WHY THE BEEF? A PUBLIC CHOICE EXPERIMENT ON MEAT ALTERNATIVES

By

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ABSTRACT

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Government-imposed labeling restrictions have become increasingly common, with the stated intention of preventing consumer confusion. One such restriction is proposed U.S. regulation that prevents meat alternatives from labeling their product with the word "meat." This thesis used data collected from a representative sample of 1,502 U.S. consumers to empirically examine whether consumers were confused about the ingredients and nutritional content associated with meat and meat alternatives. Furthermore, we examined whether restricting the word "meat" on meat alternatives reduced any consumer confusion as well as substitution between meat and meat alternatives. Results suggested that over 30% of consumers cannot accurately distinguish between meat and meat alternatives and that the labeling restrictions actually induced a higher level of consumer confusion. Consumer perceptions of trans-fat and cholesterol decreased by 2.78 and 3.78 percentage points. Perceptions of calories per serving decreased by 10.17 for meat alternatives, but perceptions of protein content in meat alternatives increased by 4.04 percentage points after the regulation was imposed. Furthermore, results suggested that labeling restrictions are likely to have an ambiguous effect on substitution between meat and meat alternatives.

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I. INTRODUCTION

News outlets, politicians, and many on social media have been puzzling for the last year over what was once a simple question: how do we define "meat"? This debate became especially policy relevant after the Missouri Senate passed a law stating the use of the word "meat" could only be used if a product was of animal origin (Missouri State Senate 2018). Proponents of the bill argued that there was a need to prevent consumer confusion (Missouri Cattlemen's Association 2018). While the argument for the Missouri regulation might be tenable, empirical analysis regarding the likely consequences of such legislation has been lacking. Without this analysis, it is unclear if consumer confusion existed, leading some to think the true intentions of the regulation were to provide government-granted privilege to one commodity group over another (Weissmueller 2018; Ball 2018).

This research explored the likely consequences of state legislation that was passed under the influence of a special interest group. Specifically, we considered Missouri Senate bills No. 627 and 925 passed and signed into law in 2018. The statutes mandated that advertisers not engage in "misrepresenting a product as meat that is not derived from harvested production livestock or poultry" (Missouri State Senate 2018). Shortly after passage, the Good Food Institute and the Tofurky Company filed a civil rights action challenging the constitutionality of the statute (Turtle Island Foods and The Good Food Instutute v. M.P.A. 2018). The Good Food Institute made their position clear: "No one buys Tofurky 'PLANT-BASED' deli slices thinking they were carved from an animal any more than people are buying almond milk thinking it was squeezed from a cow's udder" (Ball 2018). On the contrary, the Executive Vice President of the Missouri Cattleman's Association stated, "The use of traditional nomenclature on alternative products is confusing to consumers and weakens the value of products derived from actual livestock

production" (Missouri Cattlemen's Association 2018). This legislation raised many questions about the economics of labeling regulation. First, was there a need to protect consumers from uncertainty? If so, will this law actually prevent confusion? Finally, might this legislation actually be an attempt to insulate special interests in the meat industry from changing consumer preferences?

We answered these questions with a unique dataset of consumer decisions. Specifically, we asked 1,502 U.S. consumers about their perceptions of nutrition and ingredients in meat and meat alternatives before and after the regulatory change. We then conducted a discrete choice experiment (DCE) to test for likely changes in the substitution effects between meat and meat alternatives. Our results are largely consistent with findings in public choice theory, which explains why interest groups often support increases in regulation even when the regulatory change does not accomplish the stated objective. As such, results suggest that the actual reason for this regulation might have actually been supporting one commodity group over the other.

The remainder of this article is organized as follows. The next section provides a background to the regulation. We then reviews the literature on meat labeling and public choice theory. The fourth section outlines the testable hypotheses, while the fifth describes our experimental design, which tests for changes in consumer confusion and substitution effects. The sixth section describes the results of our analysis, which suggest that the proposed legislative changes actually induce *more* consumer confusion, and the seventh section provides a discussion of the policy implications. The article concludes with a discussion of next steps and future research.

II. BACKGROUND

The U.S. Department of Agriculture (USDA) Food Safety and Inspection Service (FSIS) does not currently define "meat," but requires labeling to state if it is derived from meat/bone separation and meat recovery systems (U.S. Department of Agriculture, Food Safety and Inspection Service 2011). As such, the U.S. Cattleman's Association has petitioned the USDA FSIS to enforce a definitional claim to the word "meat" to products of animal origin (U.S. Cattlemen's Association 2018). Missouri Senate bills No. 627 and 925 mirror a similar 2018 law in France that states products comprised mostly of vegetables could not use names associated with animal origin, such as "meat," "bacon," or "filet" (France, Assemblée Nationale 2018). Proponents of the Missouri Senate bills explained their stance to the Missouri Standing Committee on Agricultural Policy: "The livestock industry has spent a lot of time and money educating consumers and promoting its products. This bill would keep manufacturers of plant-based proteins from calling their products meat and benefiting from the work of the livestock industry" (Standing Committee of Agriculture Policy 2018).

After bill No. 627 and 925 passed, the sponsor of the original bill (HB2607) Jeff Knight explained "We're not trying to mislead anyone. We're just trying to protect our product" (Associated Press 2018). The Missouri bill was contested in the U.S. District Court, and the implementation is still pending the results of the case (Erickson 2019; Turtle Island v. M.P.A. 2018). One news report has stated that the parties came to a tentative agreement on the meat labeling lawsuit (Erickson 2019). The potential results of the lawsuit may establish legal precedent for state and local governments to regulate food labeling and advertising, and may invogorate special interest groups to follow similar legislative strategies (U.S. Congress, Senate, Committee on Healh, Education, Labor, and Pensions 2017; U.S. Cattlemen's Association 2018).

III. LITERATURE REVIEW

The academic research on food labeling legislation is exhaustive.[1] Often, studies discussed the mechanisms by which labeling might increase consumer surplus (Greaker 2006; Eggert and Greaker 2011; Roe, Teisl and Deans 2014). Some authors argued that food labels represent a mechanism for fixing asymmetric information (Kolodinsky 2012; Drichoutis et al. 2017). Other authors argued that mandatory labeling has the potential to lower competition (Roe, Teisl, and Deans 2014). Understanding the consequences of labeling regulation is of critical importance if the objective of the policy is to create more efficient economic outcomes (Messer, Costanigro and Kaiser 2017). As such, the next section reviews some of the research on how government regulation may alter economic outcomes.

A. Public Choice

Public choice theory focuses on how economic motivations influence the democratic process (Mitchell and Munger 1991). One key aspect of public choice theory is the role of special interest groups in political decision-making (Buchanan and Tullock 1962). Specifically, public choice theory argues special interest groups extract rents through the political process (Buchanan and Tullock 1962; Lowery and Gray 1995). Of particular value for this study is the "Bootleggers and Baptists" (BAB) paradigm (Yandle 1983; Yandle et al. 2008), which often utilizes historical narratives to describe how two seemingly unrelated interest groups can support the same regulation – such as the Depression-era opinions of bootleggers and Baptists regarding alcohol prohibition. The Baptists truly believed in the societal and religious implications of prohibition while the

[1] For a review of the food labeling literature, see (Messer, Costanigro, and Kaiser. 2017)

bootleggers sought to eliminate competition and boost profits through their thinly veiled support of prohibition for the common good (Yandle et al. 2008).

The BAB paradigm has generated insights for recent public policy discussions. For example, the U.S. Lung Association backed cigarette regulation in the 1980's, arguing cigarettes posed a significant health risk. Despite their arguments, research suggested that the cigarette industry advocated for similar regulations to create higher barriers to entry and allow the industry to artificially inflate prices (Yandle et al. 2008). Few studies have empirically examined the BAB paradigm in agricultural value chains. One exception is Gohmann (2016), who found that the difference between the number of brewery startups in the Northern and Southern United States was consistent with the BAB paradigm.

Despite limited quantitative evidence, the BAB paradigm can provide insight into historical regulatory decisions in agricultural production. In fact, one of the first U.S. food labeling regulations was consistent with the BAB paradigm (Dupre 1999). Margarine was invented in France in 1869 as a low-cost substitute for butter (Rupp 2014), and almost immediately after businesses brought the product to the United States, they were met with fierce opposition (Dupre 1999). By 1886, 27 states either banned or heavily regulated the labeling and manufacturing of margarine. By 1902, the federal government passed legislation requiring that margarine be colored differently from butter (Dupre 1999). While these regulations were intended to support consumer health and stop margarine producers from falsely selling butter, dairy interest groups were the primary proponents of the regulations (Dupre 1999). Regulation severity towards margarine was more likely in states where butter was produced. Dupré (1999) concluded that, "…governing bodies are quite reluctant to tax or restrict the production of a food product, especially if the product

is mostly consumed by the poor… the legislative saga shows that considerable political clout can make governments do strange things" (Dupré 1999, pp. 370).

History has shown how special interest groups may run contrary to the interests of specific industry actors, and this may be evident in the modern meat industry. While the policy directives of the Missouri Cattlemen's Association are often in alignment with both meat processors and retailers, their motivation toward restricting demand growth for meat alternatives has their special interests competing with many large producers in the meat value chain. Tyson Foods Inc., one of the world's largest producers of meat, is investing significantly in lab-grown and plant-based proteins (Little 2018). Similarly, Cargill, one of the largest agri-food businesses in the world, recently invested in the development of plant-based proteins (Starostinetskaya 2018a). Meat consumers already have easier access to meat alternatives; TGI Fridays now sells a Beyond Meat Cheese Burger and Burger King sells the Impossible Whopper® (Beyond Meat 2018; Cassetty 2019).

IV. HYPOTHESES

A. Hypothesis 1 and 2

Supporters of the Missouri law argued that consumers are unwittingly purchasing meat alternatives with the intention of buying meat (Missouri Cattlemen's Association 2018). Consumer acceptance of meat and meat alternatives has been studied significantly, and the literature suggests that consumers widely prefer meat to meat alternatives (Malone and Lusk 2017; Lusk and Tonsor 2016; Tonsor, Mintert and Schroeder 2010; Elzerman et al. 2015; Hartmann and Siegrist 2017; Graça, Calheiros and Oliveira 2015a). As such, we hypothesized:

(H1) – There is no significant difference between the true nutritional content of meat and meat alternatives and the mean consumer's perceived nutritional content of meat and meat alternatives, nor do consumers believe that meat is an ingredient in available meat alternatives.

Even with labeling regulation, it is possible consumer confusion will persist. Labeling regulations have the potential to reduce confusion, although the effects can often be unclear (Roe, Teisl, and Deans 2014; Kolodinsky 2012; Drichoutis et al. 2017; Balcombe, Fraser, and Hussein 2016; Tonsor, Schroeder and Lusk 2013). Prior research suggests that government intervention in labeling regulation does not always achieve its intended outcomes (Ellison, Lusk, and Davis 2014; Balcombe, Fraser, and Hussein 2016; Tonsor, Mintert, and Schroeder 2013). Thus, labeling regulation may cause changes in perceptions and ingredients, but might actually *increase* consumer confusion. We hypothesized that:

(H2) - Mandatory labeling policy eliminating the word "meat" on labels for meat alternatives does not decrease consumer confusion between meat and meat alternatives.

B. Hypothesis 3

If the proposed legislation does not effectively reduce uncertainty, the proposed labeling change may still change consumer demand for meat alternatives. There has been extensive research demonstrating how labeling affects willingness to pay (WTP) for food products (Drichoutis et al. 2017; McFadden and Malone 2018; Balcombe, Fraser, and Hussein 2016; Tonsor, Mintert, and Schroeder 2013). Consumers are more likely to substitute meat for meat

alternatives if they are similar to meat (Elzerman et al. 2015; Hartmann and Siegrist 2017). As such, the BAB paradigm suggests that the actual objective of the labeling legislation might be limiting competition between meat and meat alternatives. Given this, *ceteris paribus*, the labeling change may decrease substitution effects between meat and meat alternatives. As such, we hypothesized:

(H3) – Mandatory labeling policy that restrict usage of the word "meat" to labels of animal origin will reduce the likelihood that consumers substitute meat for meat alternatives.

Figures 1a and 1b display these substitution effects (Nicholson and Snyder 2012). In a hypothetical two-good world where good *X* is a meat product and good *Y* is a meat alternative product, and these products are gross substitutes and normal goods, a decrease in the price in good *Y* will shift the budget constraint for the two goods outward from I_0 to I_1. All else equal, utility would shift to U_1 from U_0 and demand would shift to X_1 and Y_1 (figure 1a). This would be an increase in demand for good *Y* and a decrease in demand for good *X*. This demand change in *X* would result in an inward shift of the demand curve to *Demand'* from *Demand*, thereby decreasing producer surplus (figure 1b).

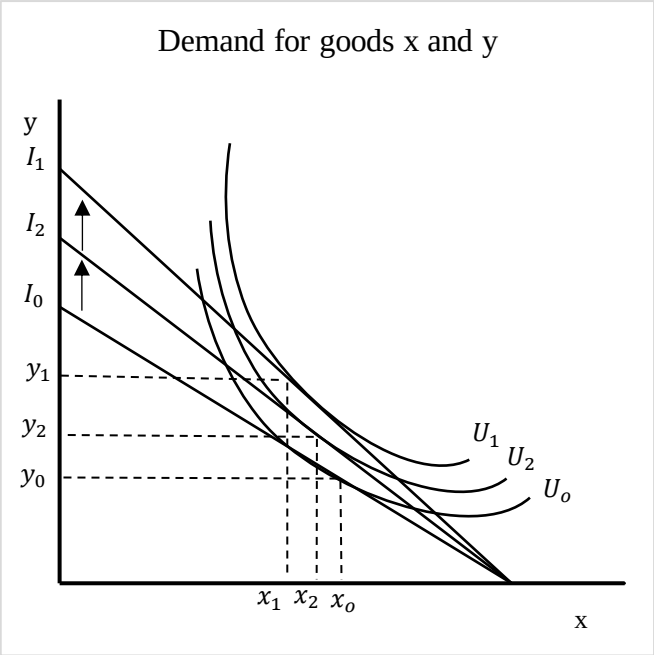

Figure 1a: Change in Demand Due to Price Decrease of Good Y

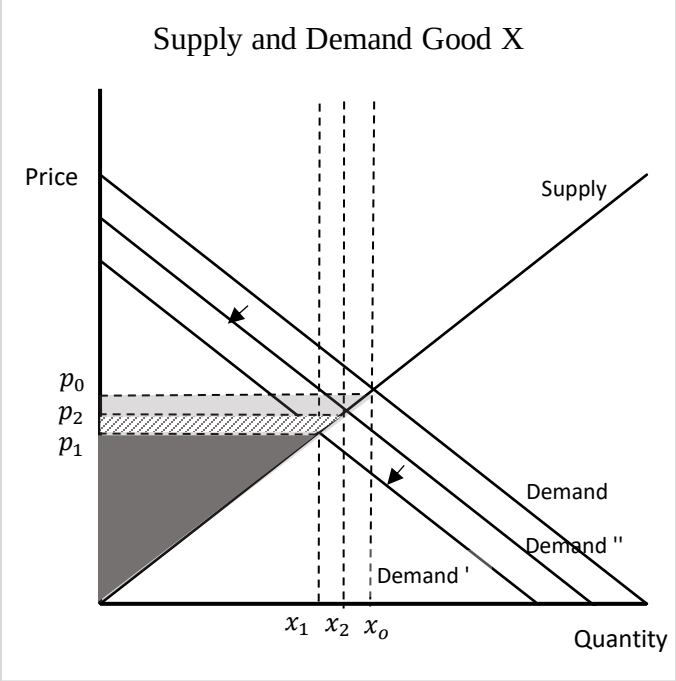

Figure 1b: Demand Shift for Good X Due to a Change in the Price of Substitute Good Y

Implementation of the labeling policy might make consumers less likely to substitute meat for a meat alternative. If there was a decrease in the price of meat alternative good *Y*, the budget constraint for the two goods would shift outwards from I_0 to I_2 and demand would be X_2 and Y_2 (figure 1a). Of critical importance is the demand curve of the substitute product *X* (figure 1b). We can see the demand shift for good *X* going to the demand curve labeled *Demand''* instead of the demand curve labeled *Demand'*. This shift in demand represents a BAB attempt to decrease the substitutability of the demand for good *X* and increase producer surplus. Hence our hypothesis that the legislation is an attempt to increase producer surplus by restricting substitution effects.

V. METHODS AND DATA

A. Methods

At the time of survey development, lab-grown products were not available in the marketplace although many companies were in the startup phase. Given these challenges, we utilized a stated preferences approach via online surveys to capture a representative sample of U.S. consumers. Preliminary market research was conducted by visiting eight supermarkets and retailers in the greater Detroit Metropolitan Statistical Area in October 2018. Survey pretesting was conducted with 100 participants recruited on Amazon Mechanical Turk and each participant was paid $0.80 for survey completion. Their responses provided feedback on topics regarding survey flow and question wording to improve the survey usability on cellphones and desktop computers.

Consumers were identified via Survey Sampling International and paid roughly $1.50 in gift cards for completing the survey. The data were collected through a survey designed in Qualtrics®. The first section of the survey consisted of a discrete choice experiment (DCE) as well

as questions on the ingredients and nutritional content of meat and meat alternatives. The second section included questions on their past and future expenditures of food, and their perceptions of meat and non-meat environment effects. The last section collected demographic information to assure the sample was consistent with the U.S. population and two sample groups.

A between subjects survey design was used to test the hypotheses. Participants were randomly placed into a group with labels consistent with the marketplace before or after regulation. The group before regulation received a survey where meat and meat alternative products had pre-law labels and the group after regulation received a survey with product labels consistent with the new legislation (figure 2). Two meat alternatives were selected for the project. The Beyond Beef Burger® was selected as it was often cited in the Missouri regulation controversy (Starostinetskaya 2018b). JUST Meat® was chosen as it was one of the first lab-grown meat startups with a concept at the time of survey.

Figure 2: Beyond Meat and JUST Meat Before and After Regulation

Figure 3 displays the two animal products presented to both survey groups. The two animal products selected are commonly available at Walmart, Kroger, or other supermarkets.

Figure 3: Ball Park Beef Patty and Homestyle Beef Patty

In the first set of ingredient questions, participants identified which ingredients were in each of the meat and meat alternative products (figure 4). Possible choices included ground beef, natural and artificial flavors, onions, soy, sesame oil, corn, wheat, beets, and peas. These ingredients were selected as many could be found in the Beyond Beef, Ball Park, and Homestyle products.

Figure 4: Consumer Selection of Ingredients in Beyond Protein

Even if consumers could accurately identify which products contain animal protein, they may be unsure of the differences in nutritional content. Consumers were asked to identify the total calories in a single serving and percent daily value of cholesterol, trans fats, proteins, and sodium in each product (figure 5).

Figure 5: Consumer Selection of Perceived Cholesterol in Meat and Meat Alternatives

To empirically test for confusion in nutritional content (H1), unpaired t-tests were conducted between the mean perceived nutritional values of the five nutritional categories (per-law labeling) and the actual nutritional values. To test the effectiveness of the labeling change in reducing consumer confusion (H2), we estimated the following econometric model:

$$(1) \qquad Nutrition_{i,j,t} = \beta_0 + \delta_0 treatment + \beta_1 meat_{sub} + \delta_1 treatment * meat_{alt} + \varepsilon_{i,j,t}$$

where *treatment* is a dummy variable indicating the group who saw the label after the legislative change and $meat_{alt}$ represented whether the product was a meat alternative. The variable of

interest was the interaction between *treatment* and $meat_{alt}$, δ_1, which represented a change in the average difference in nutritional values between the meat and meat alternative products after the labeling changes.

A discrete choice experiment (DCE) was conducted to examine (H3) - changes in substitution due to the new regulation. DCEs effectively generate an instantaneous panel, allowing researchers to exogenously vary price, thereby generating causal inferences (Hensher, Rose and Greene 2015). The DCE method was chosen as they are largely consistent with neoclassical microeconomic theory (Maples, Lusk and Peel 2016; Lusk and Tonsor 2016; Malone and Lusk 2017). While stated preferences DCEs often overestimate consumer WTP because of hypothetical and social desirability bias, the DCE's marginal effects are largely consistent with revealed preference approaches (Lusk and Schroeder 2004).

A branded discrete choice experiment was designed with five choice alternatives: the same products for testing (H1) and (H2) and a no choice option; and three price levels (Appendix Table 7). A DCE can be burdensome to the survey taker due to the many combinations of attributes and levels of attributes (Hensher, Rose and Greene 2015). To prevent cognitive burden in this survey, a main effects orthogonal fractional factorial design was created in SAS®. This design reduced the DCE to nine choice sets for the five choice alternatives and three price levels, and assured brands could be paired with prices while being uncorrelated with one another (Appendix Table 8). An example of one question for the groups before and after regulation are is figure 6a and 6b. Participants randomly assignment to the two groups for (H1) and (H2) remained consistent for the DCE. To minimize the potential consequences of inattention bias for (H3), the discrete choice experiment was at the beginning of the survey (Malone and Lusk 2018).

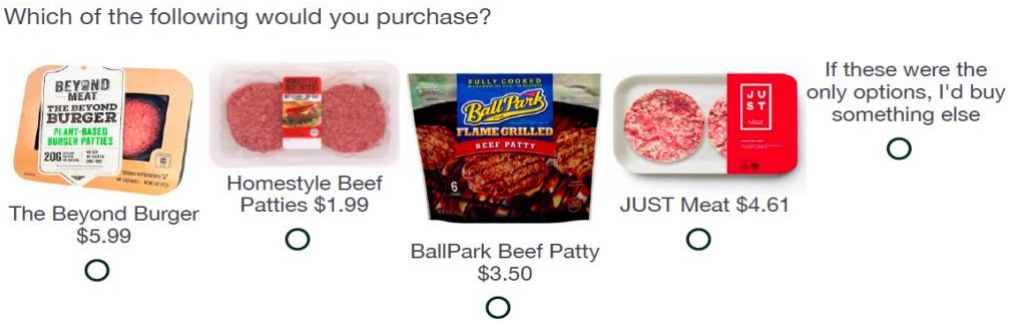

Figure 6a: Example of a Choice Set Before the Regulation

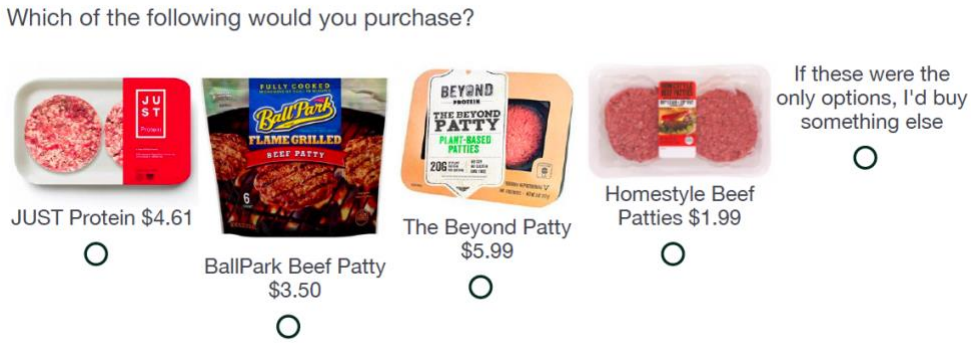

Figure 6b: Example of a Choice Set After Regulation

We utilized indirect utility theory to estimate our empirical model (Hensher, Rose, and Greene 2015):

$$U_{isjt} = V_{isjt} + \varepsilon_{isjt}, \quad (2)$$

where the observed portion of the indirect utility function is V_{isjt} and the unobserved portion is ε_{isjt}. Subscript i refers to the survey participant and subscript s refers to the randomized choice set with choice alternatives varying by attribute levels. Subscript j is the choice alternative, and the last subscript t represents the group before or after regulation. The observed portion was as follows:

$$V_{ijst} = \alpha Price_{js} + \beta_j ASC_{jt} \quad (3)$$

where V_{ijst} is participant $i's$ observed indirect utility for choice j during choice set s in the group before or after regulation group t. Equation (3) is a function of price and alternative specific constants (ASC), which were the meat, meat alternative, and no choice options. $Price_{ijst}$ represents the price for choice j, and α represents the utility for $Price$ of good j in choice set s. β_j represents the utility of the ASCs, and for estimation purposes, our model normalized the no choice option to zero.

We estimated the indirect utility model of equation (3) based on random utility maximization (RUM) theory (McFadden 1973) through a Multinomial Logit (MNL), generating the probability individual *i* selects of choice *j*, which can be defined as:

$$(4) \qquad Probability(\ j\ is\ chosen\ ) = \frac{e^{V_{ijst}}}{\sum_{s=1}^{9} V_{ijst}}$$

where V_{isjt} represented the attributes that determined the utility of choice j for the group before and after regulation t conditional on the no choice alternative. For this model we assumed that the error term ε_{isjt} was i.i.d. with a normal distribution of mean zero and standard deviation of one.

One assumption in MNL estimation is the principal of independence of irrelevant alternatives (IIA). The IIA principal states the ranking of alternative choices remain constant for all subsets of choices (Hensher, Rose, and Greene 2015). Because this principal restricts heterogeneity in cross price elasticities, we opted to estimate a random parameter logit (RPL) models (Lusk and Tonsor 2016). The RPL model was estimated by changing the generic form of the observed portion of utility equation (4) to equation (5) as shown by Lusk and Tonsor (2016):

$$(5) \qquad V_{ijt} = \beta_j\left(ASC_{jt} + \Gamma\right) + \alpha Price_j + Nochoice_t\,,$$

where the ASCs were randomized with a normal distribution of mean zero and standard deviation one, and Γ was the lower triangular matrix of the Cholesky decomposition. $Price_j$ remained fixed to assure negativity and the no choice variable was not randomized as this variable was normalized to zero for estimation purposes. One thousand iterations were completed for the RPL to be consistent with the literature (Hensher, Rose, and Greene 2015). Likelihood ratio tests were utilized to determine whether the regulation significantly alters consumer decision-making. With the parameter estimates β_j of equation 5 we calculated the cross price elasticities with equations 6 (Hensher, Rose, and Greene 2015):

$$\epsilon = \alpha_i X_{ij}(-\beta_{ij}) \tag{6}$$

B. Data

The survey sample included 1,502 consumers in the United States and was collected in January 2019. To participate in the survey, consumers needed to be the primary or joint primary shopper of their household and above 18 years of age. The group before regulation (pre-law labeling) had 732 consumers and group after regulation (post-law labeling) had 772 consumers. The survey took approximately seventeen minutes to complete.

Table 1 summarizes the demographic information of the sample groups as well as information from the 2017 U.S. Census Bureau. Although there is minimal variation in the groups before and after regulation, both groups were consistent with the U.S. Census on gender, region, household size, and ethnicity. Income, age, and education were comparable to the U.S. Census, but the survey underrepresented participants with incomes greater than $100,000, educations greater than a bachelor's level, and participants aged 75 or higher.

Table 1: Descriptive Statistics for the Survey Experiment Before and After Regulation

Demographic		Before (N = 732)	After (N = 772)	US Census
Gender	Male	46.0	47.7	49.2
Age	18 to 24 years old	13.3	12.6	9.7
	25 to 34 years old	19.0	19.2	13.7
	35 to 44 years old	16.9	17.9	12.7
	45 to 54 years old	16.0	14.8	13.4
	55 to 64 years old	18.2	18.8	12.7
	65 to 74 years old	16.7	16.7	8.6
	75 or older	0.0	1.3	6.3
Region	Northeast	18.6	17.4	17.2
	Midwest	20.8	23.3	21.0
	South	39.8	39.0	38.0
	West	20.8	20.2	23.8
Income	Less than $20,000	17.9	18.9	11.2
	$20,000 - $39,000	26.2	29.0	15.9
	$40,000 - $59,999	23.4	21.9	15.1
	$60,000 - $79,999	16.4	16.8	13.1
	$80,000 - $99,999	7.9	5.7	10.6
	$100,000+	8.2	7.7	34.1
Education	High School or less	24.3	24.1	40.5
	Some College	39.8	38.0	31.2
	Bachelors, Grad, Professional Degree	35.9	38.0	28.4
Household Size		2.44	2.36	2.61
Ethnicity	White	60.5	60.0	61.5
	Black or African American	17.5	17.4	12.3
	Hispanic or Latin American	9.4	8.8	17.6
	Asian	5.1	6.1	5.3
	Other	7.5	7.8	3.3
Diet	Vegetarian	8.2	8.4	-
	Vegan	4.8	4.9	-
	Neither	87.0	86.7	-

Footnotes: U.S. Census Bureau, Current Population Survey, Annual Social and Economic Supplement, 2017
Numbers reported are percentages of the column total except for household size.

VI. RESULTS

A. Hypotheses 1 and 2: Consumer Confusion

The mean perceived values of nutritional content pre-label regulation for the meat and meat alternatives is displayed in table 2 alongside the actual nutritional values. There are no values for the product JUST Meat as this product was not yet commercially available. Unpaired t-tests indicated that participants could not accurately identify the nutritional values of the meat and meat alternatives for all nutritional questions. Specifically, participants overestimated cholesterol, protein, sodium and trans fats, and underestimated calorie content in all of the products. As such, we concluded that consumers are confused by the nutritional content of the meat, and meat alternatives.

Table 2: Difference Between Mean Perceived and Actual Nutrition Values Before Labeling Regulation

Variable	Mean	Std. Dev	Actual	Difference	t-test statistics
Cholesterol % Daily Value					
Beyond	34	26	0	34	-35.62***
Just	45	26	-	-	-
Ballpark	52	26	22	30	-47.02***
Homestyle	47	26	23	24	-30.34***
Protein % Daily Value					
Beyond	38	27	32	6	-12.87***
Just	42	27	-	-	-
Ballpark	53	27	26	27	-23.33***
Homestyle	44	26	34	10	-15.35***
Sodium % Daily Value					
Beyond	45	27	16	29	-22.57***
Just	46	26	-	-	-
Ballpark	49	26	16	33	-36.95***
Homestyle	48	25	3	45	-41.70***
Daily Calories					
Beyond	133.92	70.05	270	-136.08	52.56***
Just	162.55	73.68	-	-	-
Ballpark	184.30	73.09	210	-25.70	9.52***
Homestyle	165.41	70.66	250	-84.59	32.39***

Table 2 cont'd

Trans Fat % Daily Value					
Beyond	32	27	0	32	32.70***
Just	41	27	-	-	-
Ballpark	49	28	0	49	-46.64***
Homestyle	43	26	0	43	-43.97***

Footnote: * implies $0.05 < \alpha < 0.1$, ** implies of $0.01 < \alpha < 0.05$, *** implies $\alpha < 0.01$. T-Test Statistics tests null hypothesis perceived and actual nutritional values are equal.

Figure 7 displays the percentage of consumers that correctly chose ground beef as one of the ingredients in the meat and meat alternatives. Respondents selected ground beef in the meat products 85% of the time. Selection of ground beef was mixed for meat alternatives. For the Beyond Burger, 31.4% of participants selected ground beef prior to the label restrictions. Results were nearly similar at 30.4% when the labels changed. For the cultured-meat meat alternative, 80.6% of respondents selected JUST Meat as having ground beef, but respondents decreased selection to 63.08% for the JUST Protein burger.

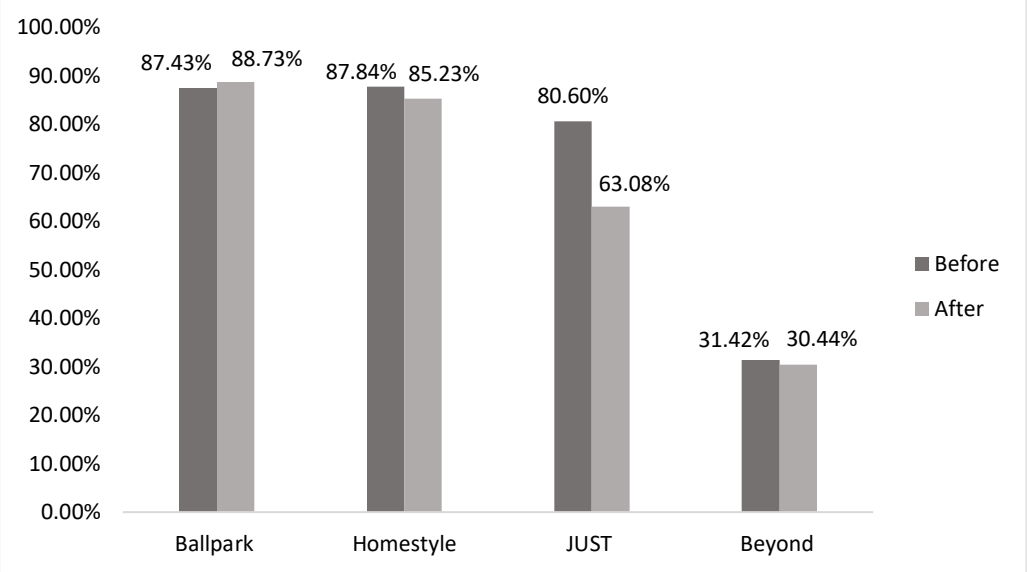

Figure 7: Percent of Respondents Selecting Ground Beef as an Ingredient Before and After Regulation

Table 3 displays the descriptive statistics of the nutritional content perceptions for the survey participants in each group. A comparison of the mean values for the meat and meat alternatives suggested that the policy will lower consumer perception of daily values of cholesterol, sodium, and trans fats as well as the total number of calories, but perceptions of protein content increased after the legislation was implemented

Table 3: Descriptive Statistics of Perceived Nutrition Values Before and After Labeling Regulation

	Before		After	
Variable	**Mean**	**Std. Dev**	**Mean**	**Std. Dev**
Cholesterol % Daily Value				
Meat	49.23	26.18	48.60	25.50
Meat Sub	39.62	26.48	35.21	26.10
Protein % Daily Value				
Meat	48.33	25.49	47.43	24.80
Meat Sub	45.42	26.25	48.55	26.18
Sodium % Daily Value				
Meat	48.44	27.24	46.84	25.98
Meat Sub	40.18	27.04	38.89	25.81
Calories				
Meat	174.85	72.48	172.00	71.23
Meat Sub	148.23	73.28	135.22	68.09
Trans Fats % Daily Value				
Meat	45.89	27.56	44.88	27.47
Meat Sub	36.61	27.19	32.81	26.76

Footnote: Results from 732 observations in the group before the regulation and 774 in the group after the regulation

Results on the effects of reducing consumer confusion are in table 4. The variable *labeling regulation* (the interaction variable of *treatment* and $meat_{alt}$) suggested that after the labeling change, consumers decreased their perception of trans-fat and cholesterol by 2.78 and 3.78 percentage points. The labeling change also decreased perceptions of calories per serving for the

non-meat products by 10.17. Consumers showed an inverse response to perception of protein; daily perception of protein for meat alternatives increased by 4.036 percentage points. Results suggested that we were able to reject the null hypothesis two, suggesting that the proposed legislation may actually *increase* consumer confusion.

Table 4: Change of Perceived Nutritional Content Due to Labeling Regulation

	Sodium % Daily Value	**Trans Fat % Daily Value**	**Calories Per patty**	**Cholesterol % Daily Value**	**Protein % Daily Value**
Treatment	- 1.598*	-1.014	- 2.845	- 0.628	- 0.904
	(0.967)	(0.994)	(2.599)	(0.951)	(0.937)
Meat Sub	- 8.253***	- 9.282***	- 26.621***	- 9.610***	- 2.917***
	(0.980)	(1.007)	(2.634)	(0.963)	(0.949)
Labeling	0.304	- 2.783**	-10.172***	- 3.782***	4.036***
Regulation	(1.368)	(1.406)	(3.676)	(1.344)	(1.325)
_cons	48.436***	45.893***	174.855***	49.231***	48.334***
	(0.693)	(0.712)	(1.862)	(0.681)	(0.671)
R^2	0.02	0.04	0.05	0.05	0.00
N	6,016	6,016	6,016	6,016	6,016

Footnotes: Numbers in parentheses are standard errors.
* implies $0.05 < \alpha < 0.1$, ** implies of $0.01 < \alpha < 0.05$, *** implies $\alpha < 0.01$.

Regression analysis was conducted to see who among the subpopulation were most likely to be confused prior to the regulation change by creating a variable that represented confusion.[2] This variable was regressed on a set of demographic and socioeconomic variables, [3] and the results are shown in the Appendix for tables 9 to 13. From the results, those with low income were less likely to falsely perceive the nutritional contents of the Beyond Meat, Ballpark, and Homestyle burgers for all of the nutritional questions. Middle-income participants perceived nutritional values

[2] This was done by subtracting the mean average of the perceived nutritional value for the five nutritional questions for the Beyond Burger, Ball Park Beef Patty, and Homestyle Patty, from their actual nutritional values
[3] *low income* incomes of less than $40,000 per year, *middle income* incomes of $40,000 to $100,000. *no college* high school degree or less, *some college* an associate degree or classes as some college, *Gender* one if female and zero if male, *Veg/Vegan* one if a vegetarian or vegan and zero if not.

to be closer to the actual values than other participants. For those without a college degree, the results of correctly perceiving the actual nutritional values were mixed. Those with no college degree overestimated cholesterol for the Beyond Burger, but they correctly chose the level of protein. Perhaps most surprising was that vegetarian and vegan consumers. They were most likely to incorrectly perceive the results of all the nutritional values.

B. Hypothesis 3: Substitution Effects

Figure 8 displays the aggregate choice selection for the sample groups before and after regulation for meat, meat alternatives, and no-choice. Meat was among 61.9% and 62.0% of the choices selected in both groups respectively. Before and after regulation, meat alternative selection changed from 20.4% to 18.7% and appears to have been substituted for no-choice which increased from 17.7% in the before regulation group to 19.3% in the group after regulation. These results suggested that consumer selection towards meat changed minimally before and after regulation, but the labeling effects may have pushed people to no selection.

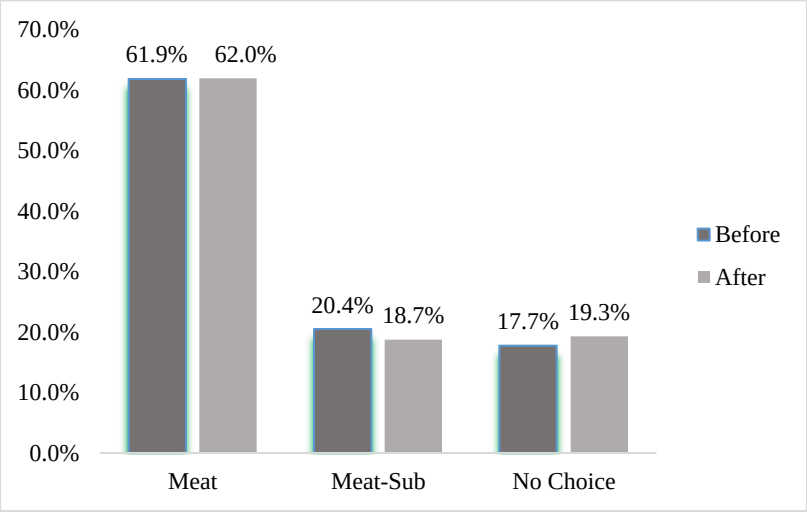

Figure 8: Choice Selection by Product Category Before and After Regulation

Baseline multinomial logit (MNL) parameters for the pooled and un-pooled data for the groups before and after regulation are displayed in table 5. Likelihood ratio tests suggested that

the MNL has improved when the pooled group is separated into groups before and after regulation. Consistent with economic theory, the price coefficients were negative for both groups; suggesting that price increases lead to a decrease in the probability a consumer will choose the product. Similar to other choice experiments with meat and meat alternatives, the meat products ranked highest in indirect utility (Lusk and Tonsor 2016; Slade 2018; Apostolidis and McLeay 2016). For both MNL models, the two meat products had the highest level of indirect utility followed by Beyond Burger and Beyond Patty, relative to not choosing any product.

Two random parameter logit (RPL) models were estimated with 1,000 normally distributed iterations for the groups before and after regulation. The alternative specific constants for the meat and meat alternatives were randomized with a normal distribution of mean zero and standard deviation of one while price was held fixed to assure negativity. Most important to hypothesis 3 is comparing the change in the substitutability of the meat and meat alternatives between the groups before and after regulation. Estimated mean/median cross-price elasticities are in table 6 for the cross-price elasticities at the 95% confidence interval and displayed in figure 9a and 9b.The results of the MNL and RPL are in Table 5 below.

Table 5: Model Estimates for DCE Before and After the Labeling Regulation

	Pooled	**Before**	**After**	**Before**	**After**
Variable	**MNL**	**Standard MNL**		**Random Parameter Logit**	
				Means of Random Parameter	
JUST Meat	0.0340	0.100	-0.028	0.051	-0.232
	(0.052)	(0.075)	(0.074)	(0.215)	(0.228)
Beyond Beef	0.773***	0.885***	0.665***	0.557**	0.437*
	(0.057)	(0.081)	(0.080)	(0.257)	(0.230)
Ball Park Beef	1.274***	1.354***	1.120***	2.093***	1.568***
Patty	(0.042)	(0.059)	(0.058)	(0.176)	(0.187)
Homestyle Beef	1.132***	1.150***	1.117***	1.862***	1.958***
Patty	(0.034)	(0.049)	(0.047)	(0.157)	(0.168)
				Mean Non-random Parameter	
Price	- 0.145***	-0.145***	-0.145***	-0.302***	-0.301***
	(0.006)	(0.008)	(0.008)	(0.0129)	(0.013)

Table 5 cont'd

				Std Dev Random Parameter	
JUST Meat				3.080***	3.249***
				(0.199)	(0.202)
Beyond Beef				3.673***	3.669***
				(0.214)	(0.230)
BallPark Beef Patty				3.688***	3.513***
				(0.201)	(0.168)
Homestyle Beef Patty				3.345***	3.492***
				(0.168)	(0.190)
N choices	13,536	6,588	6,948	6,588	6,948
Log Likelihood	-19820.004	-9,675.465	-10,135.082	-6503.481	-6776.506
Likelihood Test[4]		20289.078***	19369.844***	6343.968***	6717.153***

Footnotes: Numbers in parentheses are standard errors.
* implies $0.05 < \alpha < 0.1$, ** implies of $0.01 < \alpha < 0.05$, *** implies $\alpha < 0.01$.

Figure 9a shows the cross-price elasticities for the change in price of the Beyond Meat and JUST Meat in the groups before and after regulation due to a 1% increase in the cross price of the Ballpark Beef Patty. Results revealed that the cross elasticities remained consistent with the label change suggesting consumers remain rather consistent for the substitution effect. These results suggested that we were not able to reject the null hypothesis that the label change will lower the substitution effect between products for the average U.S. consumer.

[4] Loglikelihood Ratio Test: -2 ($LL_{\text{base model}} - LL_{\text{estimated model}}$) ~ X^2 number of new parameters estimated in the estimated model) (Hensher, Rose, and Greene 2015)

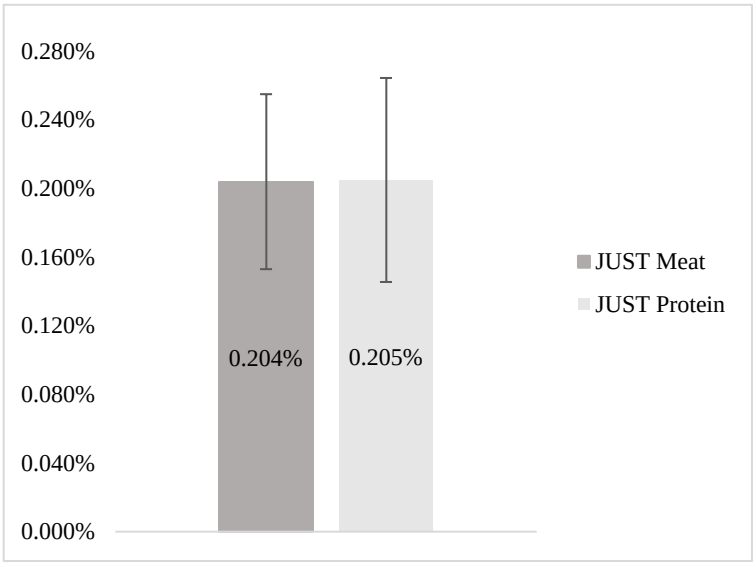

Figure 9a: Cross-Price Elasticities for JUST Meat Before and After Regulation

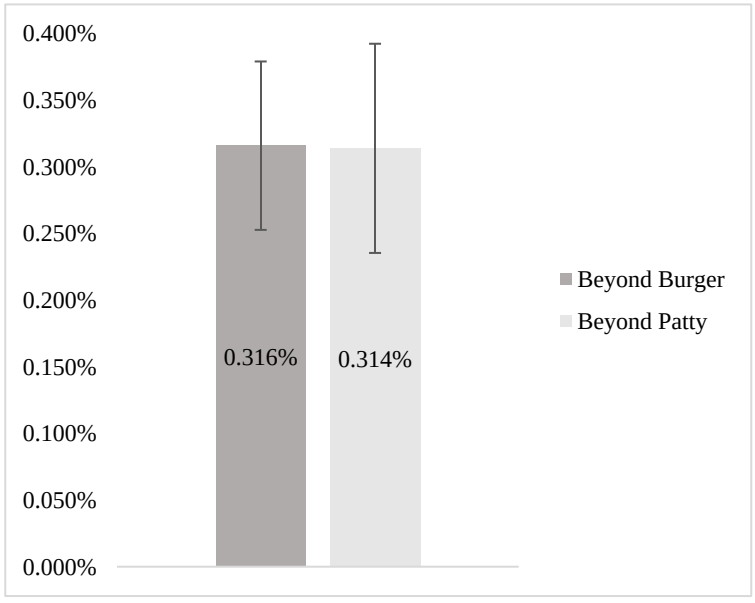

Figure 9b: Cross-Price Elasticities for Beyond Meat Before and After Regulation

Table 6: Cross Price Elasticities for Before and After the Labeling Regulation

Product	Before	After
JUST Meat/Protein (JM/JP)	0.204 % [0.164, 0.249]	0.205 % [0.141, 0.28]
Beyond Beef/Protein (BB/BP)	0.316 % [0.261, 0.375]	0.314 % [0.243, 0.402]
Ball Park Beef Patty (BPB)	0.551 % [0.481, 0.628]	0.469 % [0.397, 0.542]
Homestyle Beef Patties (HP)	0.480 % [0.421, 0.547]	0.532 % [0.455, 0.621]

Footnotes: Numbers in brackets are the 95% confidence intervals as calculated using (Krinsky and Robb 1986).
Interpreted as the effect of a 1% increase in price on quantity demanded for the alternative products.

The results in table 6 suggested that the labeling restrictions might reduce substitution between meat and meat alternatives for some consumers. Prior research showed consumers are consuming less red meat due to their perceived negative health and environmental effects (Van Loo, Hoefkens and Verbeke 2017; Apostolidis and McLeay 2016; MINTEL 2017; Tonsor, Mintert, and Schroeder 2010). Concurrently, research has shown that consumers have strong affinity for meat and meat attributes (Graça, Calheiros, and Oliveira 2015a; Graça, Oliveira and Calheiros 2015b; Malone and Lusk 2017; Lusk and Briggeman 2009). If consumers are to accept meat alternatives, they are more likely to accept those that are similar to meat (Elzerman et al. 2015; Elzerman et al. 2011; de Boer, Schösler and Boersema 2013). If there is a subcategory of consumers that are most likely to have their substitution effects decreased, it may be flexitarians, consumers that want a meat alternative similar to meat but with a perceived health or environmental benefit.

VII. POLICY IMPLICATIONS

Findings of this article have key implications for public policy. First, our results supported the industry claim that consumers are confused about the nutritional and ingredient content of meat alternatives. Indeed, more than 30% of our sample believed that ground beef could be found in Beyond Meat®. At first glance, this finding might justify the need for labeling intervention, but our results also display that restricting use of the word "meat" is unlikely to reduce consumer confusion. If anything, the labeling restriction might actually *increase* consumer confusion. Of course, this article cannot accurately identify what proportion of this confusion is due to actual confusion on the part of the consumer or deception on the part of the meat alternative industry. Regardless, this study suggests that regulators would benefit from considering likely unintended consequences of the labeling restriction.

Results from the DCE suggest that substitution effects will not change for the average consumer if the labeling restriction were to come to fruition. As such, findings of this article have important implications for both the policy agenda of the meat and meat alternative industries. As noted by the results reported in table 4, labeling restrictions decreased consumer perceptions of cholesterol and trans fats in the meat alternatives and increased consumer perceptions of protein content. In other words, labeling restrictions might actually *increase* demand for the meat alternatives for health-conscious consumers. Rather than focusing on the word "meat," industry interest groups might be better off focusing their policy strategy on promoting the health benefits in meat that cannot be found in meat alternatives, including ketogenic diets high in fat (Poff, Ari, Arnold, Seyfried, & D'Agostino, 2014; Westman et al., 2007).

VIII. CONCLUSION

Missouri Senate Bills 627 and 925 were allegedly passed in order to protect consumers, but this article suggests that labeling changes are unlikely to reduce consumer harms associated with labeling confusion. Indeed, when respondents were asked to state the ingredients and nutrition of meat and meat alternatives, respondents incorrectly distinguished the ingredients and nutritional differences for all products, and this remained consistent with the labeling changes. This paper tested whether the economic outcomes of the proposed meat labeling policy are likely to be consistent with the bootlegger and Baptist paradigm. Results of the branded DCE suggest that the substitutability from the meat to the meat alternatives is unlikely to change due to the new labeling regulations.

Some limitations remain. While this research is one of the first to estimate the substitution effects between meat and meat alternatives, it is possible key variables were omitted including product expiration dates (Tonsor 2011). Future studies might include brands of meat alternatives such as Boca Burger, Morning Star, Gardenburger, Dr. Prager's, Gardenburger, and more. Given the company Beyond Burger has been the most aggressive in their product placement, and has drawn controversy, if consumers are confused with this brand it is likely they are confused with others. The selection of the JUST Meat and Beyond Burger are also novelty items that might be receiving choice because consumers are curious about the products (Alemu and Olsen 2018). Despite these limitations, results suggested the proposed regulation targeted at protecting consumers from food labeling confusion is unlikely to be successful as the regulation may cause more problems than solutions. If the attempt is to protect consumers from confusion, regulators may consider regulating supermarket's placement of meat and meat alternatives. Researchers have proposed regulating product choice at supermarket checkouts to lower impulse purchases of

unhealthy foods (Cohen and Babey 2012). Finally, given the growing trend in food labeling regulation, future research might consider labeling for other products such as rice or milk. In addition, the literature might also benefit from comparing our results to results of studies on other meats. Despite these limitations, our results suggest that meat labeling restrictions are unlikely to effectively mitigate consumer confusion.

APPENDIX

APPENDIX

Table 7: Factors and Factor Levels for the Discrete Choice Experiment

Factor	JUST Meat/Protein	Beyond Burger/Patty	Ball Park Beef Patty	Homestyle Beef Patty	No Buy
Factor Levels	$4.61	$5.99	$3.50	$1.99	If these were the only options, I'd buy something else
	$6.45	$7.98	$5.75	$3.98	
	$8.99	$11.98	$7.99	$5.99	

Discrete Choice Experiment design before and after regulation
Five choice factors and three price factor levels

Table 8: Main Effects Orthogonal Fractional Factorial Design

Choice Set	JUST Meat/Protein	Beyond Burger/Patty	Ball Park Beef Patty	Homestyle Beef Patty	No Buy
1	$4.61	$5.99	$3.50	$1.99	1
2	$4.61	$7.98	$7.99	$5.99	1
3	$4.61	$11.98	$5.75	$3.98	1
4	$6.45	$5.99	$7.99	$3.98	1
5	$6.45	$7.98	$5.75	$1.99	1
6	$6.45	$11.98	$3.50	$5.99	1
7	$8.99	$5.99	$5.75	$5.99	1
8	$8.99	$7.98	$3.50	$3.98	1
9	$8.99	$11.98	$7.99	$1.99	1

Table 9: OLS of Incorrect Nutrition of Cholesterol Before Regulation

	Incorrect Beyond	Incorrect Ballpark	Incorrect Homestyle
Low Income	-7.010***	-6.815**	-4.964*
	(2.634)	(2.710)	(2.610)
Mid Income	-5.093**	-5.977**	-3.929
	(2.544)	(2.617)	(2.520)
No college	6.212***	1.688	1.694
	(1.796)	(1.848)	(1.780)
Some College	0.233	-2.978*	-2.267
	(1.549)	(1.593)	(1.534)
Gender	-2.967**	-1.541	-1.835
	(1.302)	(1.339)	(1.290)
Veg/Vegan	17.719***	9.524***	11.145***
	(1.933)	(1.989)	(1.915)
_cons	36.195***	35.683***	27.389***
	(2.449)	(2.519)	(2.426)
R^2	0.07	0.03	0.03
N	1,504	1,504	1,504

Footnotes: Numbers in parentheses are standard errors.
* implies $0.05 < \alpha < 0.1$, ** implies of $0.01 < \alpha < 0.05$, *** implies $\alpha < 0.01$.

Table 10: OLS of Incorrect Variable of Sodium Before Regulation

	Incorrect Beyond	Incorrect Ballpark	Incorrect Homestyle
Low Income	-4.674*	-5.548**	-6.849***
	(2.706)	(2.648)	(2.553)
Mid Income	-4.613*	-4.302*	-5.305**
	(2.612)	(2.557)	(2.465)
No college	2.647	2.199	1.028
	(1.845)	(1.806)	(1.741)
Some College	-1.207	-1.449	-1.243
	(1.590)	(1.556)	(1.501)
Gender	-0.362	-3.140**	-1.881
	(1.337)	(1.309)	(1.262)
Veg/Vegan	12.452***	12.052***	8.681***
	(1.986)	(1.943)	(1.873)
_cons	16.117***	26.799***	19.246***
	(2.515)	(2.462)	(2.373)
R^2	0.03	0.04	0.02
N	1,504	1,504	1,504

Footnotes: Numbers in parentheses are standard errors.
* implies $0.05 < \alpha < 0.1$, ** implies of $0.01 < \alpha < 0.05$, *** implies $\alpha < 0.01$.

Table 11: OLS of Incorrect Variable of Sodium Before Regulation

	Incorrect Beyond	Incorrect Ballpark	Incorrect Homestyle
Low Income	-4.805*	-6.368**	-3.992
	(2.701)	(2.776)	(2.641)
Mid Income	-2.712	-5.391**	-4.133
	(2.608)	(2.680)	(2.550)
No college	2.365	2.036	2.376
	(1.842)	(1.893)	(1.801)
Some College	0.117	0.644	-0.399
	(1.588)	(1.632)	(1.552)
Gender	-4.079***	0.502	-2.926**
	(1.335)	(1.372)	(1.305)
Veg/Vegan	14.494***	10.098***	14.140***
	(1.982)	(2.037)	(1.938)
_cons	25.260***	39.398***	42.909***
	(2.511)	(2.580)	(2.455)
R^2	0.05	0.02	0.04
N	1,504	1,504	1, 504

Footnotes: Numbers in parentheses are standard errors.
* implies $0.05 < \alpha < 0.1$, ** implies of $0.01 < \alpha < 0.05$, *** implies $\alpha < 0.01$.

Table 12: OLS of Incorrect Variable of Calories Before Regulation

	Incorrect Beyond	Incorrect Ballpark	Incorrect Homestyle
Low Income	-18.329***	-16.102**	-13.521*
	(7.063)	(7.582)	(7.277)
Mid Income	-9.739	-7.080	-3.376
	(6.819)	(7.321)	(7.026)
No college	-3.838	-10.601**	-12.842***
	(4.816)	(5.171)	(4.962)
Some College	-6.556	-2.350	-4.341
	(4.151)	(4.457)	(4.277)
Gender	-6.972**	-2.818	-1.676
	(3.491)	(3.747)	(3.596)
Veg/Vegan	27.135***	4.034	14.010***
	(5.183) ***	(5.565)	(5.340)
_cons	-122.594	-12.649)*	-73.846***
	(6.566)	(7.049	(6.765)
R^2	0.03	0.01	0.02
N	1,504	1,504	1,504

Footnotes: Numbers in parentheses are standard errors.
* implies $0.05 < \alpha < 0.1$, ** implies of $0.01 < \alpha < 0.05$, *** implies $\alpha < 0.01$.

Table 13: OLS of Incorrect Variable of Trans Fats Before Regulation

	Incorrect Beyond	Incorrect Ballpark	Incorrect Homestyle
Low Income	-7.714***	-6.207**	-5.761**
	(2.687)	(2.900)	(2.762)
Mid Income	-5.200**	-4.652*	-3.087
	(2.594)	(2.800)	(2.666)
No college	7.011)***	5.664***	3.611*
	(1.832	(1.977)	(1.883)
Some College	-0.548	-0.712	-0.469
	(1.579)	(1.705)	(1.623)
Gender	-3.219**	-0.597	-1.265
	(1.328)	(1.433)	(1.365)
Veg/Vegan	16.308***	11.569***	12.268***
	(1.972)	(2.128)	(2.027)
_cons	34.968***	50.813***	45.062***
	(2.498)	(2.696)	(2.567)
R^2	0.07	0.03	0.03
N	1,504	1,504	1,504

Footnotes: Numbers in parentheses are standard errors. * implies $0.05 < \alpha < 0.1$, ** implies of $0.01 < \alpha < 0.05$, *** implies $\alpha < 0.01$.

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