A meta-analysis of willingness to pay for local beef

by

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ABSTRACT

Over the past few decades, consumer demand for fresh locally produced foods has been increasing. This demand is most evident in the increasing number of farmers markets that brought farmers and their fresh locally produced produce closer to local consumers across the country. Between 2002 and 2012, US farm operations with food sales directly to consumers increased from 5.5 % to 6.9%. The 2007 Census of Agriculture reported direct-to-consumer sales revenue of $1.2 billion, a significant increase from $551 million reported a decade earlier.

As the direct-to-consumer market for farmers expanded, researchers' interest in the factors influencing consumers' willingness to pay also increased. Numerous studies were conducted between the early 1990s and the mid-2000s about this topic. They covered numerous products, locations, and consumers segments. It is difficult to make sense of the results given their diversity and breadth. This research attempts to bring some clarity to the results from the various studies by focusing on a single product in the US: locally produced ground beef. The study used five qualifying studies in the US and a meta-analysis approach to estimate the factors influencing consumers' willingness to pay given their characteristics. The results from this study bring the diverse results from the five different studies together to provide a comprehensive insight into the characteristics of consumers that determine their willingness to pay. These results would be helpful to beef farmers and their supply chain partners who are seeking to enhance their value extraction by working in the local direct-to-consumer market.

The results show that the average willingness to pay for local ground beef was about $1.28 per pound above commodity ground beef, with a standard deviation of $0.04 per pound. There was statistical difference between the premium female and male consumers were willing to pay for fresh local ground beef. However, the difference in the premiums those with bachelor's degree or higher and those without was statistically significant at the 1% level. Similarly, the difference between the premiums those with incomes above $75,000 and those with incomes below $75,000 were willing to pay was statistically significant at the 5% level. Race did not influence the premiums consumers were willing to pay. Consumers in the Midwest, the Northeast and the South were all willing to pay more than consumers at the national level, and the differences between their premiums were statistically significant at the 1% level. The foregoing would suggest that farmers interested in producing fresh local ground beef for direct to consumer marketing should segment the market to target those with higher education and incomes. Agricultural regions of the country present more competition, and it may be more difficult for farmers in these regions to extract higher premiums that farmers in non-agricultural regions.

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CHAPTER I: INTRODUCTION

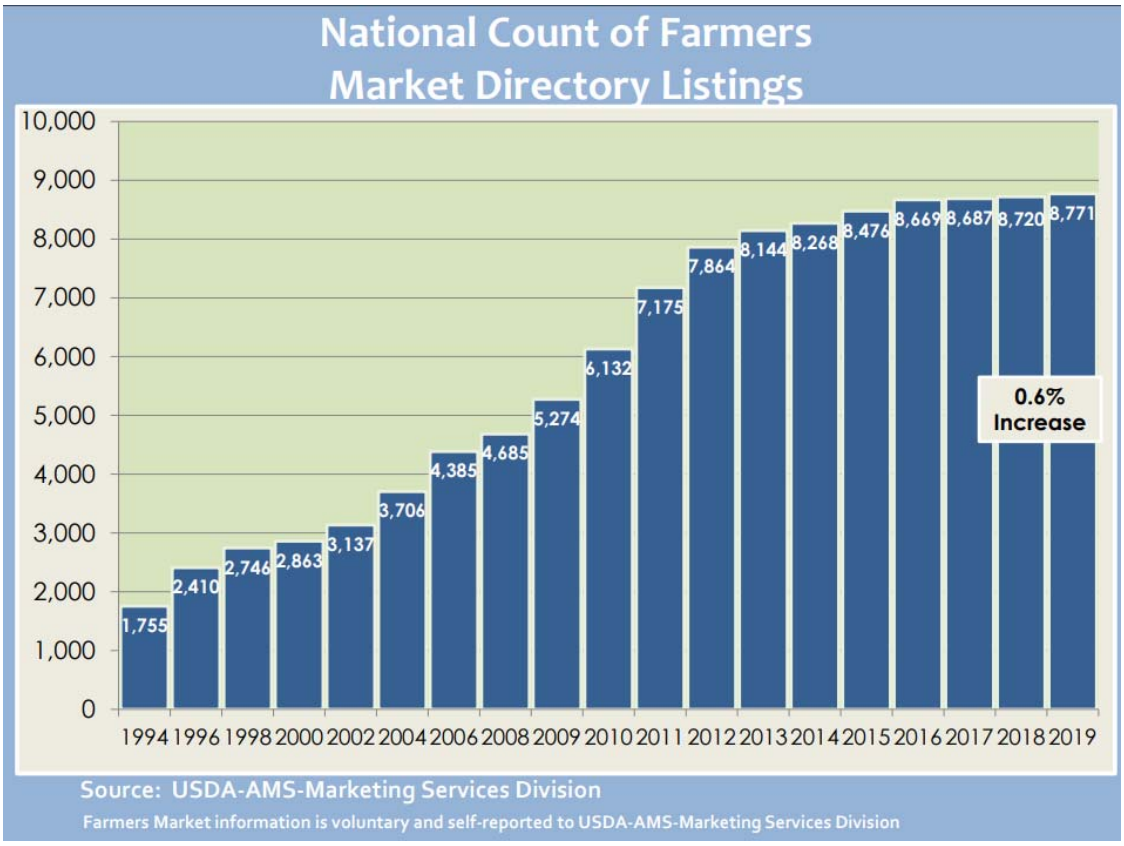
Over the past few decades, consumer demand for fresh locally produced foods has been increasing. Between 2002 and 2012, U.S. farm operations with food sales directly to consumers increased from 5.5 % to 6.9% (Low, et al. 2015). In 2007 the Census of Agriculture reported a direct-to-consumer marketing of $1.2 billion in sales which was a large comparison from the $551 million reported in the previous decade. (Martinez, et al. 2010)

Another indicator of growth in this local food system movement can be seen in the large increase in farmers markets, a common retail outlet for locally produced goods. The United States Department of Agriculture reports a 6% increase in registered farmers markets since 1994 (U.S. Department of Agriculture, Agricultural Marketing Service (AMS) 2019). Each year, more and more markets register with the USDA (Figure 1). These farmers markets create an important platform to link farmers and consumers.

Farmers markets have been increasing because of a perception that the spread between farm gate price and retail price for farm commodities are becoming too wide, implying farmers' share of the consumers' expenditure on food products have been declining.

One important segment of this movement is locally produced meat, which in recent years has seen an increase in demand. For example, a 2013 consumer survey showed that 39% of them had tried locally produced meat within the previous 12 months (Woods n.d.) This survey also showed a larger proportion of consumers interested in locally produced meat compared to other niche segments for meat, such as natural, organic and grass-fed.

Figure 1.1 Farmers Market Listings (1994 -2019)



Studies have shown that consumers who are purchasing local beef are motivated by a variety of factors with supporting local economy and reducing impact on the environment at the forefront. (Bernard 2012). These consumers are putting high value on extrinsic characteristics associated with locally produced beef.

On the production side, the USDA reports that farmers who market food directly to consumers had a greater chance of positive sales in 2007 and 2012 compared to those with traditional channels. This is especially true for beginning farmers. As seen in figure 1.2 (Low, et al. 2015). Positive sales are very important as farm business survival rates are very low. The census of agriculture reports that in 2007, only 55.7% of all farms reported positive sales (Low, et al. 2015).

The growth in this consumer segment provides a unique opportunity for beef producers looking to add value to their products and increase their overall revenue.

Figure 1.2 Business Survival Rates 2007-12 by Initial Farm Size and Marketing Arrangement

	All operations		Beginning farmer in 2007	
2007 sales category	No direct sales in 2007	Direct sales in 2007	No direct sales in 2007	Direct sales in 2007
$1-9,999				
Survival rate, 2007-12	0.453	0.549***	0.416	0.507***
Observations	484,211	51,535	177,392	22,170
$10,000-49,999				
Survival rate, 2007-12	0.581	0.667***	0.521	0.611***
Observations	268,758	23,729	68,053	7,647
$50,000-249,999				
Survival rate, 2007-12	0.656	0.738***	0.593	0.649***
Observations	194,563	11,270	35,364	2,661
$250,000+				
Survival rate, 2007-12	0.728	0.791***	0.66	0.704***
Observations	178,515	5,450	27,115	800
All				
Survival rate, 2007-12	0.553	0.609***	0.474	0.543***
Observations	1,126,047	91,984	307,924	33,278

Notes: Asterisks denote rejection of the null hypothesis that the difference in means is zero at the (*) 10%; (**) 1%; and (***) 0.1% statistical significance levels. Sample includes all operations with positive sales in 2007. The survival rate is defined as the share of 2007 Census respondents with positive sales who reported positive sales in the Census in 2012.

Source: USDA, NASS, Census of Agriculture, 2007, 2012.

Due to the unique nature of this consumer segment, it is important to understand how much this consumer base is willing to pay for local beef so producers can successfully operate in this market. Over the past decade several studies have sought to understand consumers' willingness to pay for locally produced beef in a variety of regions throughout the United States. Each study provides unique insight into the overall premium available to producers in this niche market.

In addition to understanding how much consumers are willing to pay, the studies also identify the characteristics of the consumers who exhibit a preference for local beef products. What they lack is the overall effect of consumer characteristics on these regional willingness to pay estimates for beef products. Developing a broader view beyond these atomistic estimates found these studies, so that inferences about the types of consumers and the amount they are willing to pay above non-local beef products can be made may be valuable for many beef cattle producers interested in participating in this market. This is the problem that this research seeks to address.

1.1. Research Question and Objectives

The previous studies conducted on beef cover many types of beef products including steak and ground beef. This study focuses on ground beef because of a couple of reasons. First it is a commodity that has a common definition across many markets, allowing the price premiums to be compared and aggregated with minimum risk of aggregation fallacies. The other reason is that there were more studies available on ground beef than any other single beef product. The research question of interest is this: What is consumer willingness to pay for ground beef across the United States and to what extend do consumer characteristics influence the amount they are willing to pay?

The overall objective is to estimate the extent to which consumer characteristics determine their willingness to pay. The specific objectives are as follows:

1. Review, identify and select the appropriate studies to include in a meta-analysis study of consumers' willingness to pay for ground beef products in the United States.
2. Employ a Monte Carlo simulation method to expand the data to allow for an effective estimation of a regression model exploring the effects of consumer characteristics on their willingness to pay for locally produced ground beef.
3. Estimate the extent to which consumers' willingness to pay can support farmers with interest in undertaking direct-to-consumer production.

1.2. Outline of the Thesis

This opening chapter has described the background to the study, arguing that demand for locally produced products, including locally produced beef products has been increasing in the United States. This increase, we argued, warrants the determination of consumers' willingness to pay such that the feasibility of undertaking direct-to-consumer sales and marketing activities in beef products can be better understood by interested farmers. A review of the literature on willingness to pay in general, the approaches used to discover it and their limitation and advantages is presented in Chapter 2. Additionally, the extant literature on meta-analytical method is presented. Chapter 3 presents the data, conceptual framework and empirical analysis. The estimation results are presented and discussed in Chapter 4, while the summary, conclusions and suggestions for further study emanating from the weakness of the current study are presented in Chapter 5. Also in Chapter 5 is the

discussion of the strategic direction that the study offers farmers who may be interested in undertaking direct-to-consumer ground beef sales in the United States.

CHAPTER II: REVIEW OF THE LITERATURE

In this chapter, a review of the literature on locally produced beef is presented. The methods used assess consumer preferences for locally produced beef are also presented. The chapter is divided into four main sections. The first section reviews literature over the methods used to conduct this research. The second provides an overview of the qualifications of the products for the "local" assignment and its strategic importance in farm economics. The third section focuses on the principal methods used to evaluate the preferences of consumers who demand local food and local beef products. The final section is a review the literature on willingness to pay for local beef specifically.

2.1 Willingness to Pay

According to (Gall-Ely 2009) a consumer's willingness to pay is essentially the maximum price a consumer will pay for a product. It can be considered floor reservation price which is essentially the last point a consumer is 100% certain to buy a certain product. (Gall-Ely 2009) This is measurement is very individualized as each consumer has unique motivations and preferences for their purchases. It is important for producers to understand what consumers are willing to pay for locally produced beef, as well as what motivates them to do so.

2.2 Meta-Analysis Approach

As described in (Stanley, Wheat from Chaff: Meta-Analysis As Quantitative Literature Review 2001), quantitative research synthesis like meta-analysis gives researchers the tools to effectively pool together empirical research results from a number of independent studies. The combination of the individual datasets help increase the explanatory power and

potentially provide insight that was otherwise unseen. This analytical approach is very useful when combining willingness to pay studies as these studies are generally conducted on a smaller, more regionalized scale.

Stanley et. al. (2001) outlines a distinct pathway in order to successfully conduct a meta-analysis: 1. include all relevant studies., 2. select a common metric., 3. select and code variables., 4. meta-regression & analysis. We will use this process to guide our research.

2.3 Demand for Local Beef

Maynard at al. (2003) conducted a sensory panel in Kentucky of 61 consumers and determined that 15% of consumers would pay a 40% premium for locally produced steaks. They also determined that 64% of the population would pay a 20% premium for locally produced ground beef. The research indicated that consumers who would pay a 40% premium put a high emphasis on source verification.

Maynard, et al. (2004) conducted a survey of 227 consumers in Lexington, Kentucky and determined 55% of participants purchased locally produced steak, making it the highest participation rate in the study. The researchers warned however that the demand for locally produced steak was the most price elastic of the options presented to consumers.

Umberger et al. (2009) used contingent valuation to review preferences and willingness to pay for consumers in the United States. They determined 46.5% of consumers would pay a premium for natural, regionally produced ground beef.

2.4 Preferences and Attributes linked to Willingness to Pay

Several studies captured in our literature search identified links between consumers' willingness to pay and other attributes associated with beef. Li et al. (2018) determined consumers who purchase locally produced beef place a higher value on helping local economies and supporting local farmers. Pennsylvania and West Virginia consumers were surveyed in (Evans, et al. 2011) and they reviewed consumer perceptions for Appalachian grass-fed beef. They determined that consumers who viewed local production at a priority were also significantly more likely to purchase grass-fed steak. Providing a link between grass-fed and locally produced beef.

Umberger et al. (2009) determined that consumers, who placed a high value on humane treatment of cattle, had a higher willingness to way for natural, regionally produced beef. This finding is consistent with (Bernard 2012) findings that consumers who purchased locally produced beef considered humane treatment as the third most motivating factor for their purchase.

2.5 Willingness to Pay for Locally Produced Beef Steak

Local beef can hold a variety of definitions. The United States Department of Agriculture defines local productions as less than 400 miles from its origin or within the state in which the product was produced (Martinez, et al. 2010).

Using the local definition of product produced within the boundaries of state, (Dobbs, et al. 2016) surveyed consumers in metro areas of Tennessee. They conducted telephone surveys based off a random selection of consumers in five large cities (Memphis, Nashville, Chattanooga, Knoxville and Tri-Cities). They found that the Willingness to pay for

boneless ribeye steak produced from cattle raise and produced within the boundaries of Tennessee by 42.3% participants was $5.06/lb. above base price for boneless ribeye steak. This is an estimated premium of 54.7% for local steak.

Merritt, et al. (2018) surveyed consumers in both metro and non-metro regions of Tennessee. They found for USDA Choice boneless rib-eye beef steak consumers in a control group had a willingness to pay of $2.42/lb. and consumers in the information group (provided more label context) would pay $2.89/lb., both over base price. Both studies showed a positive willingness to pay for Tennessee Certified Beef.

Sackett et al. (2016) conducted a choice experiment on a national level to determine interest in four label attributes (sustainable, organic, local or unlabeled). They determined that consumers would pay a premium of $2.29/lb. for locally produced steak. This willingness to pay premium was consistent with the organic attribute and was slightly higher than the sustainable label. Another important finding was that the willingness to pay coefficient was significantly higher than a private or USDA label. The results of this study highlight consumers' preferences for the local label attribute.

Li, et al. (2018) conducted a large national survey and found a willingness to pay for locally produced beef steak of $2.59/lb. The consumers were presented with the USDA definition of local of within 400 miles or production within the state of residence.

Chen, et al. (2015) surveyed consumers in Delaware and estimated a willingness to pay of $2.75/lb. for locally produced beef. They determined that locally produced beef had a lower willingness to pay compared to organically produced beef.

CHAPTER III: DATA AND METHODS

In this chapter, the data and methods employed in addressing the objectives of the study are presented and discussed. The section is organized into two main sections. The first presents the data used and their sources. The second presents the methods used.

3.1. Data

As described in Chapter 2, in order to appropriately collect the willingness to pay data, a thorough review of scientific literature was conducted. As described in (Stanley, Wheat from Chaff: Meta-Analysis As Quantitative Literature Review 2001), all relevant studies found in this search were included to reduce potential biases in this meta-analysis review. This search was conducted through Kansas State University's library online search function and the following external databases were reviewed: Worldcat, Google Scholar, and EBSCO. These databases provided a robust source of scientific literature. In order to find relevant literature, the following search terms were used: "Local Beef", "Willingness to Pay + Local Beef", "Regionally Produced Beef", "Consumer Preference for Local Beef". The search was initially expanded to the years 1990 to 2020. The preliminary search populated a good amount of literature from 2010 to 2020. In order to look for older literature, a search for material between 1990 and 2010 was conducted. Using these parameters and the search terms described previously this search produced no literature with Willingness to Pay data for locally produced beef. With this information the literature review period was moved from a 30 year review to a 10 year review. The search concluded with a group of 12 studies that referred to the willingness to pay for local beef. Five studies were initially removed as they did not contain an actual willingness to pay estimation. Seven pieces of literature that estimated willingness to pay for locally produced

beef throughout the United States. Out of this set, one study was removed from the analysis because it did not specify the cut of beef product. It only referred to the product as locally produced beef.

Ensuring consistency across the different datasets developed from the studies is important for accuracy of the results. The first step to ensuring this was the product of interested must be the same. Therefore, only studies that focused on or included willingness to pay for 85% lean/15% fat ground beef were included. Based on this parameter, two additional studies were removed from the dataset as referenced in Figure 3.1. A remaining five studies used in the analyses are described in Table 3.1.

Figure 3.1 Systematic Literature Review for Meta-Analysis

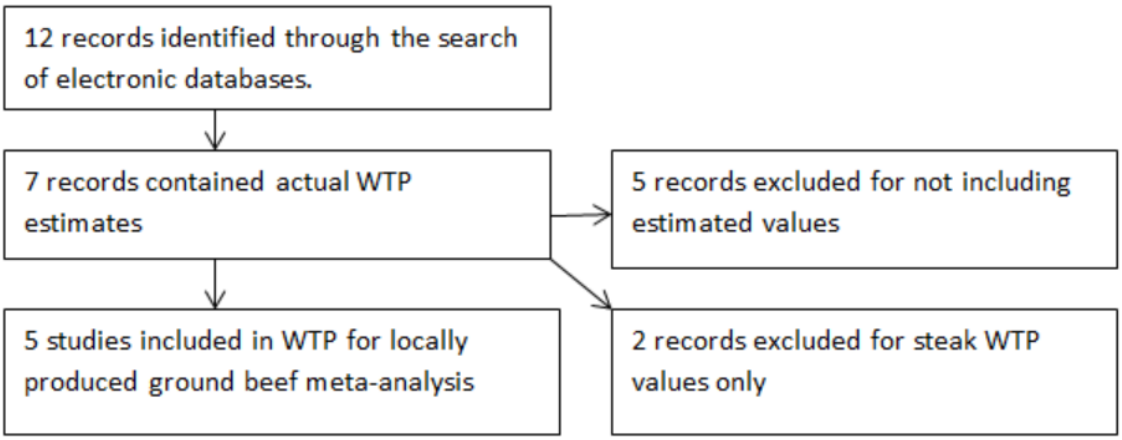


Table 3.1 Literature Focusing on Ground Beef Included in Research

Year	Author	Journal	Sample Size	Region	Product	WTP $/lb.
2013	Chang, et al. 2013	Journal of International Food & Agribusiness Marketing	53	South Dakota	Ground Beef	$0.71
2015	Adalja, et al. 2015	Agricultural and Resource Economics Review	327	Maryland	Ground Beef	$2.72
2016	Dobbs, et. Al. 2016	Journal of Food Distribution Research	314	Tennessee	Ground Beef	$1.66
2018	Merritt, et al. 2018	Journal of Agricultural and Applied Economics	204	Tennessee	Ground Beef	$1.53
2018	Li, et al. 2018	Journal of Agricultural and Applied Economics	1688	National	Ground Beef	$0.95

3.2 Review Data

3.2.1 Northern Midwest Region of the United States

Chang et al. (2013) conducted a choice experiment with consumers in Brookings, South Dakota to determine their willingness to pay for ground beef. Their survey evaluated seven total product attributes including the two relevant to this research, price and brand. The brand attribute was broken into four levels: National Brand, State Level brand, Locally Grown and None. State and locally grown were broken apart to determine if consumers had a preference to one or the other based on their personal definition of local.

The consumer questionnaires were broken into two groups, a control and a “cheap talk” group. The “cheap talk” consumers were provided a statement to think about their choices in real life situations in an attempt to help reduce overestimation.

Consumers in both groups had a strong preference for locally produced beef over a popular national brand Omaha Steaks. It also determined there was little difference in the preference for South Dakota Certified over Locally Produced labels. Based on this finding, we work under the assumption that consumers view these attributes as similar in nature. For our analysis, we used the willingness to pay data in the change between the national brand to locally produced.

Consumers in the control group showed a willingness to pay of $1.55/lb. for locally produced beef over Omaha Steaks ground beef. The "cheap talk" group showed a slightly lower willingness to pay at $0.71/lb. for local beef over the national brand. The demographic characteristics of respondents in the Brookings, South Dakota area are summarized in Table 3.2.

Table 3.2 Respondent demographics in Chang et al. (2013) paper

Variable Type	Variable	Frequency	Sample Size
Gender	Female	77%	53
Race	Percent White	94%	53
Income	Over 75,000	27%	53
Education	Bachelor's degree or higher	83%	53
Age	60 and over	19%	53

3.2.2. Southeast Region of the United States

During the review of literature, two studies were identified that estimated willingness to pay for locally produced ground beef in Tennessee. Dobbs, et al. (2016) surveyed consumers in five metropolitan cities in Tennessee: Memphis, Nashville, Chattanooga, Knoxville and Tri-Cities. The demographics for these consumers are outlined in Table 3.3. A total of 314 consumers were surveyed to understand the importance of intrinsic attributes and extrinsic attributes, including local production. Through this method, the researchers

were able to determine that 36.3% of consumers valued local production and would pay a premium for ground beef produced in Tennessee.

Through an additional contingent valuation question, they estimated these consumers would pay $1.66/lb. above base price for 85% lean/15% fat ground beef produced in Tennessee. This was a premium of 49.4% for locally produced ground beef.

Table 3.3 Respondent demographics in Dobbs et al. (2016) literature

Variable Type	Variable	Frequency	Sample Size
Gender	Female	59%	314
Race	Percent White	75%	314
Income	Over $75,000	30%	314
Education	Bachelor's degree or higher	41%	314
Age	65 years old or older	31.2%	314

Merritt, et al. (2018) used choice experiments to look at consumers' Willingness to Pay for Tennessee Certified Beef. This research was extended to consumers in both metro and nonmetro areas of Tennessee. The demographics for this sample size is described in Table 3.4. Consumers were broken into two groups, a control and information group. The control group was not given additional information about local products and consumers in the information treatment were provided a brief definition of Tennessee Certified Beef. Both groups exhibited a positive willingness to pay for Tennessee Certified Beef. For USDA Choice 85% lean/15% fat ground beef, informed consumers had a willingness to pay over base price of $1.53/lb. and $1.15/lb. for the control group.

Table 3.4 Respondent demographics in Merritt et al. (2018) literature

Variable Type	Variable	Frequency	Sample Size
Gender	Female	75%	204
Race	% White	77%	204
Income	Over $75,000	34%	204
Education	Bachelor's degree or higher	33%	204
Age	65 years and older	16%	204

3.2.3. Northeastern Region of the United States

Adalja et al. (2015) looked at Maryland's consumers' Willingness to Pay for locally produced ground beef. Using a hypothetical survey, they sampled two groups of consumers. One was a Maryland buying club that consist of consumers who placed orders online and had fresh groceries delivered to their home each week. The second group was a random sample of consumers. The consumers in the buying group would pay a premium of $1.21/lb. for ground beef produced within 100 miles of their location. The random sample of consumers were willing to pay a higher premium, $2.72/lb. and $2.39/lb. for ground beef produced within 100 miles and 400 miles respectively. Interestingly enough, the consumers in the buying group would not pay a premium for ground beef produced within 400 miles of their location. Adalja, et al. (2015) extended this research to a nonhypothetical experiment with random consumers in a Maryland grocery store. They found a Willingness to Pay of $1.47/lb for ground beef produced within 100 miles. They also determined that distance was important for over 44% of consumers sampled. The demographics of the treatment group is outlined in Table 5.

Table 3.5 Respondent demographics in Adalja, et al. (2015) literature

Variable Type	Variable	Frequency	Sample Size
Gender	Female	58.5%	327
Race	% White	78%	327
Income	Over $75,000	62.25%	327
Education	Bachelor's Degree or Higher	82.8%	327
Age	65 years and older	18%	327

3.2.4. National

Li, et al. (2018) conducted a contingent choice experiment with a large national study designed to represent U.S. Population demographics. The demographics for this study were not reported in the literature. A representative sample was derived from (United States Census Buearu 2018) demographic data and can be seen in Table 6. The consumers were asked a series of questions based upon extrinsic characteristics at a variety of price points. The researchers found a willingness to pay of $0.71 /lb. over the base price of ground beef.

Table 3.6 Respondent demographics in Li et al. (2018) literature

Variable Type	Variable	Frequency	Sample Size
Gender	Female	51%	1688
Race	% White	76.5%	1688
Income	Over $75,000	33.5%	1688
Education	Bachelor's Degree or Higher	31.5%	1688
Age	65 years and older	16%	1688

3.3 Meta-Regression Modeling

Now that we have identified five studies that contained relevant empirical estimates, we needed to work to combine the results so they can be effectively analyzed together. (Stanley, Wheat from Chaff: Meta-Analysis As Quantitative Literature Review 2001) To keep consistency, we reviewed the treatment group of each of the five studies. Grouping together the literature gave us an initial sample size of 2586. In order to increase the overall

power of the dataset, we increased the sample size to 5003, while maintaining the proportional representation of each sample size in the overall dataset.

For this expansion, we used a Monte Carlo simulation technique. A Monte Carlo simulation as it is a powerful tool that allows us to mimic our sample distribution. Using the standard deviation and mean from each study, we were able to simulate values that are essentially drawn from the sample population. This simulation allows us to add randomness to our variables while maintaining proportional representation.

To start, four of the five studies did not explicitly report standard deviations in their report. They did, however, report confidence intervals. Using a method described in (Higgins and Green 2011) it was possible to estimate the standard deviation. The method was as follows:

$$s = \sqrt{n} * (u - l)/T(\rho)$$

Where s is standard deviation, n is the sample size, u and l are the upper and lower limit estimates of the confidence interval and t is the t-value at the confidence interval, p. The rule of thumb, according to Cochrane, is 3.92 for 5% confidence interval.

Once a standard deviation for each study is determined and using the reported mean willingness to pay value, we were able to run a Monte Carlo simulation using Microsoft Excel® to expand the sample size of the variables. For each of the simulated values, y, the Excel formula was used:

$$y = NORMINV(RAND(\quad), s, \mu)$$

Where s is standard deviation and μ is the mean.

The next step in analysis was to code common characteristics into variables that can be used for a regression.

Dependent Variable. The dependent variable used for this analysis is the willingness to pay value reported in each of the five studies. This variable is reported in a U.S. dollar per pound basis. The units are the amount consumers will pay over the base price of beef in each reported region. The inherent problem with this meta-regression is a small set of willingness to pay values. The literature reported a total of five unique willingness to pay values for an expanded sample size of 5003. In this form, a proper regression modeling would not occur. We needed to make adjustments. Consequently, we used the Monte Carlo simulation described in the previous section. This approach allowed us to go from 5 Willingness to pay values to 5003 values.

Independent Variables.

Female. A common theme in the reviewed literature was a gender variable. We coded this variable as binary with 1 equaling female and 0 for male. It is hypothesized that the sign for the female variable will be negative as reported in previous local food willingness to pay research as with (Printezis, Grebitus and Hirsch 2019).

Race. Race is included because there is a belief that willingness to pay for local ground beef is influenced by the non-varying characteristics of race. The hypothesis is the whites are more likely to pay for locally produced ground beef than non-whites. Thus, race was coded 1 if the respondent was white, and 0 if non-white.

Income. Income is another demographic observed in a majority of the research listed. It is expressed as a dummy variable with 1 equaling an income over $75,000 a year and 0 meaning less than $75,000 per year. This threshold was based upon the findings of (Dobbs, et al. 2016) showing a change in the tendency to purchase locally produced beef in the

range of $50,000 and $70,000. This threshold is used to defined higher versus lower income households. We are estimating that this coefficient will be positive as seen in (Brown 2003)with other local food products.

Education. The education variable is formatted as a dummy variable with 1 equaling a bachelor's degree or higher and 0 as no. This was an important variable to include to understand the relationship between higher education and the propensity to purchase locally produced ground beef. We anticipate that this coefficient will be positive.

Age. The age variable was formatted as a dummy variable with 1 equaling over the age of 65 years old and 0 for those younger in age. Age was not reported consistently through the research we reviewed. (Li, et al. 2018), (Merritt, et al. 2018), (Dobbs, et al. 2016) did not directly report age. This data was extrapolated by the data reported through (United States Census Bureau 2018) (United States Census Bureau 2018) (Bureau, United States Census 2016) respectively. (Adalja, et al. 2015) reported the median age of participants and in order to get this into the binary format, we pulled the age range for this region from (United States Census Bureau 2015). Additionally, we anticipate that this coefficient will be negative as seen in (Dobbs, et al. 2016) indicating that older consumers were less likely to find value in the local attribute.

National. The national variable is indicative of whether the study was conducted on a national scale or a more regionalized area. This is coded as a dummy variable with yes = 1 and no = 0. We anticipate that this coefficient will be negative.

Expend. The expenditure variable is based on the average dollar amount spent on beef in households. This variable was not included in the analyzed research; rather this data was

pulled from (U.S. Bureau of Labor Statistics n.d.) for the region and year appropriate for each study. This variable was included to determine if there is a relationship between overall beef purchases for a home and a increase in the purchase for locally produced beef.

As with the Willingness to Pay variable, we were limited to five total Consumer Expenditure values, one for each study. Adjustments would be necessary to ensure regression was possible. Again, we used a Monte Carlo simulation technique. Using the reported mean and standard deviation for each expenditure value, we were able to simulate values within the sample. This allows us to get random values that are essentially pulled from the population. We hypothesized that this coefficient will be a positive value.

Sqrt(n). In order to reduce the impact of the uneven sample sizes of the literature used for this meta-analysis, we needed to include a precision variable. A precision measure such as sqrt(n) as an independent variable can adequately explain the variation in the Willingness to Pay estimates. (Printezis, Grebitus and Hirsch 2019).

Our base hypothesis for the meta-regression model is that the willingness to pay for locally produced ground beef can be influenced by the identified independent variables. The variables and general descriptive statistics can be seen in Table 7.

The base model can be seen in equation 1.

$$WTP_i = \beta_0 + \beta_1 (SQRTn) + \beta_1 (Female) + \beta_1 (Race) + \beta_1 (Income) + \beta_1 (Education) + \beta_1 (Age) + \beta_1 (National) + \beta_1 (Expenditure) \quad (1)$$

In order to discuss results as a change in percent as opposed to a change in a unit of willingness to pay, we need to adjust our base model. We will take the log of the willingness to pay dependent variable. The adjusted model is as follows:

$\log WTP_i = \beta_0 + \beta_1$ (SQRTn) + β_1 (Female) + β_1 (Race) + β_1 (Income) + β_1 (Education) + β_1 (Age) + β_1 (National) + β_1 (Expenditure) (2)

Equation (2) was estimated using gretl cross-platform software package for econometric analysis.

Table 3.7 Summary Statistics of Meta-Regression Variables

Variable	Definition	Mean	Standard Deviation	Expected Sign
Dependent Variable				
WTP	WTP for the locally produced ground beef $/lb.	1.297	2.907	+
Independent Variable				
Female	Percent of female participants in the study = 1, 0 otherwise.	0.556	0.496	-
Race	Percent of participants that identity as white = 1, 0 otherwise.	0.772	0.419	+
Income	Participants who make over $75,000 per year = 1, 0 otherwise.	0.363	0.480	+
Education	Participants who have a bachelor's degree or higher = 1, 0 otherwise.	0.402	0.490	+
Age	Participants who are 65 years old or older = 1, 0 otherwise.	0.181	0.385	-
National	Experiment was conducted on a national level = 1, 0 otherwise.	0.652	0.476	-
Expenditure	Simulated estimate of annual consumer expenditure on ground beef ($).	126.83	71571.99	+
Precision Variable				
Sqrt(n)	SQRT of expanded sample size.	45.230	16.46	-

CHAPTER IV: RESULTS

In this chapter, the meta-regression results and application of the findings are discussed. This section is organized into two main sections. The first presents the results of the regression, including key findings. The second portion presents potential application as it relates to beef producers.

4.1. Regression Results

The linear regression (Table 4.1) shows us that income and education are the two demographic independent variables that positively impact consumers' willingness to pay for locally produced ground beef. These results are consistent with our expected values. The results show that the education variable is the most positively associated with increased willingness to pay. Consumers with a higher education, carrying a Bachelor's degree or higher are 0.11% more likely to pay for the local attribute. This is significant at a 1% level.

Income was the next most influential variable. More specifically, those who make more than $75,000 per year are 0.09 percent more likely to pay for local ground beef. This result is significant at a level of 5 percent. This result is important to note as (Dobbs, et al. 2016) found that income had a non-linear effect on willingness to pay for locally produced beef.

The expenditure (Expend) coefficient was also positive as expected; however it was not statistically significant. This shows us that an increase in the amount of beef purchased in households does not necessary translate into a strong linear relationship with purchasing locally produced ground beef. The result highlights the niche market nature of local production.

Our results also point to gender (Female) playing an important role in purchasing behavior. Females were shown to be 0.03 percent less likely to purchase local ground beef. This did not come as a surprise as we expected a negative coefficient for this variable.

The coefficient on race was not statistically significant, implying that there was no difference between white and non-white consumers in their willingness to pay for local ground beef. The hypothesis is that whites were more likely to pay a premium for local ground beef is, therefore, rejected.

It had been hypothesized that older respondents would be less willing to pay premiums than younger respondents would. The rationale was that with the age threshold at 65 years, most consumers at that age are on fixed incomes from their retirement and are therefore more selective about their expenses. The results indicate that respondents over 65 years old would pay 0.17% less than those below 65 years old, and the difference was statistically significant at the 1% level.

Likewise, the results indicate that consumers in national studies were willingness to pay about 3.8% less than consumer in local studies, and this was statistically significant at the 1% level. This may be because the meaning of local is more diffused at the national level than at the regional level. At the regional level, respondents can identify with who the local producer is.

Table 4.1: Meta-Analysis Regression Results for Willingness to Pay for Ground Beef in the United States

Log_WTP	Coefficient	Std. Error	p-value
Constant	−1.24***	0.084	0.000
Female	−0.037 *	0.022	0.096
Race	−0.021	0.021	0.328
Income	0.093 **	0.036	0.011
Education	0.115 ***	0.034	0.000
Age	−0.174 ***	0.024	0.000
National	−3.861 ***	0.120	0.000
Expend	0.00	0.000	0.564
Sqrtn	0.088 ***	0.003	0.000

*, **, *** denote significance at the 10%, 5%, and 1% levels, respectively.

4.2 Strategic Application of Results for Interested Farmers

The results from this study can be helpful to beef producers and their supply chain partners who seek to enhance their value extraction by working in the local direct-to-consumer market. They can use this information to customize their overall strategic approaches to appeal to this specialized segment of the market.

First, producers will want to ensure appropriate pricing so they can optimize value innovation. They are selling a premium product, however they should proceed with caution to ensure they are not pricing themselves out of the market. The results show that the average willingness to pay for local ground beef was about $1.28 per pound above commodity ground beef. This can be used as a benchmark for a pricing strategy. They will need to adjust pricing to match the niche market they are working within. It is important to note that agricultural regions of the country present more competition, and it may be more difficult for farmers in these regions to extract higher premiums that farmers in non-agricultural regions.

Second, producers will need to understand who their target consumer is. This study outlines demographic variables that either increase or decrease the percentage at which consumers are willing to pay for locally produced beef. The results help identify the consumer base that is willing to pay the highest premium.

Based upon the results of this study, producers would want to focus their marketing efforts on: 1) younger consumers and explicitly those under 65 years of age., 2) higher earning consumers who make over $75,000 per year., and 3) consumers who have a higher education with bachelor's degree or higher. Consumers that fit this demographic should be considered their core consumer. There results also show statistical differences between the premium female and male consumers were willing to pay for fresh local ground beef, with females willing to pay less. Race did not influence the premiums consumers were willing to pay.

It would be of value for producers to seek out the ideal retail environments for these consumers. This may be either through farmers markets with the core consumer demographic as a known clientele or retailers that focus on premium items and will apply emphasis on locally produced foods.

Third, producers will also want to tailor their marketing message to a more regionalized market. As the results indicated, consumers in a national audience were not as likely to purchase locally produced beef as those in a smaller region. It seems that the value of "local" disappears when the product's locality is beyond the consumers' idea of local. This highlights the need for local marketing programs. Truly focusing in on the specifics of the niche market they are working within. Help with targeting this message may come in the

form of state branding programs. Many states have branding programs associated with their Department of Agriculture programs. These programs can provide a valuable resource in appropriately branding their products for the specific niche market they are targeting.

As mentioned in Chapter 1, one factor that motivates consumers to purchase local products is the desire to stimulate local economy. Another motivation is environmental protection, as these consumers seek to reduce their carbon footprint (Bernard 2012). There is potential value in creating marketing messages that combine both environmental and local support.

By combining a marketing message that focusing on known core motivations for purchasing local beef with targeting a core demographic, producers can maximize the share in the niche market.

CHAPTER V: CONCLUSION

This final chapter is broken into two sections, a summary and a review of the limitations and future considerations for this research. The summary is a brief overview of the research and generalized findings. The second section highlights the inherent limitations with the research and ways to potentially expand in the future.

5.1. Summary

The overall objective of this research was to conduct a meta-regression analysis of the willingness to pay for locally produced ground beef. Using meta-analysis principles, we combined relevant literature to define relationships on a larger scale. The results of this regression pointed to key demographic factors that either increase or decrease the percentage that consumers are willing to pay for the local attribute. The demographics that have the largest influence are education and income. At the same time, national and increased age played the largest role in decreasing the percentage in which a consumer would be willing the pay. Additionally, the results show that the average willingness to pay for local ground beef was about $1.28 per pound above commodity ground beef.

These findings can help producers define a target consumer base. Through the development of this target consumer base, producers can adjust their marketing efforts to optimize their placement within this niche market.

5.1. Limitations and Considerations of Research

An inherent limitation of this meta-analysis is a lack of enough relevant literature to draw on. As described in Chapter 3, it was necessary to apply a Monte Carlo simulation in order to create a dataset that could effectively be used in a meta-regression. Although this simulation as effective, we needed to make assumptions.

Going forward, there may be value in extending this research to a global scale. By increasing the search parameters, we could potentially add a larger data set. Another benefit of adding literature from other regions is the potential for understanding how target consumers may be similar or different throughout the world.

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