organic production due to pest control and profitability concerns. Organic wheat production has seen annual reductions in yields, as much as a 10% year-over-year decline (Koory, 2018). While respondents were also concerned with the amount of time necessary to transition to organic production and marketing methods, future research and policy should focus on improving organic wheat yields and overall profitability, if organic wheat production is to keep up with demand.

This is also evidenced by results showing that current organic wheat producers were motivated to adopt organic methods by the profit potential and personal values at the time of transition. While these producers may be more motivated by altruistic ideals, obviously profitability is also a major concern. While information and knowledge surrounding organic production seemed to be less important to organic adoption decisions in the study sample, Cooperative Extension workshops, field-days, and publications were highly used and trusted. Hence, Extension may play a valuable role in conducting (especially through farm-based field trials) and disseminating research on yield improvements and financial planning in organic wheat production. Also, policies that provide subsidies to dampen the financial burden of transition and improve profitability potential may be more effective than others.

Acknowledgments

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Factors Affecting the Propensity to Purchase Specialty Eggs in the United States

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Abstract

The popularity of specialty eggs has grown in the United States as eggs provide healthy fats and proteins in the American diet. To benefit from this new trend, producers must strategize their marketing efforts. Using 2015 Nielsen Homescan data and probit analysis, we developed a profile for consumers of specialty eggs that producers and marketers can use to determine the best allocation of resources. Results found that the average consumers of specialty eggs are young households with high income, high education, with no children who live in the Pacific region of the United States.

Keywords: Nielsen data, probit model, specialty eggs

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Introduction

The specialty food market in the United States is a relatively new phenomenon. Specialty foods, of which organic are the most popular, are defined as "foods or beverages of the highest grade, style, and/or quality in their respective categories. Their specialty nature derives from uniqueness, origin, processing method, design, limited supply, unusual application or use, extraordinary packaging, or channel of distribution or sales" (Purcell and Tanner, 2015). The U.S. food market has recently been flooded with specialty varieties of common products. Consumer preferences for specialty food products have experienced double-digit growth, outpacing mainstream food staples (Specialty Food Association, 2017). The increased demand for these products may be the result of Americans embracing lifestyles that focus not only on health but also on the origins and ingredients of food products.

New health trends have placed extreme importance on high protein, low carb, minimally processed diets, which have significantly altered the buying habits of U.S. consumers. Retail sales of specialty foods grew 19% over 2012–2014 (Purcell and Tanner, 2015). Purcell (2016) reported that the core group of specialty food consumers were 62% of men, 58% of women, and they are 25–44 years of age. The percentage of consumers purchasing specialty foods varied by region, making up 71% of the population in the Pacific region, 66% in the Mountain states, and 62% in the Mid Atlantic. Of these consumers, 85% nationwide earn more than $150,000 per year. Millennials were also found to be more likely to buy organic produce, indicating that the specialty market will continue to increase in coming years.

Today, eggs are marketed as a good source of protein, a healthy breakfast that gives you energy throughout the day and keeps you fuller longer, good for mental energy, and a good source of vitamin D. This has allowed them to regain their popularity in the American diet. In 2016, 88.4 billion eggs were sold as table eggs. The average American consumes 268 eggs annually (Statista, 2019a).

Egg consumption dropped slightly in 2015 (to 253 eggs per person) due to turmoil caused by an outbreak of avian influenza. Although the virus is not transferable to humans, the disease resulted in thousands of laying hens being euthanized, severely impacting egg and poultry production. Researchers have two different views regarding consumer behavior in 2015: One group believes that after the price increases caused by the avian flu, the lower price of conventional eggs was just too tempting for the average consumer, causing greater demand for conventional eggs than specialty eggs (Wong, 2017). This trend continued as prices for conventional eggs dropped considerably in the following 2 years, resulting in the lowest prices of the last decade and a decrease in purchases of cage-free specialty eggs (Hirsch, 2017).

The second group believes that "a sharp drop in U.S. egg production due to impacts from an outbreak of Avian Influenza would increase sales of specialty eggs such as cage-free and organic because the price between conventional eggs and specialty eggs narrowed" (Lee, 2015). Several organic egg producers saw an increase in demand for their products as supply tightened and conventional egg prices increased. From 2000 to 2005, organic egg sales grew by an average annual rate of 19% (Nutrition Business Journal, 2006). Using Nielsen Homescan data, the U.S. Department of Agriculture estimated that organic eggs accounted for 1% of the fresh egg market in 2004. Growth in the specialty egg market is rapid, and organic eggs represent the fastest growing item in this category (Oberholtzer, Greene, and Lopez, 2006). However, specialty eggs go beyond organic and have expanded to include cage-free, free-range, nutrient-enhanced, omega-3, vegetarian-fed, and all-natural eggs. Aforementioned extra categories of specialty eggs on top of organic eggs are due to the extra production costs that are associated with choosing to forgo the conventional production process for the sake of satisfying the customer.

Companies have found that consumers will pay premium prices for goods with special nutritional claims on their labels, a behavior that the Agricultural Marketing Resource Center (2017) believes is a result of a combination of focus on consumer health, environmental concerns, and issues from animal welfare groups. Organic, free-range, cage-free, and omega-3 eggs have experienced growth in the recent marketplace. About 60% of consumers buy specialty eggs (Cowan, 2014), and sales of specialty eggs at U.S. retail stores increased from $28 million in 2014 to $78 million in 2016 (Statista, 2019b). A response to this increase in consumer demand has led about 100 grocery chains, 60 restaurant chains, and dozens of other major food businesses to promise to switch to cage-free eggs in the next decade (Wong, 2017). For the purposes of this research, any nontraditionally produced egg—including cage-free/free-roaming, free-range, organic, vegetarian-fed, pastured, nutrient-enhanced, and fertile—is considered a "specialty" egg.

The increased focus on health and natural eating in the United States has created a unique opportunity for specialty egg producers, making it important to identify characteristics of consumers of specialty eggs. This information will also provide the potential to grow target markets and create new customers who are willing to pay premium prices to purchase specialty eggs. Once target markets are identified, marketers and advertisers of specialty eggs can use this information to position and promote specialty eggs among those who buy as well as those who have not bought (the potential market for specialty eggs).

This study analyzes the socioeconomic and demographic factors affecting U.S. consumers' propensity to purchase specialty eggs. The specific objectives are to (i) determine the propensity to purchase of specialty eggs in the United States based on households' socioeconomic and demographic factors; and (ii) provide marketers of specialty eggs with recommendations on where to market to create maximum resource efficiency. We find that the average consumers of specialty eggs are young households with high income, high education, and no children who live in the Pacific region of the United States.

Data and Methodology

Using Nielsen Homescan panel data for 2015,[1] we identified households that purchased all eggs, regular eggs only, specialty eggs only, and both regular and specialty eggs. We used a probit model to determine the factors affecting households' propensity to purchase each type of egg.

[1] Based on data from the Nielsen Company (US), LLC, and marketing databases provided by 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 researchers 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.

For a dichotomous event, 0 and 1, the probit model can be depicted as follows:

(1) $$\Pr(Z = 1 \mid X, \beta) = F_P(Z_i)$$

(2) $$\Pr(Z = 0 \mid X, \beta) = 1 - F_P(Z_i)$$

Probability is depicted by the standard normal cumulative distribution function as shown in equation (3):

(3) $$P_i = F_P(X_i'\beta) = F_P(Z_i) = \int_{-\infty}^{Z_i} \frac{1}{\sqrt{2\pi}} e^{Z_i^2/2} \, ds$$

X are explanatory variables, β are associated regression coefficients, and $Z_i = X'\beta$ is the index value. Unknown parameters β are estimated using a maximum likelihood estimation technique.

Household demographics included in this analysis are income, household size, race, Hispanic ethnicity, education, age, child presence, employment, and region. Price of eggs was considered as an explanatory variable in each regression. For those households that did not purchase eggs, price of eggs was imputed using standard price imputation procedure in the literature (see Capps, et al., 1994; Alviola and Capps, 2010; Kyureghian, Capps, and Nayga, 2011; Dharmasena and Capps, 2012, Dharmasena and Capps, 2014; Wen et al., 2018).[2] All continuous variables (income, price, and household size) were converted to natural logarithms to improve model fit and statistical significance of parameter estimates. Table 1 reports the variables used and the respective base categories for dummy variables.

Results and Discussion

As shown in Table 2, the market penetration of households that purchased any type of eggs is 92.4%, regular eggs only is 59.2%, specialty eggs only is 6.7%, and both regular and specialty eggs is 32.1%. Each household purchased, on average, 15.41 dozen of any type of eggs, 14.3 dozen of regular eggs only, 9.4 dozen specialty eggs only, and 18.6 dozen both regular and specialty eggs. The average price was \$2.22/dozen for regular eggs and \$3.44/dozen for specialty.

The probit model uncovered factors affecting the propensity to purchase each type of eggs. For brevity, we only report such factors affecting the purchase of specialty eggs. An increase in household size makes the household less likely to buy only specialty eggs, but an increase in income makes a household more likely to purchase specialty eggs.

Compared to those classified as white, those classified as black were less likely and those classified as Asian were more likely to purchase specialty eggs. Compared to those with no high school education, college graduates were more likely to purchase only specialty eggs. This could

[2] These imputation regression results are not presented in the paper for brevity but are available from the authors upon request.

Table 1. Variables and Explanations

Variable Name	**Description**
ln_Price_Eggs	Natural logarithm of the price of eggs
ln_Price_RE	Natural logarithm of the price of regular eggs
ln_Price_SE	Natural logarithm of the price of specialty eggs
ln_Price_Both	Natural logarithm of the weighted average of both regular and specialty eggs
ln_household_size	Natural logarithm of the size of the household
ln_income	Natural logarithm of the size of the income of the household
Black	Race Black
Asian	Race Asian
Other	Race other
White (base)	Race White
Hispanic	Hispanic ethnicity
Non-Hispanic (base)	Non-Hispanic ethnicity
No-High School	No high school education
hs_grad	High school graduate education
Some_college	Some college-level education
College_grad	College education
Age_lt_ 35 (base)	Age under 35 years
Age36to50	Age 36–50 years
Age51to75	Age 51–75 years
Age 75plus	Age greater than 75 years
No-child (base)	No child in the household
Child	Child/children present in the household
Notforfullpay (base)	Employment not for full pay
Emphhpt	Employment part time
Emphhft	Employment full time
NewEng (base)	New England region
MidAtl	Mid-Atlantic region
EaNCen	East North Central region
WeNCen	West North Central region
SouAtl	South Atlantic region
EaSCen	East South Central region
WeSCen	West South Central region
Mount	Mountain region
Pacif	Pacific region

Table 2. Market Penetration, Price and Quantity

	Market Penetration	Quantity Purchased (dozens)	Average Price ($/dozen)
Purchased any type of eggs	92.4%	15.4	$2.41
Purchased regular eggs only	59.2%	14.3	$2.22
Purchased specialty eggs only	6.7%	9.4	$3.44
Purchased both regular and specialty eggs	32.1%	18.6	$2.71

Table 3. Probit Regression Results for Households that Purchased Specialty Eggs Only

Variable	Estimate	*p*-Value
Intercept	−3.2262	<0.0001
ln_Price_SE	0.0131	0.8210
ln_household_size	−0.2471	<0.0001
ln_income	0.1801	<0.0001
Black	−0.1478	<0.0001
Asian	0.1060	0.0078
Other	−0.0153	0.7149
Hispanic	−0.0525	0.1559
hs_grad	−0.0125	0.8527
Some_college	0.0684	0.3047
College_grad	0.2075	0.0017
Age36to50	0.0048	0.8978
Age51to75	−0.1360	0.0002
Age75plus	−0.1798	0.0001
Child	0.0121	0.6799
Emphhpt	0.0653	0.0049
Emphhft	−0.0251	0.2104
MidAtl	−0.1299	0.0015
EaNCen	−0.2847	<0.0001
WeNCen	−0.3050	<0.0001
SouAtl	−0.1631	<0.0001
EaSCen	−0.2394	<0.0001
WeSCen	−0.1783	<0.0001
Mount	−0.1250	0.0060
Pacif	0.2407	<0.0001

indicate that more education leads to healthier buying habits, or higher education could be correlated with an increase in income. Consumers under 35 years of age are more likely to purchase specialty eggs than those above the age of 51, which could be due to emerging health trends that have become popular among the millennial generation. Part-time workers are more likely to purchase only specialty eggs. These results could be associated with the fact that younger people purchase only specialty eggs, which is usually when part-time employment would be more common. Consumers in the Pacific region (Alaska, California, Hawaii, Oregon, and Washington) were most likely to purchase specialty eggs.

Conclusions, Recommendations, and Future Research

Based on the results, we are able to develop a profile of those consumers who are most likely to purchase –only specialty eggs. Producers and marketers of specialty eggs would benefit the most by placing their products in locations with not only a higher income level but also those in which income level is increasing. They should also market their products in areas with young populations and small average household size. Areas with higher percentages of single adults or young couples would be most desirable. It is probable that these areas would also have smaller numbers of children, which is another characteristic that matches the profile for a specialty egg consumer. This was the most surprising result from the data. Intuition would suggest that household would attempt to purchase specialty products in the presence of a child, but this was not the case for specialty eggs. It could be that specialty eggs are too expensive for the average household with children. It is more economical for parents to spend less per dozen by purchasing regular eggs. Consumers with higher levels of education were found to be more likely to purchase specialty eggs, so areas with high levels of education or towns where colleges are located would be the best places to sell specialty eggs. They should also be marketed in places with high levels of part-time employment. The Pacific region is best to market specialty eggs (California, Hawaii, Washington, Alaska, and Oregon). Producers of specialty eggs can use this information to market their products in areas that will create the most sales revenue and profit. Building on this work, quantitative estimation of marginal effects and demand elasticities for regular and specialty eggs is considered fruitful future research.

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Economic Productivity and Profitability Analysis for Whiteflies and Tomato Yellow Leaf Curl Virus (TYLCV) Management Options

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Abstract

Tomato yellow leaf curl virus (TYLCV), transmitted by whiteflies, is a major threat to tomato production worldwide (Moriones and Navas-Castillo, 2000; Lefeuvre et al., 2010). Yield losses up to 100% in affected fields are common (Rakib et al., 2011; Pan et al., 2012; Wu et al., 2012). This study investigates the economic productivity and profitability of treatment for TYLCV management. The economic models adopted for this study include farm enterprise budgeting, sensitivity analysis, and break-even analysis. Results show that total preharvest variable cost was $4,200/acre and the expected net return of $1,958/acre was attainable 50% of the time.

Keywords: enterprise budget, fixed costs, productivity, profitability, tomato, TYLCV, variable cost, white flies

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Introduction

Worldwide, fresh market tomato (*Lycopersicon esculentum* Mill.) production was 156.1 million pounds in 1978 (Fonsah and Hudgins, 2007), rising rapidly to about 3.0 billion pounds between 2009 and 2012. Thereafter, annual production experienced a slight decline to 2.6 billion pounds in 2013 and 2.7 billion pounds in 2014. Tomatoes are also the leading processed vegetable crop in the United States (Kelley and Boyhan, 2006), with average production of 26.2 billion pounds during 2009–2012, rising to 24.6 billion pounds in 2013 and 29.3 billion pounds in 2014. In 2015, an estimated 30 billion pounds of tomatoes were contracted by U.S. processors—an 11% increase compared to 2014 (Wells, Bond, and Thornsbury, 2015).

Background

Tomato Yellow Leaf Curl Virus (TYLCV)

Tomato yellow leaf curl virus (TYLCV), which causes yellow leaf curl disease in tomato, is a major threat to tomato cultivation worldwide (Czosnek, 2008). TYLCV is transmitted by the sweet potato whitefly, *Bemisia tabaci* (Genn.) (Moriones and Navas-Castillo, 2000; Lefeuvre et al, 2010). TYLCV was first identified in Israel in late 1950s and is now documented throughout the world (Czosnek, 2008). In the United States, it was introduced to Florida (Polston, McGovern, and Brown, 1999) possibly from the Caribbean (Alvarez and Abud-Antún, 1995). Subsequently, the virus spread into Georgia and the Carolinas (Momol et al., 1999; Polston et al., 2002; Ling et al., 2006). More recently, the virus was detected in Texas and California (Isakeit et al., 2007). Incidence of TYLCV has been steadily increasing ever since.

Though there is no official estimate of TYLCV-induced losses in tomato, losses are assumed to be in tens of millions of dollars, with quite a few fields suffering up to 100% yield loss. U.S. tomato production is predominantly in the field. In many parts of the world, TYLCV also infects greenhouse tomato due to spikes in *B. tabaci* populations (Rakib et al., 2011; Adi et al., 2012). Tomatoes infected by the virus exhibit various symptoms such as stunting and flower abortion, curling of the leaflet margins, yellowing of young leaves, inferior fruit quality, and decreased yields. Plant symptoms depend on many factors including the selected cultivar, management options, and environmental conditions (Moriones and Navas-Castillo, 2000; Wu et al., 2012; Chen et al., 2013; Rakib et al., 2011; Pan et al., 2012).

Strategies for Managing Whiteflies and TYLCV

Management of TYLCV is challenging and costly. A combination of management options is necessary to successfully manage the disease and limit losses. For instance, a combination of cultural and chemical management tactics is required (Polston and Lapidot, 2007; Van Brunschot et al., 2010).

Resistant Cultivars and Mulches

Planting TYLCV-resistant cultivars is probably the most important management option available to growers today. TYLCV resistance to cultivated tomato was successfully introgressed following breeding with numerous wild *Solanum* species (Lapidot and Friedman, 2002). Several commercially available TYLCV-resistant cultivars (such as Tygress, Shanty, Security, and Inbar) are currently available in the southeastern United States, and a number of additional breeding accessions are in the pipeline. The resistance imparted is generally mediated by a single semidominant gene (*Ty*). These cultivars are not immune to the virus and accumulate TYLCV, but they are known to exhibit only mild symptoms following TYLCV infection. However, these cultivars do not possess any resistance to whiteflies and support substantial whitefly populations (Srinivasan et al., 2012; Legarrea et al., 2015). Several resistant cultivars are available, but less than one-third of production acreage is planted with resistant cultivars. There are several reasons why growers have not resorted to planting resistant cultivars. Growers believe that the resistant cultivars have poor horticultural attributes compared with the standard TYLCV-susceptible tomato cultivars (Srinivasan et al., 2012). However, recent breeding efforts have resulted in currently resistant cultivars with horticultural attributes comparable to grower-preferred, TYLCV-susceptible cultivars.

Economic Evaluation

Although several studies have discussed the economic evaluation for preventing tomato with respect to pesticide use (Awondo et al., 2012; Engindeniz, 2006; Engindeniz and Cosar, 2013; Fonsah and Hudgins, 2007; Fonsah et al. 2008; Fonsah et al., 2010; Fonsah and Chidebelu ., 2012; Yardim and Edwards, 2003), exclusion screens (Taylor et al, 2001), intercropping and cultivars (Adeniyi, 2011; Cembali et al, 2003; Cembali, Folwell and Wandschneider, 2004; Rudi et al., 2010), limited recent studies have provided economics analyses of TYLCV prevention. This study developed an economic productivity and profitability analysis aimed at determining the financial and economic viability (if any) of managing TYLCV.

Methods

This experiment was conducted at the Coastal Plains Research Station in Tifton, Georgia, on the Horticulture Farm during the summers of 2013 through 2015. We specifically evaluated the use of TYLCV-resistant cultivars, metallic silver mulch, and the use of the insecticides AdmirePro (imidacloprid) and Verimark (cyantraniliprole) relative to white mulch, a TYLCV-susceptible tomato, and no insecticide check, respectively. Experimental response variables measured were whitefly adult, immature, and egg incidence; TYLCV symptom severity; and marketable yield. The experiments were split-split-split plot designs with four replicates, so that both main mulch treatment effects and treatment interactions could be compared relative to providing TYLCV and whitefly control. Reflective mulch acted as the main effect, insecticides acted as the subeffect, and TYLCV-resistant cultivars acted as the subsubeffect.

Tomato cultivars used included Shanty (Hazera, Coconut Creek, FL), Security (Harris Moran, Rochester, NY) Tygress (Seminis Vegetable Seeds, St. Loius, Missouri), and the susceptible cultivar FL-47 (Seminis Seeds, California,). Types of mulch used were reflective (Agricultural Metallized Mulch Film, Imaflex USA, Thomasville, NC) and a standard nonreflective white mulch (Intergro, Inc., Clearwater, FL). Insecticides used were cyantraniliprole (Verimark 20 SG, Dupont Crop Protection, Wilmington, DE) applied at 13.5 fl oz/acre, imidacloprid (AdmirePro 4.6F, Bayer

CropScience, Monheim am Rhein Monheim, Germany Global Headquarters) at 10.5 fl oz/acre, and water as a control. Each treatment was replicated four times.

Results

The inputs used in the economic analysis of insecticides for management of whitefly-transmitted TYLCV in tomato production differed slightly from conventional tomato production practices. For instance, the planting materials were TYLCV-resistant lines plants, which cost $466/acre. Silver mulch was $513/acre, while insecticide used to control white flies was $159/acre. The combined fertilizer cost was $692/acre. Fumigation, fungicides, and labor costs were $570/acre, $189/acre, and $550/acre, respectively. Total preharvest variable costs were $4,200/acre (Table 1).

Table 1. Preharvest Variable Costs of Producing Tomatoes in the Presence of Whitefly-Transmitted Tomato Yellow Leaf Curl Virus (TYLCV) in the Southeast United States, 2017

Preharvest Variable Costs	Unit of Application	Quantity of Application	Price per Application ($/unit/year)	Total Cost ($/acre/year)
TYLCV-resistant line plants	Thousand	3.97	117.50	466.48
Lime and gypsum	Ton	1.50	108.00	162.00
Fertilizer, granular[a]	Ton	1.00	350.00	350.00
Fertilizer, liquid (7-0-7)	Gallon	120.00	1.50	180.00
Plastic mulch[b]	4000-foot roll	2.23	230.00	512.90
Fumigation	Acre	200.00	2.85	570.00
Insecticide + TYLCV[c]	Fl oz	24.50	6.50	159.25
Fungicide	Application	3.00	63.33	189.99
Herbicide	Acre	1.90	31.34	59.55
Stakes	Thousand	4.00	40.00	160.00
String	Acre	30.00	1.55	46.50
Labor, machine operation	Hour	5.00	7.00	35.00
Labor, production transplant	Hour	100.00	5.50	550.00
Crop insurance	Acre	1.00	140.00	140.00
Consultant	Acre	1.00	70.00	70.00
Cleanup (plastic and stakes)	Acre	1.00	150.00	150.00
Machinery	Acre	1.00	25.76	25.76
Irrigation	Acre	1.00	220.83	220.83
Land rent	Acre	1.00	0.00	0.00
Interest on operation capital.	$	4048.25	0.08	151.81
Preharvest variable costs[d]				**4,200.06**

[a] Fertilizer use and quantities should be based on soil test.
[b] Metalized silver plastic mulch was used for this study.
[c] AdmirePro (Imidacloprid) and Verimark (cyantraniliprole) were used for the trials.
[d] Totals may not round up because of rounding errors.

A sensitivity analysis based on total cost of production indicated that the expected net return from producing tomatoes in the presence of TYLCV, obtainable 50% of the time, was $1,958/acre. The result further showed that −$887 may be obtained 7% of the time in a worst case scenario, while a rare net return of $4,802 is also realizable 7% of the time. This also means that good agricultural practices and adherence to management recommendations from research and extension scientists are necessary and sufficient conditions for success (Table 2).

Table 2. Sensitivity of Net Return of Producing Tomatoes in the Presence of Whitefly-Transmitted Tomato Yellow Leaf Curl Virus (TYLCV) in the Southeast United States, 2017

Net return levels (TOP ROW);
The chances of obtaining this level or more (MIDDLE ROW); and
The chances of obtaining this level or less (BOTTOM ROW).

	Best	**Optimistic**		**Expected**	**Pessimistic**		**Worst**
Net return levels ($)	4,802	3,854	2,906	1,958	1,010	62	-887
Chance of obtaining this level or more (%)	7%	16%	31%	50%			
Chance of obtaining this level of less (%)				50%	31%	16%	7%
Chances of Profit		**85%**		**Net Revenue**			**$1,958**

These results were based on an expected yield of 1,700 boxes/acre and an expected price of $8.00/box. The results also indicated that there was an 85% chance of obtaining a profit from adopting the appropriate recommended whitefly and TYLCV management production techniques.

Conclusions

Tomato yellow leaf curl virus (TYLCV) is a major problem for tomato farmers. The virus can reduce production and profitability if not managed, to the point of destroying an entire tomato farm. Studies conducted in the Coastal Plain by the University of Georgia scientists show that farmers can successfully produce tomato by adopting a combination of management tactics including resistant cultivars, reflective mulch, and insecticides. The inputs used in the economic analysis of integrating multiple management tactics adopted for the management of whitefly-transmitted TYLCV in tomato production were slightly different from the conventional tomato production practices. A sensitivity analysis based on total cost of production indicated an expected net return of $1,958/acre for producing tomatoes in the presence of whiteflies and TYLCV, obtainable 50% of the time.

Our results show preharvest breakeven variable cost of $2.47/carton, while the breakeven total cost of production is $6.85/carton.

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Nevada Value-Added Marketing Research and Education Program

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Abstract

Value-added products are an important direct marketing strategy to help Nevada small farms increase profitability. The project (i) educated food entrepreneurs and producers on the legal production and sales of food products in Nevada, markets, and food business; (ii) resulted in 31 new products sold by participants, with future targets of 102 new products and $304,800 in sales; (iii) increased income by over 3% among specialty-crop producers; and (iv) found fewer local food products in the natural grocery store market from 2015 to 2017. Value-adding of specialty crops in Nevada is now more accessible.

Keywords: food markets, food processing, local foods, value-added

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Background

Direct marketing strategies and the development of value-added products are essential for Nevada small farms to increase profitability for year-round farm sales. Small farms selling local foods struggle to be profitable (Lynch et al., 2018; Lacagnina et al., 2017). Small farms have incurred losses of 10%–40% for products that were of high quality for value-adding but not for selling to chefs or at farmers markets (Bishop, Gatzke, and Curtis, 2010). The combination of sales options can help improve the feasibility for sales and value-adding of local foods in rural areas (Gatzke, Cowee, and Harris, 2015). The path for processing food products for sale in Nevada was often unclear and shifted over time and depending on the health department personnel consulted. We established a project to support producers and aspiring specialty-food entrepreneurs to develop and profitably sell value-added products in Nevada.

Methods

We built a curriculum to be used in workshops by performing a literature review of strong food-processing value-added education programs, researching Federal and Nevada's food-processing requirements, compiling results from previous studies of local food markets, and researching local food markets in natural grocery stores. The curriculum used proven value-added education materials produced by Penn State Extension (2018) and the University of Maine Cooperative Extension (2018), federal food regulations, and Nevada-specific materials developed in this project. Before being incorporated into the curriculum, components of the curriculum were tested on small groups in three workshops held in 2016 and 2017. Post reflective surveys measured knowledge gain among workshop participants, and 4-to-6-month follow-up surveys were completed by phone. The University of Nevada, Reno, Institutional Review Board approved these tools.

Natural Grocer Market Study

The market research consisted of the types and amounts of local foods and competing products in natural grocery stores. We collected data on local foods in natural grocery markets by tracking required store policies for local foods and producers' experiences and documenting the local food items available in the stores yearly from 2015 to 2017 in the Reno and Las Vegas areas. The market analysis of farmers' market consumers and chefs' purchasing desires used for the project were from previous studies by University of Nevada Cooperative Extension (UNCE) (Curtis et al., 2008, 2010).

Results

Educate Steps for Making a Food Product Legal for Sale in Nevada

We designed and piloted a value-added curriculum to cover specific business organizing skills to enable Nevadans to increase their knowledge and develop or improve their food business profitability. The workshops taught business skills, an understanding of requirements for value-added foods, and marketing concepts. The curriculum included information on how to interpret federal and state requirements for food processing, inventory needs, and a full series of business considerations. Peer-reviewed publications on food businesses based on flavored vinegar, candy, pickles, jams, dried fruits and herbs, and cut and frozen products were produced as background on Nevada state law and used as content for presentations and workshops (Gatzke, Allen, and Bishop, 2017; Gatzke, Allen, and West, 2016a,b; Roemer, Gatzke, and Allen, 2017a,b; West, Gatzke, and Allen, 2015a,b). Food-processing specialist Karin Allen taught in some of the workshops and helped extensively in curriculum development.

The three-workshop series involved 46 participants who reported a 90% average gain in knowledge on the target information areas (Table 1). The survey results indicated that 30 participants planned to take action in their business based on this workshop; 9 indicated that they were not sure, 0 would not take action and 4 did not respond to the question in the survey. Written comments indicated that participants felt they had gained knowledge needed to create successful businesses.

Table 1. Food Business Workshop Results

Rate effectiveness of the workshop series (scale of low 1 to high 5)	***N***	**Mean**	**Std. Dev.**
Value of workshop	42	4.76	0.47
Usefulness of educational materials/information	44	4.64	0.53
Helpfulness to begin your food business	44	4.57	0.63

Please rate your understanding of the following topics before and after today's workshop (scale of low 1 to high 5)	***N***	**Mean before Workshop**	**Mean after Workshop**	**Percentage Increase**
How to source locally grown ingredients	20	2.20	4.25	93%
The food regulations and where to acquire help to ensure I comply	20	1.70	4.50	165%
How to label my products and manage inventory	20	2.30	4.53	97%
What to consider to price and determine the cost of my food product	20	2.95	4.76	61%
The characteristics of Nevada's local food markets	20	2.40	4.38	83%
The value of business management and planning	20	2.80	4.55	63%
How to find the best business structure for my business	20	2.60	4.43	70%
The insurance coverage I should consider for a food business	20	2.30	4.43	93%

In addition to the workshops, 199 individuals attended five presentations provided at other events and conferences about starting a cottage food or commercial food business in Nevada, including over 100 Las Vegas Master Gardeners in late 2015, 21 participants at a specialty-food workshop in Carson City, 25 participants at the 2017 Nevada Small Farm Conference, and 53 participants at two presentations at the 2016 Nevada Small Farm Conference. At these last two presentations, participants believed that their knowledge increased by 60% (N = 26) and 67% (N = 17), respectively.

Beyond the workshops and presentations, discussions on value-adding were held with over 120 people at the 2016 University of Nevada Research Station Field Day.

Identify Markets for Value-Added Products in Nevada Natural Grocery Stores

The requirements set by natural grocery stores for selling local food products have become more rigorous since the study was conducted. Regional natural food chains have changed their policies, adopting more complicated requirements for internal quality-control certifications for local products. During our study, the store contacts for sales moved to regional sales centers located in other states. As a result, personal contact and easy communication became more difficult.

The study results of local foods in natural grocery stores followed well-known market factors: Products made more convenient for eating were priced higher per unit weight; products made by locals and known by consumers bore the highest prices in their category; and unique products not found in regular grocery or big box stores were higher priced. During the study, stores started making more of their own labeled products, creating more competition for cut and prepared produce, salsas, and other locally-made products. Despite increased interest and demand for local foods, the number of local foods available for sale in natural food stores decreased by 20%–75%. Small, privately-owned stores, farmers' markets, and festivals currently provide the most significant opportunity for local food sales. Participants learned how to analyze the desires of target consumers, collect market information, and study potential market trends that aligned with their products.

Impacts

The collaboration and research provided by this project have provided a much clearer path to move value-added local foods to Nevada consumers. Participants in this project made 28 products before the start of the project. At the end of the project, 4–10 months after the workshops, 31 additional new products were being sold by the small number of the participants reached for a post-survey. Participants indicated that they anticipate producing 102 products within the next year. The targeted income from the value-added food sales in the next year was indicated as \$0–\$200 by eight participants, \$2,001–\$10,000 by four participants, \$10,001–\$30,000 by two participants, \$30,001–\$50,000 by one participant, and over \$100,000 by two participants. Project participants estimated they would create \$304,800 in sales in the next year.

Local communities will gain jobs and income from the development of the local food industry. Sales of food locally can provide economic benefits due to the positive 1.3–1.9 multiplier effect (Thilmany McFadden et al., 2016). Using the common 1.3 multiplier effect for rural areas, new value-added production could generate $396,240 in the coming year. People will continue to learn from the curriculum, creating ongoing impacts.

If 10% (1/3 of the estimated 30% industry-standard food costs) of value-added business income of $304,800 used specialty crops as an ingredient, charging a price 30% higher, then specialty-crop sales would result in $100,000 extra in growers' pockets. Producers who participated in the project indicated that their income easily increased by the targeted 3% for their specialty-crop operations due to a captured value from less than premium crops or surpluses.

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Are Concerns about Repaying Student Loan Debt Related to Health Status Rankings?

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Abstract

Student loan repayment concerns are influenced by marital status, income levels, race, and levels of financial literacy but not by age, area of residence, household size, work status, or gender. Students who are single, live in higher-income households, are non–African Americans, or are more financially literate are less likely to have repayment concerns. The negative and statistically significant coefficient for payoff suggests that borrowers who worry about repaying their student loan debts are less likely to rank their health as very good or excellent. Consequently, loan repayment concerns adversely affect how students rank their overall health status.

Keywords: binomial and ordered logit models, financial stress, health status, loan repayment, student loan debt

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Introduction

Data from the Federal Reserve Bank of New York (2018) indicate that, as of September 30, 2018, student loan debt stood at $1.44 trillion, the long-term delinquency (90+ days late) rate at 11.53%, and the new delinquency (30+ days late) rate at 9.21%. These delinquency rates imply that some borrowers experience difficulties repaying their student loan debt, and this could impact their overall health status. This inference is drawn from a 2017 survey of student loan borrowers in which more than 61% of these borrowers expressed some repayment concerns and more than 70% indicated that they were suffering from headaches, insomnia, anxiety, and social isolation due to the stress associated with the repayment of their student loan debt (Insler, 2017).

A consensus is now emerging among researchers that debt contributes to financial stress and that rampant stress affects the health and well-being of adults and young adults alike. In general, stress affects the nervous system, sleep, heart, and memory; elevates blood pressure levels; causes hair loss and changes in skin health; and worsens self-reported general health status (Sweet et al., 2013; Dilmaghani, 2017). When financial stress is added to the mix, self-rated health status falls. Choi (2009) agrees that financial stress adversely affects health and well-being; increases incidences of headaches, backaches, and ulcers; and elevates blood pressure and anxiety, among others. Chronic financial stress can also cause workplace absenteeism, affect workplace performance, or lead to depression. Choi (2009) also suggests that debt stress affects children and young adults, especially those from low-income families, who can become trapped in a perpetual cycle of poor health.

Financial illiteracy is very high in the general population, but it is more rampant among young adults. Thus, it is no surprise that many college students borrow more money than they need and, in some instances, underestimate how much they owe (Andruska et al., 2014). Consequently, more college students are reporting that they are under financial stress because of their student loan debt and the challenges in meeting their debt obligations (Walsemann, Gee, and Gentile, 2015). Research also suggests that students with high levels of financial stress are more likely to drop out of college before completing their academic programs (Britt et al., 2017). Other researchers have documented the long-term negative effects of student loan debt on career, marriage, and wealth accumulation, among others (Sieg and Wang, 2018). Zhang, Xiang, and Elliott (2016) indicate that educational loans negatively affect post-college net worth, financial and nonfinancial assets, and the value of primary housing. These effects are seen most strongly in young black adults.

For several decades, college costs have outpaced income growth. Many students and their families have had to use student loans to finance college. The situation worsened with the 2008 Financial Crisis and recession because many state governments were forced to make drastic cuts to higher education funding so that they could balance their budgets. As a result, colleges and universities were forced to shift more of their operating costs to students and their families by raising tuition and fees. During the recession, many displaced workers enrolled in college to improve their skill sets and career prospects, which led to additional increases in tuition and fees. Today, educational loans have become the primary way to pay for college, and an estimated 45 million Americans have student loan debt (Federal Reserve Bank of New York, 2018).

Because of the rapid increases in educational costs, student loan delinquency and default rates, and self-reported financial stress levels among college students, we designed our research project around financial literacy. Our main goal is to provide baseline data on undergraduate students' levels of financial literacy and related issues so that we can provide them with a few key tools and resources to expand their literacy levels and improve their money management skills and health status.

Objectives

The study's primary objectives are to (i) describe the relationship between concerns about repaying student loan debt and self-reported rankings of health status; (ii) examine the role that sociodemographic characteristics and financial literacy play on student loan repayment concerns; and (iii) determine whether selected sociodemographic characteristics and repayment concerns affect health status rankings.

Methods and Procedures

The study's data were derived from a 2015 survey of 499 undergraduate students. For this paper, we analyzed the presence of student loan debt, student loan repayment concerns, self-assessments of health status and levels of financial literacy, sociodemographic characteristics, financial behavior, and performance on a financial literacy quiz. We used Pearson correlation and the χ^2 test for independence to analyze the strength of the relationship between repayment concerns and health status rankings and discrete choice modeling techniques to estimate the multivariate models.

The response category for loan repayment concerns was binary; therefore, we used a binomial logit regression model to analyze the relationships between the dependent variable, PAYOFF, and the selected independent variables: AGE, LIVE, HSIZE, STATUS, INCOME, WORK, RACE, GENDER, and SCORE. The health ranking variable, HEALTH, initially had five response categories—poor, fair, good, very good, and excellent—but these were collapsed into three categories: poor/fair, good, and very good/excellent. We used an ordered logit regression model to analyze the relationships between the dependent variable, HEALTH, and selected independent variables: LIVE, HSIZE, WORK, RACE, GENDER, KNOW, BUDGET, and PPAYOFF. Because of our hypothesis that payoff concerns affect health, we used the predicted values from the payoff model (PPAYOFF) as an instrumental variable in the HEALTH model. The variables, their definitions, and summary statistics are presented in Table 1.

Empirical Results and Discussion

Of the 499 students sampled, 360 (72%) reported having student loans and 184 (51%) reported having student loan debt repayment concerns. The estimated Pearson correlation coefficient is −0.123 and is statistically significant at the 1% level of probability (Table 2). Thus, a negative linear relationship exists between payoff concerns and students' rankings of their overall health status. This finding is reinforced by the χ^2 test for independence between the two variables in Table 3. The statistically significant χ^2 coefficient (7.585) implies that the two variables are dependent and that students who express payoff concerns are less likely to rank their health status as good, very good, or excellent.

Table 1. Variables, Definitions, and Summary Statistics

Variables	Definitions	Summary Statistics
Independent		
AGE	Average age of participants in years	20
LIVE	Lives on campus = 1; lives off campus = 0	51%
HSIZE	Median number of persons living at participants' permanent address	3
STATUS	Single, never married = 1; otherwise = 0	97%
INCOME	Family's total household income: <$15,000 = 1;	22%
	$15,000–$34,999 = 2;	30%
	$35,000–$49,999 = 3;	22%
	≥$50,000 = 4 (reference variable)	26%
WORK	Working = 1; otherwise = 0	47%
RACE	African American = 1; otherwise = 0	93%
GENDER	Male =1; female = 0	39%
SCORE	Percentage earned on financial quiz	38%
KNOW	Level of financial knowledge: Poor = 1	6%
	Fair = 2	37%
	Good = 3	41%
	Very good = 4	12%
	Excellent = 5	4%
BUDGET	Uses a monthly budget: yes = 1; no = 0	36%
PPAYOFF	Predicted probabilities from the payoff model	
Dependent		
HEALTH	Poor/fair = 0;	16%
	Good = 1;	33%
	Very good/excellent = 2	51%
PAYOFF	Student loan repayment concerns: yes = 1; no = 0	37%

Table 4 presents results from the binomial logit model. Six of the selected variables have statistically significant coefficients, suggesting that they are likely to affect students' concerns about repaying their student loans. Participants who are single are 25 percentage points less likely to indicate repayment concerns compared to students who are not single. Students whose household incomes range from less than $15,000 to $49,999 have greater levels of repayment concerns than those from households with income levels of at least $50,000. African American students are 2.637 times more likely to indicate repayment concerns compared to non–African American students. The greater the level of financial literacy (SCORE), the lower the likelihood of having payback concerns. The model predicts 65% of observations correctly and is statistically significant at the 1% level of probability. Based on the statistically significant χ^2 coefficient ($\chi^2 = 44.567$), the model fits the data well.

Table 2. Correlation between Student Loan Repayment Concerns and Health Status Rankings

Variables	PAYOFF	HEALTH	p-Value
PAYOFF	1	−0.123***	0.006
HEALTH	−0.123***	1	

Note: Triple asterisks (***) indicate statistical significance at the 1% level.

Table 3. Cross-Tabulations between Loan Repayment Concerns and Health Status Rankings

	PAYOFF			
Variables	Yes	No	χ^2	p-Value
PERCENTAGES				
TOTAL	37	63		
HEALTH				
Poor/fair	49	52		
Good	39	61		
Very good/excellent	32	68	7.585**	0.023

Note: Double asterisks (**) indicate statistical significance at the 5% level.

Table 4. Binomial Logit Model's Results for Payoff Concerns

Variables	Estimated Coefficients	Standard Error	Wald	p-Value	Exp(β)
CONSTANT	−0.341	1.304	0.069	0.793	0.711
AGE	0.060	0.038	2.468	0.116	1.062
LIVE	0.106	0.218	0.238	0.626	1.112
HSIZE	−0.061	0.069	0.783	0.376	0.941
STATUS	−1.369*	0.698	3.839	0.050	0.254
INCOME					
<$15,000	1.219***	0.300	16.474	0.000	3.385
$15,000–$34,999	0.851***	0.285	8.901	0.003	2.341
$35,000–$49,999	0.891***	0.306	8.493	0.004	2.437
WORK	0.245	0.212	1.333	0.248	1.277
RACE	0.970**	0.462	4.400	0.036	2.637
GENDER	0.066	0.203	0.106	0.744	1.068
SCORE	−0.020**	0.010	4.500	0.034	0.980
Likelihood ratio test					
χ^2 (11)	44.567***			0.000	
Correctly predicted	65%				

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

Self-rated health status is influenced by area of residence, race, level of financial knowledge, and repayment concerns (Table 5). Students living on campus are less likely to rank their health status as poor or fair compared to students living off campus. Non–African American students are more likely to think of themselves as being in very good or excellent health. Those who ranked their level of financial knowledge as good, very good, or excellent are more likely to rank their health status higher. The negative and statistically significant coefficient for the instrumental variable, PPAYOFF, implies that rankings of overall health status decrease as repayment concerns increase. The statistically significant χ^2 coefficient (24.004) implies that the overall predictive capacity of the model is good. The statistically insignificant χ^2 coefficient suggests that the slope coefficients are the same across response categories.

Table 5: Ordered Logit Model's Results for Health Status Rankings

Variables	Estimated Coefficients	Standard Error	Wald	*p*-Value
LIVE	−0.342*	0.187	3.347	0.067
HSIZE	−0.058	0.063	0.859	0.354
WORK	−0.185	0.190	0.949	0.330
RACE	−0.865**	0.363	5.686	0.017
GENDER	0.253	0.182	1.940	0.164
KNOW	0.269***	0.100	7.316	0.007
BUDGET	0.043	0.187	0.053	0.819
PPAYOFF	−2.116***	0.719	8.655	0.003
Likelihood Ratio Test				
$\chi^2(8)$	24.004***			0.002
Test of Parallel Lines				
$\chi^2(8)$	7.995			0.434

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

Conclusions

Because of changes in the job market, many working Americans are now totally responsible for all financial decisions pertaining to their retirement and healthcare. However, very few have the knowledge to navigate the increasingly complex world of finance. Concurrently, increases in college and healthcare costs continue to outpace income growth, forcing more consumers to use debt to finance household obligations, particularly college. However, many students and their families do not fully understand the ramifications of student debt, and a sizable number of borrowers are now stressed by their debt loads. Student loan debt has been trending upwards, but levels of financial literacy have not risen accordingly.

Louisiana residents have never had stellar track records for health status or levels of financial literacy. Our study examined the link between students' loan repayment concerns, their perceptions of their overall health status, and factors associated with both. The results suggested that marital status, income, race, and level of financial literacy influenced loan repayment concerns and that payback concerns negatively affected health status rankings. These results mirror those from the literature with respect to financial stress, health, and health-related illnesses. Student loan debt and rising healthcare costs will eventually affect U.S. economic growth. These trends must be reversed. Financial illiteracy is at an all-time high, financial products have become more complex, and we are now responsible for more of our healthcare and financial decisions. We in higher education must increase our knowledge of personal financial matters and help our students become more financially savvy, which, in turn, may lower their stress levels about money and lead them to adopt healthier lifestyles.

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Creating a Farmers' Market Living Lab: Lessons Learned in Growing a Farmers' Market

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Abstract

The United States has experienced rapid growth in the number of farmers' markets over the past decade, but there has been little empirical research on how to increase sales at farmers' markets. We conducted multiple experiments at the Historic Lewes Farmers Market to test approaches to increasing sales and SNAP redemptions at the market at the stand and market levels. The research identified approaches that increased significantly increased sales and SNAP redemptions. This research demonstrates the value of real-world experimentation and research in identifying marketing best practices for farmers' markets.

Keywords: direct marketing, evaluation, experiments, farmers market, living lab, measurement, sales, SNAP

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Introduction

Sales growth is critical for the long-term viability of farmers' markets and to the success of the many farmers whose livelihoods depend on direct sales. However, while there are many ideas and lots of impressions of what works to increase sales, there is little systematic information or hard evidence on what actions effectively increase sales and attendance at farmers' markets. To address this gap, we used our market as a "living lab" in which to test ideas to improve sales and attendance not only at our own market but at markets nationwide. Because we had over 10 years of data on sales and attendance, we were in a good position to systematically test ideas. We conducted a total of 17 experiments, many of which were replicated.

Background

Founded in 2006 by volunteers from the community of Lewes, Delaware, the Historic Lewes Farmers Market is a nonprofit organization and a producer-only farmers' market with 35 local farmers/producers. In our first 11 years, from 2006–2018, the market drove approximately $6.5 million in sales for participating farmers/producers. The market accepts SNAP (Supplemental Nutrition Assistance Program) benefits and offers a match to help stretch these customers' food budgets. The Historic Lewes Farmers Market was a valuable asset in carrying out research that can serve to both improve sales at the market and to provide data that can help other farmers and markets across the country. The farmers' market was used as a "living lab"—a place where we could conduct experiments in real time, with actual farmers and customers, and analyze real-world results.

Methods

We conducted two types of experiments: At the market-stand level, we tested ideas at a single market stand and measured and compared sales before, during, and after the trial at that stand. At the market level, we tested out ideas at the market and compared overall market sales and/or attendance to the same week the prior year and the weeks before and after the trial.

Results

We conducted multiple experiments, summarized below, over a 2-year period. These include the results of experiments that may be helpful to farmers or to farmers' market managers and lessons learned from attempts to increase the use of SNAP benefits at the market.

Photos Placed on Coolers

Farmers and producers frequently keep products for sale in coolers rather than on display. We found that placing photos of the products on the exteriors of coolers increased sales by an average of 26%.

Recipe Cards

We were surprised that simply adding recipe cards to market stalls did not have much impact on sales, although many customers took the recipe cards. We then explored ways to improve the impact of recipe cards on sales and found that offering simple, easy-to-prepare recipes for unfamiliar produce; positioning the recipe cards next to the main product in the recipe; and using the recipe cards as an opportunity to talk and engage with customers all led to an increase in sales.

Customer Loyalty Cards

We experimented with two approaches for customer loyalty cards. In one, customers received $5 in free produce after accumulating cardpunches for $50 in purchases. In the other, customers received an entry to win a picnic basket stocked with barbeque items for a group picnic for every 5 weekly purchases. Sales increased 39% year to year in the latter case and decreased 12% in the former. However, in the case in which the sales declined, the farmer's health problems had resulted in fewer goods being brought to market.

Meet the Farmer Presentations

We conducted five Meet the Farmer presentations, which involved a presentation by the farmer along with a high-quality, one-page biography handed out to participants. Sales increased very little (an average of 1%) on the day of the presentation, but sales the week after each presentation increased an average of 41% (impacts ranged from −17% to 79%). Farmers who provided samples during their presentation saw the largest increases in sales.

Market Pairing Demonstrations

We experimented with Market Pairing events that involved a demonstration by a local volunteer demonstrating a recipe that could be made at home in 20 minutes or less and that used products from at least two farmers. At each Market Pairing demo, we provided recipes and signage listing the products used and the market stalls where the foods could be purchased. This boosted sales of featured products by an average of 20%. We found that the improved sales continued into the following week. We think this was so effective partly because it was a third-party endorsement of a product and partly because the recipes were more approachable than those offered by professional chefs.

Market-Wide Special Events with Samplings

We evaluated the impact of holding market-wide special event days. Typically, each special event day included a demo and/or sampling of market products accompanied by a thank you sign recognizing the farmer who donated the product. Producers whose meats were featured in our Father's Day grilling demonstrations saw their sales increase by 15%–30%, with an average increase of 25%. We also saw a 5% increase in overall market sales compared to the same week the prior year and a $1.47 increase in the average amount spent per customer. On Customer Appreciation Day, producers who donated samples experienced sales increases of 7%–8%. On

Kids' Day, sales for the two farmers donating a kids' snack sample went up by 27% and 6%. There was a 3% year-over-year increase in total spending at the market on Kids' Day and a 13% increase in market attendance, but average spending per customer decreased by $1.55.

Advertising Test

We held a free raffle to test the effectiveness of our advertising channels. We ran advertisements announcing the raffle in our online channels (including email newsletter, social media, and website) and in our weekly newspaper advertisement, using a different "secret phrase" for each version. Anyone could enter the raffle for free, but they received two entries if they mentioned one of the secret phrases. This allowed us to identify where the customer had found out about the raffle. We found that far more customers had seen our newspaper ad than our online marketing, by a ratio of 2:1. We share this not to recommend one type of advertising over another, but to encourage analysis of marketing strategies.

Activities to Attract More SNAP Customers

We evaluated the impact of undertaking an integrated set of activities to attract more SNAP customers. These activities included distributing bilingual promotional cards, meeting with staff at local social service agencies and community organizations to describe the market SNAP matching dollar program, offering SNAP families a promotion on Kids' Day, and opening a new market more accessible to public transportation. In the first year of conducting these activities, we saw 57% year-over-year growth in new SNAP customers, a 24% increase in total SNAP customers, and a 31% increase in SNAP dollars issued. Approximately one-third of the growth in new SNAP customers came from the new market.

Conclusions

Real-world experimentation at farmers' markets can provide valuable insights about the effectiveness of activities to increase sales and attendance at farmers' markets.

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