EAT MO BEEF: EFFECTS OF REGIONAL LABELING ON MISSOURI
CONSUMERS' BEEF PREFERENCES

A Thesis

Presented to

The Faculty of the Graduate School
at the University of Missouri-Columbia

In Partial Fulfillment

of the Requirements for the Degree

Master of Science

By

CALEB ROBERTSON

Dr. Scott Brown, Thesis Supervisor

MAY 2021

The undersigned, appointed by the dean of the Graduate School, have examined the thesis entitled

EAT MO BEEF: EFFECTS OF REGIONAL LABELING ON MISSOURI
CONSUMERS' BEEF PREFERENCES

presented by Caleb Robertson,

a candidate for the degree of master of science,

and hereby certify that, in their opinion, it is worthy of acceptance.

Dr. Scott Brown

Dr. Laura McCann

Dr. Raymond Massey

ACKNOWLEDGEMENTS

First and foremost, I would like to thank Dr. Scott Brown for his mentorship that guided me to this place in my academic career. His wisdom, kindness, and willingness to contribute to my success is impossible to repay. I only hope that I can one day pay it forward to another young economist with ideas that are far beyond their own ability.

I would also like to thank Dr. Laura McCann and Dr. Ray Massey, who not only were critical in the thesis process, but also taught me a great deal in the classroom. I only wish it was possible to cite them for every thinking strategy and method of analysis in this thesis.

I would like to thank Darlene Kruse for all the work she does that often goes unnoticed. Without her reminders and assistance, there is a strong chance that this thesis would not have been finished on time.

Finally, I would like to thank my parents, Bryce and Kristin, my brother, Clayton, and my wonderful fiancée, Allison, for their support and encouragement throughout the entire degree process.

Thank you all for the time and energy you invested in my academic journey, I am forever grateful.

TABLE OF CONTENTS

ACKNOWLEDGEMENTS	ii
LIST OF TABLES/ILLUSTRATIONS	iv
ABSTRACT	v
Chapter	
1. INTRODUCTION	1
2. BACKGROUND/LITERATURE REVIEW	4
2.1 Background of Missouri Beef Industry and Market Dynamics	
2.2 Willingness to Pay	
2.3 Previous Research	
3. METHODS	14
3.1 Sample	
3.2 Data Quality	
3.3 Choice Experiment	
3.4 Choice Experiment Design	
4. EMPIRICAL RESULTS/DATA	20
5. DISCUSSION/CONCLUSION	24
3.1 Discussion	
3.2 Word Association	
3.3 Processing Costs/Concerns	
3.4 COVID-19 Disruptions	
3.5 Limitations of this Research	
3.6 Conclusion	
APPENDIX	32
BIBLIOGRAPHY	33

LIST OF ILLUSTRATIONS/TABLES

Figure/Table	Page
1.1 Size Quintiles of Slaughter Facilities (Ollinger, 2013)	2
2.1 Food Need Hierarchy (Lusk, 2018)	9
2.2 Attribute Willingness to Pay – Premium Estimates	13
3.1 Sample Choice Experiment Survey Question	19
3.2 Survey Choice Experiment Questions (Attributes and Levels)	19
4.1 Survey Summary Statistics	20
4.2 WTP premium measures for entire sample	21
4.3 Willingness to Pay Estimates by Demographic	22
4.4 Bar Graph of WTP Premium Estimates by Demographic	23
5.1 “Missouri Grown” Word Cloud	26
5.2 Local Food Word Cloud	26

EAT MO BEEF: EFFECTS OF REGIONAL LABELING ON MISSOURI
CONSUMERS' BEEF PREFERENCES

Caleb Robertson

Dr. Scott Brown, Thesis Supervisor

ABSTRACT

With recent activity suggesting a desire to increase Missouri's meat processing capacity, it is necessary to provide consumer data for industry consideration. The objective of this research is to empirically measure Missouri consumers' willingness-to-pay for various beef attributes and how this varies by age and location of respondents. Through a statewide survey and discrete choice analysis, this study found statistically significant premiums for all three variables under consideration: Missouri grown, local, and USDA prime. Of these, local demanded the highest premium across all demographics with a maximum of \$2.23 per pound of top loin steak. These premiums are indicative of value-added opportunities, but do not account for additional processing costs incurred and therefore do not guarantee increased profitability.

Chapter 1. Introduction

Missouri ranks among the top US states for beef cattle inventory, with more than 4.3 million cows and calves residing within its borders. The cattle industry is critical to overall Missouri farm income, contributing more than \$1.88 billion in production value in 2019; the second highest of all Missouri commodities after soybeans. Despite this incredible volume and importance to the state economy, the vast majority of yearly cattle production is fed, slaughtered and processed out-of-state. Missouri is a major feeder calf exporter, sending the majority of its calves to be finished in other Midwestern states such as Kansas and Nebraska (Brown 2016).

Is there a place for small-scale meatpacking in Missouri? A 2013 United States Department of Agriculture (USDA), Economic Research Service (ERS) report (Stillman, 2013) looked at processing issues for locally produced meat. They found that small-scale processing facilities faced inconsistent demand for their services, resulting in an inability to cover significant expenses like a skilled workforce and costly equipment. Their research developed expense models for three sizes of local processors, showing the large capital expenditures that require up to 8,884 head of cattle to be processed per year just to break even. When considering these levels of necessary investment resulting in economies of scale, consolidation in the meatpacking industry should not be a surprise. Figure 1.1 illustrates this by showing output by size quintile. The largest plants produce 10,000 times more than the lowest quintile plants. The incredible amount of volume and infrastructure needed to be cost-effective makes it difficult for

conventional Missouri cow-calf producers to vertically reach into these additional enterprises.

Fig. 1.1 Processing Industry: Output per plant by industry quintile (Ollinger et al., 2011)

<i>Size Quintile</i>	<i>0-19</i>	<i>20-39</i>	<i>40-59</i>	<i>60-79</i>	<i>80-99</i>
<i>Mean Pounds/Plant</i>	28,042	157,808	508,319	3,328,599	317,592,240

Note: includes only cattle slaughter facilities

However, the local food movement presents attractive opportunities for Missouri producers. Consumption trends indicate that the traditional demand factors of price, income, taste and convenience are being superseded by information regarding production methods. (Tonsor, 2010) USDA National Agriculture Statistics Service (NASS) shows that 2017 Missouri direct to consumer sales totaled \$30,330,000, and local and regionally labeled products through retail markets or hubs grossed an additional \$40,332,000. (MO Census, 2017) While this still represents a small percentage of statewide food sales, it is one of the fastest growing sectors of the industry. Previous studies indicate that there is significant market potential in this space (Franken, Parcell, and Tonsor, 2011; Adalji et al., 2015; Perkins, 2012).

However, this marketing endeavor is not without its challenges. As mentioned previously, the conventional beef processing industry is dominated by relatively few participants with high volumes and thin margins. Although USDA identified

more than 900,000 farms with cattle and calves in the 2012 Census of Agriculture, only 80 facilities accounted for 98.7 percent of cattle slaughtered during 2014. Given the economies of scale that exist with large processing facilities, as well as their proximity to the larger cattle feedlots of Iowa, Nebraska, Kansas, and Texas, competing with these facilities based on processing cost is virtually impossible (Brown, 2016).

While these challenges may be partially offset by the utilization of local and regional labeling to demand a premium price, limited research exists on the willingness to pay for Missouri beef. The willingness to pay measure is the maximum amount that a consumer is willing to pay for a particular product or attribute and is a standard metric for quantifying consumer preferences (Breidert, 2006). Ideally, this added value could cover the additional cost incurred by finishing and processing on a smaller scale than the commercial cattle industry. Discovering Missouri consumers' willingness to pay for regionally labeled beef is critical to the success or failure of these new branding strategies.

While state-labeled food is relatively new in the marketplace, demand for "local" food is well documented. (Darby, 2006) However, there is no consistent definition or geographical standard for what constitutes a product as "local" (Martinez, 2010). Since there is no clear definition, it is difficult to ascertain whether or not new processing facilities in Missouri would be considered "local" by state residents. With recent activity suggesting a desire to increase Missouri's processing capacity, it is necessary to provide consumer data for industry consideration. The objective of this research is to empirically measure what

Missouri consumers are willing to pay for alternative attributes and how this varies by age and location of respondents.

The next section will briefly discuss the background of the Missouri beef industry and shifting consumer preferences, highlighting research that examines willingness to pay and market opportunities. The following section will explain the methodology of this study, particularly the survey instrument and method of analysis. Subsequent sections will detail the survey results with an emphasis on variance between demographic groups. The final section will draw conclusions and discuss how this data can be used to benefit the Missouri beef industry and related shareholders.

Chapter 2. Background and Literature Review

2.1 Background of Missouri Beef Industry and Market Dynamics

There are three main types of cattle enterprises, each with varying levels of risk and necessary investment. The first and most common is a cow-calf operation. As the name implies, this includes a herd of breeding stock where calves are raised until weaning, when they are often sold to the next type of enterprise: a feedlot. Feedlots are responsible for taking weaned calves to slaughter-ready weight, a task also known as finishing. Once they reach the necessary weight, they are sent to a processor. Processing cattle is the business of taking slaughter-weight cattle to consumer-ready beef. While there are a few small operations that manage all three sectors of the beef production process, it is very

rare because finishing and processing can be expensive and add risk to the economic outcome. In order to avoid the additional risk that is present post-calf stage, many cow-calf producers sell their weaned calves to large operations. These enterprises are able to better manage this risk and take advantage of economies of scale to cover the high fixed costs. Due to this natural advantage, the beef processing sector is heavily concentrated, with 4 firms accounting for more than 80% of the industry's processing capacity (Packers and Stockyards Annual Report, 2018).

However, the overall Missouri agricultural economy “leaves more on the table” when calves are exported to other states for finishing and processing. According to a 2014 Missouri value-added beef study (Brown, 2016) there is \$6 million in added value for every 10,000 head of Missouri calves that remain to be finished in-state. The study also found that every \$100,000 in new beef processing industry sales provide an additional \$122,000 to the Missouri economy. Seizing this added value requires significant understanding of industry dynamics and Missouri's strengths and weaknesses, which are well documented in a recent report developed for the Missouri Agricultural Foundation.

The Show-Me-State Food, Beverage & Forest Products Manufacturing Initiative was commissioned by the Missouri Agriculture Foundation to identify areas of growth within Missouri's agricultural sector. (TECONOMY, 2019) One of the three primary areas of interest is enhanced commodity utilization, particularly the opportunity for enhanced value-added beef processing. This study found that while Missouri has a number of successful value-added, direct-to-consumer meat

processing operations, there is limited assistance available for companies and farmers looking to expand into the value-added arena. More specifically, the commission found that there is limited availability of co-packing operations for smaller runs of product, in addition to limited support outside of traditional funding sources that are surrounded by red-tape and regulation. Furthermore, Missouri has no processing authority in the state. Nebraska hosts the closest authority that companies can use to certify and meet USDA and Food and Drug Administration (FDA) labeling requirements. Processing authorities are not USDA inspectors, rather, they assist in implementing processes to meet state and federal requirements.

Despite these weaknesses, Missouri has a number of advantages in relation to competitor states. One critical advantage is Missouri's water resource availability. Cattle production requires significant amounts of water for irrigating feed acreage, fulfilling daily livestock water needs and final processing. Several competitor states rely heavily on the Ogallala aquifer, which is depleting at a rapid rate (Basso, 2013). Since the 1950's, the Ogallala High Plains Aquifer's saturated volume has declined by roughly the volume of Lake Erie. This may cause cattle feeding and processing operations to shift towards areas that have adequate water resources. Missouri has an abundance of water and is centrally located with robust distribution channels.

Another advantage is the Missouri Department of Agriculture's incentives for the local food movement through farm-to-table grants and other programs such as "Missouri Grown." These farm-to-table grants provide funding for Missouri

businesses to access resources for acquiring and processing locally grown agriculture products for use in institutions within the state. Funding can be used for coolers, freezers, packing equipment and other tools or appliances. Supporting the local food movement in a different fashion, Missouri Grown promotes food and non-food products, retailers, farmers' markets, agritourism, and agricultural experience destinations through a variety of marketing efforts and promotional events. Given this stimulus and growing consumer interest in local products, it is possible that the Missouri beef industry could market Missouri Grown or local beef to residents on a broader scale to increase the value of beef production. In order to take advantage of these possible premiums, consumer demand must be quantified.

2.2 Willingness to Pay

It is important to use a common metric when gauging consumer interest and market opportunities. In much of the literature this has been the role of “Willingness-to-Pay” (WTP). On face value, willingness to pay is exactly as it seems. It is the maximum amount that a consumer is willing to pay for one unit of a product. This metric becomes more complicated when attempting to measure specific attributes of a product rather than the product itself. For example, if a hammer is “Made in the USA” the origin cannot be sold separately from the hammer. There is no tangible “Made in the USA” that a customer could purchase in a store. The origin is inextricably tied to the product itself, along with other attributes like handle material, weight and color.

To discover the willingness to pay for specific attributes, there are two fundamental classifications of measurement: revealed and stated preference (Breidert, 2006). Market data, field experiments, and experimental auctions are all examples of revealed preference methods, since they use actual price response data; typically, in a competitive and open market. On the other hand, customer surveys, conjoint analysis and discrete choice analysis are all examples of stated preference methods since they all use survey instruments and rely on hypothetical choices. There is no one superior method as both revealed and stated preference methods have strengths and weaknesses. Stated preference methods are able to analyze demand for products that are not readily available in the existing market, but many suffer from some form of hypothetical bias. That is, consumers may make different decisions in a store during an actual purchase versus a survey where no real money changes hands. Conversely, revealed preference methods often remove hypothetical bias, but can only be used for products readily available in the market. In practice, selecting a WTP measurement method is often restricted by time or monetary constraints. Stated preference methods typically require less time and resources, and therefore are used more often than revealed preference methods.

This study utilizes discrete choice analysis, a form of choice experiment (CE). When participating in a CE, respondents are instructed to make repeated choices between similar product alternatives, which vary in attributes listed and levels of those attributes. It is assumed that respondents will make the choices that maximize their utility (satisfaction). Then, researchers can take the responses

and place them into a model of their choosing. While there are different methods of analysis, this research follows a linear regression format to reveal coefficients for each variable. One attribute's coefficient divided by the price coefficient will reveal the consumers' willingness-to-pay for that particular attribute. This topic will be covered further in the following sections.

2.3 Previous Research

Shifting demand trends have caused several recent studies to examine consumer preferences for production-related beef attributes. This is in stark contrast to historical demand that hinged on tangible attributes like income, taste and price. (Tonsor and Olynk, 2010) Figure 2.1 is economist Jayson Lusk's version of Satter's food need hierarchy, which attempts to explain consumer preferences as a function of income and resource constraints.

Figure 2.1 Food Need Hierarchy (Lusk, 2018)

Similar to Maslow's hierarchy of needs, the bottom tier must be satisfied before moving higher up the pyramid. In societies with high income constraints, consumers are concerned with food on a survival basis. In contrast, modern-day America represents the highest point of the pyramid, where consumers are concerned with food on a preferential level. The focus has shifted from food needed for survival to food as a form of personal expression. This is the origin of disagreement among food choices and the emergence of new markets for intangible, production related attributes.

Researchers have studied consumer perceptions of intangible attributes such as local (Franken, Parcell, and Tonsor, 2011; Adalji et al., 2015; Perkins, 2012) grass-fed (Franken, Parcell, and Tonsor, 2011) and others such as hormone-free and organic (Carlberg, Froehlich, and Ward, 2007; Yang 2017).

Franklin, Parcell and Tonsor (2011) found that Missouri consumers value what they consider to be nature friendly beef attributes such as organic, all natural and low carbon footprint. In their study, grass fed/lean demanded the highest premium of all attributes under consideration with a mean premium of \$1.09/lb. And in general, younger people and those with high incomes tend to be more receptive to these nature friendly attributes than other demographic groups. Adalji et al. (2008) used both hypothetical and non-hypothetical choice analysis of Maryland consumers to estimate willingness to pay and found that respondents placed a premium of \$2.72 per pound for beef raised within 100 miles and \$2.32 per pound for beef raised within 400 miles. They also discovered that Maryland consumers consider local and grass-fed attributes to be

substitutes. This finding leads to another question: what exactly do consumers consider “local?”

Perkins (2012) observed that southeastern US consumers interpret “locally produced” to mean a range between 25 miles and the entire United States. However, the most common interpretation was that “locally produced” items originated from their own state. Do consumers consider state and locally labeled products as substitutes? If so, what is the advantage of one versus the other? These questions and others will be addressed in later chapters.

Other attributes are important to consumers as well. In fact, Carlberg, Froehlich, and Ward, (2007) derived willingness to pay for four hypothetical brands (guaranteed tender, breed specific, all-natural, premium). They found premiums ranging from \$1.12 to \$1.83 per 12 oz steak, depending on the brand being considered. They noted that the survey that included a cheap-talk script yielded lower premiums than the conventional survey, which is consistent with the larger body of literature which suggests that cheap talk scripts are effective at reducing hypothetical bias in survey responses. Cheap talk is considered non-binding communication between the researcher and respondent prior to asking hypothetical willingness-to-pay questions in order to improve data quality. For example, including information about how the data will be used to influence real business decisions often results in respondents considering their hypothetical choices much more seriously. A cheap-talk script encourages more robust results in hypothetical choice experiments, and therefore was included in this study.

When conducting consumer research, knowledge discrepancy is expected, especially in food studies. Yang et al. studied consumer willingness to pay for a “no added hormones” (NAH) attribute (2017). They found broad discrepancies in consumers’ knowledge of hormone usage in meat production and observed that the perceived hormone use rate in cattle had a strong impact on premiums for NAH labeling, even when considering high vs low value cuts. This is consistent with much of the literature citing that consumer demand is shifting away from tangible quality measures and towards production methods. Production and background knowledge of the respondent clearly has an impact on their decisions. Therefore, the type of target consumer and region where they reside may have significant impacts on hypothetical choice experiments. A large sample spanning demographics and regions is an important component of accurate analysis in the existing market.

Perhaps most relevant to this study is research done by Merritt et al. (2018) which focused on Tennessee labeled beef. They found that information about Tennessee beef programs significantly increased WTP for steak labeled Tennessee Certified Beef (TCB). More specifically, 95% of the population in the information treatment group would be willing to pay a premium of \$1.71 per pound for steak with the state-branded label. These results are encouraging for those that wish to enter niche markets like local and state labeled beef products. Table 2.2 highlights estimated WTP premiums for various beef attributes in previous studies.

Table 2.2 Attribute Willingness to Pay - Premium Estimates

<i>Attribute</i>	<i>Merritt</i>	<i>Franken</i>	<i>Carlburg</i>	<i>Adjli</i>	<i>Yang</i>
<i>State-Labeled</i>	\$2.42		\$1.84		
<i>Local</i>		\$0.83		\$2.71	
<i>Grass-Fed</i>	\$0.95	\$1.09			
<i>Hormone Free</i>	\$2.35		\$2.10		\$2.15
<i>Organic</i>		\$1.00			

*All prices are in \$/lb, Carlburg prices are adjusted to show \$/lb, since their study found premiums for 12 oz. steaks

Chapter 3. Methods

3.1 Sample

The previous studies successfully estimated willingness to pay for various attributes but did not answer questions regarding Missourians' preferences regarding regional labeling. The goal of this research is to empirically measure Missouri consumers' willingness to pay for regionally labeled products in order to provide relevant data for industry consideration. This chapter details the data collection and analysis methods used in this research.

To address the primary objective of this thesis, an online survey was conducted. The survey company, Qualtrics, was commissioned for distribution and data collection. Qualtrics utilizes a database of individuals that opt-in to participate in online surveys. The survey was developed by the author and delivered to an online panel of 381 Missouri consumers in September, 2020.

3.2 Data Quality

A large body of literature suggests that consumers' willingness-to-pay is overstated in hypothetical experiments when not faced with spending real money. To reduce this hypothetical bias, a cheap talk script was included in the instructions for the survey. Cheap talk is considered non-binding communication between the researcher and respondent prior to asking hypothetical willingness-to-pay questions in order to improve data quality (Lusk, 2003). Research has shown that cheap talk scripts are effective at reducing hypothetical bias in survey

responses (Lusk, 2003). The script used for this survey is included in the appendix. As an additional quality check, Qualtrics removed individuals from the sample if they finished the survey in less than half the median time of responses. There were 381 accepted responses in total.

3.3 Choice Experiment

Consumers are assumed to have preferences with regard to region of origin and quality labels. This study uses a choice experiment to reveal those preferences. When participating in a choice experiment, respondents are instructed to make repeated choices between similar product alternatives, which vary in attributes listed and levels of those attributes. It is assumed that respondents will make the choices that maximize their utility. The study uses choice modeling to identify and quantify the effects of beef attribute levels on consumer satisfaction. A conditional logit model is used for the statistical analysis of the responses in this choice experiment. This is a common method of analysis in the choice experiment literature, and was originally developed by McFadden in the early 1970's for transportation demand studies (McFadden, 1973). This model is based on random utility theory, which assumes that a respondent's utility is divided into two components: representative and random. The utility maximizing derivation for each respondent n for each choice alternative j in each choice scenario c can be represented as

$$U_{njc} = \beta_n X_{njc} + e_{njc}$$

where X_{njc} are the observed attributes for choice alternative j and respondent n for each choice scenario c . β_n is a vector of coefficients of the variables for respondent n . This reflects the respondent's individual preferences; a larger positive coefficient represents a higher value assigned to that attribute. In the case of price, the coefficient will nearly always be negative to reflect normal demand logic. ϵ_{njc} is a random error term that is independent and identically distributed (Train, 2003).

The representative component of utility for the “neither” option is normalized to zero, while the representative utility for the two beef alternatives is assumed to be

$$U_{njc} = ASC + \beta_0 Price_{njc} + \beta_1 MO_{njc} + \beta_2 Local_{njc} + \beta_3 Prime_{njc}$$

where U_{njc} denotes representative utility for beef j (j =option 1, option 2). ASC is the alternative specific constant used to normalize the “neither of these” option to a utility value of zero. $Price$ represents the price of beef alternative j . MO denotes a dummy variable with a value of 1 if j is labeled Missouri Grown and 0 if not. $Local$ represents a dummy variable with a value of 1 if j is labeled Locally grown and 0 if otherwise. Finally, $Prime$ denotes a dummy variable with a value of 1 if alternative j is labeled USDA Prime and 0 if otherwise.

3.4 Choice Experiment Design

The software, R, with the AlgDesign package was used to create eight choice sets through random selection from a fractional factorial design, following methodology from Aizaki et al. (2008). A fractional factorial design is an experimental design consisting of subsets of a full factorial, whereas a full factorial is every combination of levels for all factors. This process began with creating a full factorial design with function `gen.factorial()`. In this design, the independent variables (beef attributes) are manipulated, and all combinations of levels are included. However, this provides far too many options to use in practice, so the function `optFederov()` was employed to generate a fractional factorial design, which is a mixed orthogonal array created from the full factorial design. Then, R was used to randomly select lines of the fractional factorial design to be included as choice sets. This was accomplished by assigning a new uniform random variable to every fractional design, which was then sorted according to the random variable. Results were analyzed with the R survival package, which enabled use of the conditional logit model. In Aizaki's example, they created a choice experiment designed to derive willingness to pay for various liquid milk attributes.

In the beef attribute survey, respondents were asked to select their most preferred option of the top loin steaks displayed (Option 1 or Option 2) or opt out by selecting the no choice option. Top loin steaks (also known as Kansas City steaks or New York strip steaks) were chosen because steaks represent an important portion of total carcass value and are more likely to capture consumer

premiums (Maples, 2018). The choice set graphics were created by a high-resolution picture of a mid-quality steak with labels graphically adapted to match the balanced design. An example of a choice set is shown in Figure 3.1. The steak pictures are exactly the same in all choice sets, and the respondents were informed of this fact. The survey design attempted to limit respondents' time analyzing the picture, since the goal of this study is to derive preferences of specific production-related attributes.

Table 3.2 shows all attributes and attribute levels for the choice sets. Price was included with three levels: \$6/lb., \$7/lb., \$8/lb. The three price levels were chosen from USDA, Agricultural Marketing Service National Retail Report for beef at the time the survey was conducted. Prices were adjusted to allow for ease of comparison. Other attributes included were Missouri Grown, Locally Grown and USDA Prime.

After data collection, the conditional logit regression returned coefficients used in finding consumer willingness to pay.

Figure 3.1 Sample choice experiment survey question

Given these two options, which would you choose in the store? (Note: all weights and colors are the same)

☐ Option 1

- \$8.00/lb.
- USDA Prime
- Locally Grown

☐ Option 2

- \$7.00/lb.
- USDA Prime
- Missouri Grown

☐ If these were my only options, I would choose neither

Table 3.2

Survey Choice Experiment Questions (Attributes and Levels)

	Q1			Q2			Q3			Q4			Q5			Q6			Q7			Q8		
	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C
Price	\$8	\$6		\$6	\$8		\$6	\$6		\$8	\$7		\$7	\$6		\$7	\$8		\$7	\$7		\$6	\$6	
Missouri Grown	Y	Y					Y			Y			Y			Y			Y			Y		
Local		Y		Y			Y			Y			Y			Y			Y			Y		
Prime	Y			Y			Y			Y	Y		Y						Y					Y

Chapter 4. Empirical Results/Data

Summary statistics are listed in table 4.1. It is important to note that the top portion of the table shows the percentage of respondents that answered A, B, or C. The lower part of the table shows the levels of the attributes for each option; price is shown in dollars and Y represents that attribute label being included for that choice. C is always blank because it represents the “neither of these” option.

The questions are sorted in sections consisting of three columns. For example, in table 4.1 under question 5 (Q5) 68% of all respondents selected answer A.

Following that same column to the bottom of table 4.1 shows that option A steak was \$7/lb. and included a Missouri Grown, Local, and USDA Prime label.

Table 4.1 Survey Summary Statistics

	Q1			Q2			Q3			Q4			Q5			Q6			Q7			Q8		
	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C
<i>All (Total)</i>	10	82	8	33	61	6	22	71	7	39	55	6	68	25	7	69	24	7	62	32	6	70	24	6
<i>Urban</i>	14	79	6	40	54	6	23	68	9	41	50	9	62	29	9	65	27	8	62	33	5	67	26	8
<i>Suburban</i>	7	84	9	29	65	6	25	68	7	41	54	6	71	22	7	73	19	7	64	31	5	67	27	6
<i>Rural</i>	10	81	9	35	59	5	16	77	7	34	60	5	69	25	6	66	28	6	61	32	7	77	17	6
<i>Age 18-30</i>	14	78	8	35	60	5	19	75	5	40	55	5	73	19	8	69	21	10	64	30	6	68	25	8
<i>Age 31-45</i>	8	89	3	28	71	2	25	72	3	43	54	3	73	24	3	67	30	3	66	33	1	76	22	3
<i>Age 46-60</i>	16	76	8	41	53	6	17	75	8	35	56	8	65	27	8	68	27	5	65	28	7	66	28	6
<i>Age 61+</i>	2	83	15	32	57	11	25	61	14	34	56	10	61	27	11	74	15	11	55	35	10	69	20	10
	Q1			Q2			Q3			Q4			Q5			Q6			Q7			Q8		
	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C
<i>Price</i>	\$8	\$6		\$6	\$8		\$6	\$6		\$8	\$7		\$7	\$6		\$7	\$8		\$7	\$7		\$6	\$6	
<i>Missouri Grown</i>	Y	Y					Y			Y			Y			Y			Y			Y		
<i>Local</i>		Y			Y			Y			Y			Y			Y			Y			Y	
<i>Prime</i>		Y			Y			Y			Y	Y		Y					Y				Y	

Willingness to pay estimates were calculated using the following equation:

$$WTP = - \beta_k / \beta_0$$

Where β_k is the specific attribute coefficient and β_0 is the price coefficient (Chung, 2008). Willingness to pay for the entire sample population is shown below in Table 4.2. Confidence intervals were found using the Delta method in R.

Table 4.2 WTP premium measures for entire sample

<i>Variable</i>	<i>Coefficient</i>	<i>se</i>	<i>p</i>	<i>WTP</i>	<i>95% CI</i>
<i>MO</i>	0.57836*	0.04626	2.00E-16	\$ 1.41	(1.08, 1.74)
<i>Local</i>	0.78081*	0.04356	2.00E-16	\$ 1.90	(1.54, 2.26)
<i>Prime</i>	0.43281*	0.05067	2.00E-16	\$ 1.05	(0.79, 1.31)

Notes: Asterisk (*) indicates significance at the 1% level

Each WTP number represents the value that consumers place on that attribute. This means if consumers were presented with two identical steaks with the only difference being that one is “Missouri Grown”, they would be willing to pay up to an additional \$1.41 for the Missouri Grown steak compared to a generic, unlabeled steak. Consumers place a positive value on all three non-monetary variables in our study. Additionally, p-values of 2.00E-16 are extremely low, implying that these results are highly significant. Goodness-of-fit was calculated in R software using McFadden’s pseudo-R squared, or rho-squared (ρ^2). This can be interpreted much like a normal R-squared result, but ρ^2 values will often be much lower. According to McFadden (1978), “While the R^2 index is a more familiar concept to planners who are experienced in ordinary regression analysis, it is not as well behaved a statistic as the ρ^2 measure, for maximum-likelihood

estimation. Those unfamiliar with the ρ^2 index should be forewarned that its values tend to be considerably lower than those of the R^2 index and should not be judged by the standards for a 'good fit' in ordinary regression analysis. For example, values of 0.2 to 0.4 for ρ^2 represent an excellent fit." Therefore, the result of $\rho^2 = 0.278$ in this research indicates the model is an excellent fit.

Surprising to the author is the relatively low WTP value consumers assigned to USDA prime beef. The USDA prime label was included in this study to compare against other marketing opportunities for producers. However, the low consumer valuation does not necessarily indicate lower revenue opportunities for producers. There are many factors involved and this requires further inquiry.

Willingness to pay estimates were also evaluated for subsets of the sample population, as shown in Table 4.3.

Table 4.3 Willingness to Pay Estimates by Demographic

<i>Population Subset</i>	<i>Attribute Willingness to Pay Premium</i>		
	Missouri	Local	Prime
<i>Rural</i>	\$ 1.82	\$ 1.96	\$ 0.72
<i>Urban</i>	\$ 1.30	\$ 1.72	\$ 0.79
<i>Suburban</i>	\$ 1.16	\$ 1.92	\$ 1.37
<i>Age 18-30</i>	\$ 1.68	\$ 2.13	\$ 1.16
<i>Age 31-45</i>	\$ 1.66	\$ 2.21	\$ 1.42
<i>Age 46-60</i>	\$ 1.60	\$ 1.63	\$ 0.72
<i>Age 60+</i>	\$ 0.76	\$ 1.57	\$ 0.88

Figure 4.4 Bar Graph of WTP Premium Estimates by Demographic

Chapter 5. Discussion and Conclusion

5.1 Discussion

As mentioned in previous sections, the goal of this study was to empirically measure Missouri consumers' willingness to pay for local and state-labeled beef products. Results from our survey indicate that Missouri consumers across demographics are willing to place a premium on beef products labeled Missouri-grown, locally grown, and USDA prime compared to an unlabeled top loin steak. This particular finding is unsurprising, but willingness to pay by demographic group reveals more interesting results. Rural consumers value Missouri grown beef products significantly higher than their urban and suburban counterparts, with a willingness-to-pay of \$1.82 compared to \$1.30 and \$1.16 for urban and suburban respectively. One explanation could be that rural Missourians consider Missouri-grown to be a substitute for locally grown because of their proximity to Missouri beef cattle producers in their community. This is especially viable because of the higher values rural consumers also assigned to locally grown; \$1.96 compared to \$1.72 and \$1.92 for urban and suburban respectively.

Another explanation for rural consumers placing higher relative premiums on local and Missouri grown labels could be their existing usage of small local processors or direct-to-consumer operations. While this observation lacks empirical evidence, a cursory examination of Missouri Farm Bureau data on producers offering direct-to-consumer sales show that the vast majority exist in towns with populations below 10,000 (Farm Bureau, 2021).

Another significant finding is that age groups under 45 value local beef products significantly higher than age groups 46 and older. This is consistent with other studies that show younger consumers may appreciate production method attributes relatively more than older generations (Lusk, 2016; Adalji, 2008)

5.2 Word Association

Along with the choice experiment, this survey included two word association questions. 1: “What three words come to mind when you hear ‘Missouri-Grown?’” 2: “What three words come to mind when you hear ‘local food?’” Both of these were included as a risk management strategy. If the choice experiment yielded inconsistent results, the word association questions would have been used to help diagnose the issue. Common answers were fresh, good, farmers’ market, corn, and local. A notable result is that for the Missouri-Grown question, the most common response was “local.” This implies that Missouri consumers may treat local as a substitute for Missouri-Grown, although results from the choice experiment are less supportive of this theory. It is worth noting that these two qualitative questions were asked prior to the choice experiment. This was intended to “prime the pump” and get respondents thinking about their tastes and preferences. The word clouds shown in figure 5.1 and figure 5.2 illustrate the results by increasing the font size of common responses. The more often a word was used, the larger its font in the word cloud.

“Missouri Grown” Word Cloud

[illegible]

5.3 Processing Costs/Concerns

This analysis clearly shows that consumers are willing to pay a premium for certain beef product label attributes, particularly attributes related to locality. However, these premiums may not be enough to provide local ranchers a premium on their livestock, since processing costs can be much higher when on a small, localized scale. As mentioned in the introduction, large processing operations can operate at a lower cost per unit than smaller, artisanal operations. For example, large processors have no trouble finding a market for their byproducts which creates a revenue stream that does not rely on the price of meat. Byproducts, also known as “the drop” are non-meat items from the carcass such as heads, hides, hooves, bones, fat, blood, and offal. Smaller processors often do not produce enough byproduct volume to offset what the rendering service charges to collect (Gwin et al., 2013). Other costs such as regulatory compliance and recordkeeping may also be disproportionately high for smaller plants with lower volumes over which to spread these costs.

While many livestock producers would entertain the idea of processing and selling their beef locally, they have significant concerns about the logistics of following through with this strategy. Many producers have called several weeks before livestock will be ready for slaughter, only to learn that the processor is fully booked out for several months. In addition, smaller livestock operations may only have a few head ready for processing and the nearest inspected processing facilities is multiple hours away, creating high transportation and opportunity costs per pound of meat (Gwin et al., 2013).

These concerns are matched on the processor side. For instance, many small processors cite the boom and bust cycle that occurs every year. Many cattle producers follow a similar seasonal cycle, creating high demand in the fall but low demand throughout the rest of the year. This is largely due to the biological nature of producing cattle: the majority of Missouri operations prefer to calve in the spring, meaning that feeder calves will reach appropriate slaughter weight the following fall. This is a serious problem for small meat packers, since they have consistent expenses and skilled employees in need of work. A constant supply of animals is needed, and these processors have difficulty maintaining adequate throughput because of the issues mentioned previously. Without steady production, revenue is volatile and it can be difficult to keep the doors open.

Therefore, while this research does show that Missouri consumers place a premium on local- and state-labeled beef, increased profit for producers is much less clear. The WTP findings hinge on the idea that increased costs of producing local and regional beef products do not outweigh the premium consumers are willing to pay. This research is far from conclusive, and warrants further inquiry.

5.4 COVID-19 Disruptions

It is also necessary to discuss that this survey was conducted in the midst of the worldwide COVID-19 pandemic, which likely had an effect on these results.

Consumers potentially found local- and state-labeled beef products more appealing since the typical retail outlets had difficulties keeping shelves fully

stocked in the early months of the pandemic. (KC Fed, 2020) On the other hand, consumers may be operating under financial strain, restricting their willingness to pay for what they might consider “luxury goods”. If a consumer is severely limited by their budget, they are unlikely to pay for premium attributes. This scenerio is beyond the scope of this study, but has been explored by food and agricultural economist Jayson Lusk (Lusk, 2020).

5.5 Limitations of this Research

While the survey used in this research answered the fundamental question of Missouri consumers’ willingness to pay for regional labeling, there were things that could have been done differently to create more robust results. For one, the survey could have included demographic questions regarding income and household size, since this likely has a significant impact on meat consumption and preferences. Secondly, prices for meat have steadily crept upwards since the survey was delivered and it would have been logical to include another price level, perhaps \$9/lb. However, the absolute value is less important than the relative value between choices.

Using a hypothetical choice experiment was adequate for this research, but if a similar study were conducted it should consider utilizing an experimental auction. As mentioned in the methods section, hypothetical choice experiments suffer from hypothetical bias, in that respondents are willing to pay less when actual money is exchanging hands. An experimental auction solves this problem by

creating a market in a lab setting. This involves respondents bidding real money to obtain real goods in an auction designed to truthfully reveal consumer preferences (Maurizio et al., 2019). This method, while more resource intensive, would yield more robust results.

Another important note is that this survey only included top loin steak (also known as Kansas City steak or New York strip steak). Consumers value cuts differently, and may not be willing to pay as high of a premium for lower value products such as ground beef. This is an important consideration for local producers and processors, since labeling strategies may not have the same effect across different cuts of beef.

5.6 Conclusion

This research empirically estimated Missouri consumers' willingness to pay premiums for Missouri grown, local, and USDA Prime beef. All three attributes were given positive premiums with local receiving the highest premium in all demographic groups. These results are encouraging for Missouri livestock producers and small-scale meat packers who wish to capitalize on the local food movement and "Missouri-Grown" labeling opportunities. However, this research did not study supply-side economics and the potential increased costs associated with small-scale processing. While existing research suggests small-scale processing economics may not be viable, only the individual firm can decide whether or not local and state labeling is a worthwhile strategy. Both

consumer demand trends and production related costs should be considered before changing an operation's supply chain and marketing plan.

Appendix

1. Cheap talk script included in instructions to respondents:

“Please answer as if you were actually making a decision of what to purchase in a real store. The data collected from your choices will be used to inform ranchers, grocery owners and policymakers in Missouri about potential opportunities in the beef market.”

Bibliography

Adalja, A., Hanson, J., Towe, C., & Tselepidakis, E. 2015. "An Examination of Consumer Willingness to Pay for Local Products." *Agricultural and Resource Economics Review*, 44(3), 253-274. doi:10.1017/S1068280500005050

Aizaki, Hideo, and Kazushi Nishimura. 2008. "Design and Analysis of Choice Experiments Using R: A Brief Introduction." *Agricultural Information Research*, vol. 17, no. 2, 2008, pp. 86–94., doi:10.3173/air.17.86.

Basso, B., Kendall, A.D. and Hyndman, D.W. 2013. "The future of agriculture over the Ogallala Aquifer: Solutions to grow crops more efficiently with limited water." *Earth's Future*, 1: 39-41. <https://doi.org/10.1002/2013EF000107>

Breidert, Christoph & Hahsler, Michael & Reutterer, Thomas. 2006. "A Review of Methods for Measuring Willingness-to-Pay." *Innovative Marketing*. 1.

Brown, Horner, Milhollin, Madison, Roach, Tucker, Zulovich, Lenz. 2016. "Missouri Beef Value-Added Study." University of Missouri Extension.

Carlberg, Froehlich, Ward. 2007. "Willingness-to-Pay for Branded Fresh Beef Products in Canada." *Canfax Research Services, National Beef Industry Development Fund*.

Chung, Briggeman, Han. 2008. "Willingness to Pay for Beef Quality Attributes: Combining Mixed Logit and Latent Segmentation Approach." *Select paper prepared for presentation at the American Agricultural Economics Association annual meeting, July 29, 2008*.

Cornell Library. 2020. "Livestock Slaughter 2019 Summary 04/22/2020." Retrieved 2/5/2021, from <https://downloads.usda.library.cornell.edu/usda-esmis/files/r207tp32d/34850245n/5712mr72x/lsan0420.pdf>

Darby, Kim & Batte, Marvin & Ernst, Stan & Roe, Brian. 2006. "Willingness to Pay for Locally Produced Foods: A Customer Intercept Study of Direct Market and Grocery Store Shoppers." *Proc. Annu. Mtg. Agr. Appl. Econ. Assn.*

Dobbs, Jensen, Leffew, English, Lambert, Clark. 2016. "Consumer Willingness to Pay for Tennessee Beef." *Journal of Food Distribution Research* 47(2)

Drouillard JS. 2018. "Current situation and future trends for beef production in the United States of America - A review." *Asian-Australas J Anim Sci.* 2018;31(7):1007-1016. doi:10.5713/ajas.18.0428

Franken, Parcell, Tonsor. 2011. "Consumers' Willingness-to-Pay for Retail Branded Beef Products with Bundled Attributes." *Selected paper prepared for presentation at the Agricultural & Applied Economics Association's annual meeting, July 24-26, 2011.*

Gwin, Lauren, Arion Thiboumery, and Richard Stillman. 2013. "Local Meat and Poultry Processing: The Importance of Business Commitments for Long-Term Viability." ERR-150, *U.S. Department of Agriculture, Economic Research Service*, June 2013

Hole, Arne R. 2006. "A Comparison of Approaches to Estimating Confidence Intervals for Willingness to Pay Measures." Centre for Health Economics.

Lusk, J. 2003. "Effects of Cheap Talk on Consumer Willingness-to-Pay for Golden Rice." *American Journal of Agricultural Economics*, 85(4), 840-856. Retrieved October 20, 2020, from <http://www.jstor.org/stable/1244768>

Lusk, J. 2018. "Hierarchy, Disagreement, and Food Politics." Jayson Lusk Blog. Retrieved February 24, 2021, from <http://jaysonlusk.com/blog/2018/8/15/disagreement-and-food-demand>

Lusk, J. 2020. "Impacts of Coronavirus on Food Markets." Jayson Lusk Blog. Retrieved January 17, 2021, from <http://jaysonlusk.com/blog/2020/3/16/impacts-of-coronavirus-on-food-markets>

Lusk, J. 2016. "Millennials' Food Values." Jayson Lusk Blog. Retrieved February 22, 2021, from <http://jaysonlusk.com/blog/2016/6/1/millennials-food-values>

Maples, J., Lusk, J., Peel, J. 2018. "Unintended consequences of the quest for increased efficiency in beef cattle: When bigger isn't better." *Food Policy*, Volume 74, 2018, Pages 65-73

Martinez, Steve, et al. 2010. "Local Food Systems: Concepts, Impacts, and Issues." ERR 97, U.S. Department of Agriculture, Economic Research Service, May 2010.

Maurizio Canavari, Andreas C Drichoutis, Jayson L Lusk, Rodolfo M Nayga, Jr. 2019. "How to run an experimental auction: a review of recent advances." *European Review of Agricultural Economics*, Volume 46, Issue 5, December 2019, Pages 862–922, <https://doi.org/10.1093/erae/jbz038>
McFadden, D. 1973. "Conditional Logit Analysis of Qualitative Choice Behavior." Pp. 105-135 *Frontiers in Econometrics*. New York: Wiley.

McFadden, D. 1978. "Quantitative Methods for Analyzing Travel Behaviour on Individuals: Some Recent Developments." *Behavioural Travel Modelling*. Ch. 13

MERRITT, M., DELONG, K., GRIFFITH, A., & JENSEN, K. 2018. "CONSUMER WILLINGNESS TO PAY FOR TENNESSEE CERTIFIED BEEF." *Journal of Agricultural and Applied Economics*, 50(2), 233-254. doi:10.1017/aae.2017.35

Missouri Farm Bureau. 2021. Missouri Meat Producer Directory. Retrieved March 5, 2021, from <https://mofb.org/missouri-meat-producers/>

Ollinger, Michael, Mary K. Muth. Shawn A. Karns, and Zanethia Choice. 2011. "Food Safety Audits, Plant Characteristics, and Food Safety Technology Use in Meat and Poultry Plants." EIB-82, U.S. Dept. of Agriculture, Economic Research Service. October 2011.

Packers and Stockyards Division USDA. 2018. Packers and Stockyards Annual Report 2018, U.S. Dept. of Agriculture, Agriculture Marketing Service. 2018

Perkins, S. 2012. "Assessing the Demand for Locally Produced Natural Beef." M.S. Thesis. University of Georgia, Athens, Georgia.

TECONOMY Partners LLC. 2019. Show-Me-State Food, Beverage & Forest Products Manufacturing Initiative. Performed for Missouri Agricultural Foundation

Tonsor, G.T. and N.J. Olynk. 2010. "Impacts of Animal Well-Being and Welfare Media on Meat Demand." *Journal of Agricultural Economics* no. doi: 10.1111/j.1477- 9552.2010.00266.x:1-14.

Train, K.E. 2003. "Discrete Choice Methods with Simulation." Cambridge: *Cambridge University Press*, 2003.

USDA NASS. 2019. 2019 Missouri State Agriculture Overview. Retrieved February 5, 2021, from

https://www.nass.usda.gov/Quick_Stats/Ag_Overview/stateOverview.php?state=MISSOURI&year=2020

USDA. 2019. 2017 Census of Agriculture Missouri State and County Data.

Retrieved from

https://www.nass.usda.gov/Publications/AgCensus/2017/Full_Report/Volume_1,_Chapter_1_State_Level/Missouri/mov1.pdf

Yang, Raper, Lusk. 2017. "The Impact of Hormone Use Perception on Consumer Meat Preference." *Selected Paper prepared for presentation at the Southern Agricultural Economics Association Annual Meeting, February 4-7, 2017.*