Essays in Agricultural and Food Policy: Impact of Crop Insurance on Fertilizer Use, Willingness to Pay a Premium on Beef, and Estimating the Demand for Carbonated Sweetened Beverage

by

Ekene Stephen Aguegboh

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Approved by

Adam Rabinowitz, Chair, Associate Professor and Extension Economist, Agricultural Economics and Rural Sociology
Joel Cuffey, Co-Chair, Assistant Professor, Agricultural Economics and Rural Sociology
Wenying Li, Assistant Professor, Agricultural Economics and Rural Sociology
Nedret Billor, Professor of Statistics
Jason McKibben, Assistant Professor, Curriculum & Teaching

ABSTRACT

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In recent years, empirical economic research has witnessed significant advancements. Simple linear regressions have evolved into different applied econometrics toolkits, which cover methods such as difference-in-difference and event study type strategies, the double hurdle model, and the finite mixture model. This dissertation comprises three essays that concentrate on applying these causal inference approaches and econometric techniques to address issues in agricultural and food policy.

The first essay utilizes the difference-in-difference and event study methodologies to examine the impact of the 1994 Federal Crop Insurance Reform Act (hereinafter referred to as "the Act") on Fertilizer use rate. We employ a novel dataset on nitrogen fertilizer use rate on corn and soybeans, as well as an identification strategy focused on the Act. We address the challenge of identifying the effects of the Act by exploiting the pre-1994 county-level variations in crop insurance participation rates. We define county-level crop insurance participation rates as the ratio of insured acres of a crop type to the maximum insured acreage of the crop type in the county. Our estimation strategy compares counties with low pre-1994 crop insurance participation rates to counties with high pre-1994 insurance rates. The Act should have more "bite" in counties with low pre-1994 crop insurance participation rates. Consistent with our hypothesis, we show that counties with low pre-1994 crop insurance participation rates prior to the Act experience a higher increase in insured acres (and therefore, are referred to as "more treated" counties) compared to counties with high pre-1994 crop insurance participation rates (which are referred to as "less treated" counties). We exploit this differential increase caused by the Act across counties to quantify its effect on fertilizer use rate using the event study and difference-in-differences methodologies. Our results reveal that crop insurance significantly increased fertilizer use rate for corn. The event study results show that the differential increase in fertilizer use rate began precisely two years following the Act. Moreover, fertilizer use rate was

uncorrelated with the insured rates prior to the Act: both the levels and trends in fertilizer use were nearly identical between “less treated” and “more treated” counties before 1994. The difference-in-differences results suggest that compared to “less treated” counties, “more treated” counties experienced relatively short-and-medium-run increase in fertilizer use rate on corn after the implementation of the Federal Crop Insurance Reform Act of 1994. Our estimates indicate that a percentage point increase in insured acres for the “more treated” counties relative to the “less treated” counties leads to a 1.466% and 1.377% rise in fertilizer use rate for corn in the short term and medium term, respectively.

The second essay employs a hypothetical experimental approach known as the Multiple Price Lists method in a survey of beef consumers in Alabama. This survey data was then analyzed using the double hurdle (DH) model as well as the tobit model to assess consumers' willingness to pay (WTP) for local beef. Specifically, the DH model was used to analyze supermarket and direct-to-consumer (DTC) market choice problems while the tobit model was used to analyze options in the DTC market. For the comparisons between supermarkets and DTC markets, we find that consumers' age and race influence the first and second stages of the DH model. Furthermore, we find that the first-stage decision to consider a DTC option depends on household characteristics such as income, household size, age, gender, race, ownership of freezer, and an understanding of the correct definition of beef. On the other hand, we find that the second-stage decision to pay a premium depends on the "no information" and "information and hormone-free" treatments, as well as gender and race. In comparing options in the DTC markets, results from the tobit model indicate that the WTP a premium is influenced by the same treatments as the second stage of the DH model, as well as household characteristics such as age, race, ownership of freezer beef, and an understanding of the correct definition of freezer beef. On consumers’ valuation for the different labels of beef and steak, our results reveal that two niche labels—namely the “no information” and “information and hormone-free” labels—have the highest premiums across all choice problems. This study highlights the evolving beef market in the wake of the COVID-19 pandemic. The findings emphasize the importance of tailoring offerings to meet consumer preferences, improving consumer education, and targeting young consumers in DTC marketing.

The third essay employs scanner data, a popular big data source, to estimate the demand for carbonated sweetened beverages (CSBs). We estimate the impact of a one percent price increase on the demand for CSBs in a one-class model compared to a three-class model, taking heterogeneity into account. In terms of methodological approach, we control for price response endogeneity using the Fisher's price index approach as well as the Hausmann-type instrument through the two-stage residual exclusion. We further account for heterogeneity by employing a finite mixture model, which allows for the existence of different classes of models within the dataset. Within each class, the model endogenously identify the optimal number of sub-groups. Our results suggest the existence of a two-class model, which therefore has two latent sub-groups of consumers. One of the sub-group exhibits a relatively low sensitivity to price changes, whereas the other sub-group displays a relatively high sensitivity to price changes. For the sub-groups of consumers with relatively low sensitivity to price changes, we find that a percentage increase in the own price of CSBs results in a 0.03% decrease in the demand of CSBs. For the sub-groups of consumers with relatively high sensitivity to price changes, a percentage increase in the own price of CSBs leads to a 0.54% decrease in the demand for CSBs. In both the sub-groups, we find an "inelastic" demand for own price of CSBs, which implies that changes in the price have a limited impact on the quantity of the CSBs that consumers are willing to purchase.

These essays collectively contribute to the body of knowledge in applied economics and underscore the need for policymakers and businesses to consider the nuances and complexities of consumer behavior and policy implementation in the areas of agriculture, food, and beverage consumption. The methodologies employed in these essays demonstrate the versatility and effectiveness of applied econometrics in addressing real-world economic challenges.

DEDICATION

In loving memory of my dear sister, Nkeiru Aguegboh, whose untimely passing occurred during the course of my Ph.D. program. You are missed and may your soul rest in peace.

BIOGRAPHY

The author was born in Gusau, a small town that serves as the capital of Zamfara State in Nigeria. He earned a Bachelor of Science degree and a Master's degree in Economics from the University of Nigeria. Additionally, he holds a Master's degree in Environmental and Natural Resource Economics from Durham University Business School, as well as another Master's degree in Agricultural, Food, and Resource Economics from Michigan State University.

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Chapter 1 The Impact of Crop Insurance Program on Fertilizer Use in U.S. Agriculture

1.0 Introduction

The primary objective of fertilizer use in agricultural production is to replenish the nutrients in the soil to enhance yield; however, it is estimated that the level of fertilizer nitrogen retained in crops is hardly above 30% - 70%, even with the best practice (Fugile & Bosch, 1995). Moreover, fertilizer use causes major environmental problems as unused fertilizer escapes into the environment resulting in water quality impairment, air pollution, and greenhouse gas (GHG) emissions. As far back as the 1980s, agricultural fertilizers were discovered to be the leading cause of accelerated eutrophication of surface waters, nitrate content of drinking water, emissions of nitrous oxide and increased levels of soil Cadmium (Gilliam, Logan & Broadbent, 2015). Crop insurance is a major agricultural policy in the United States (U.S.) that was first introduced in the 1930s. Over the years, there have been concerns that crop insurance may distort the use of farm inputs, including fertilizer use (Weber, Key & O'Donoghue, 2016; Claassen, Langpap & Wu, 2017; Deryugina & Konar, 2017; Yu, Smith & Sumner, 2018). Early studies, however, have found mixed evidence (Horowitz & Lichtenberg, 1993; Smith & Goodwin, 1996; Babcock & Hennessy, 1996; Wu, 1999). We revisit the issue by using a novel approach analyzing a novel dataset. This study examines the impact of crop insurance on fertilizer use. We focus on fertilizer use in the U.S. because it constitutes one of the key farm inputs consumed by plants.

In 1960, nitrogen fertilizer constituted 40 percent of total nutrients consumed by plants at 2.7 million tons per annum. The use of nitrogen fertilizers increased more than ninefold between 1961 and 2021, primarily as a result of the fact that fertilizer application increased crop yield (Lin *et al.*, 1995; Zhang, Cao & Lu, 2021). Even though nitrogen fertilizer increases yield, fertilizer use is generally known to be influenced by other factors such as weather and certain production practices. For example, nitrogen fertilizer can be

significantly optimized by adjusting application timing and methods. Notwithstanding these agricultural practices and changes in weather conditions, projections indicate that fertilizer use is poised to rise over the next three decades, provided current dietary habits and agricultural methods remain the same (Howarth *et al.,* 2002). If this projection persists, it will exacerbate the health and environmental risks posed by nitrogen fertilizer, especially as it remains a larger source of nitrogen compared to nitrate oxide from fossil-fuel combustion (Zhang, Cao & Lu, 2021).

Modern crop insurance in the U.S. has more than 40 years of history. The Federal Crop Insurance Corporation (FCIC) was created in 1938, as part of the New Deal, to help farmers recover from the effects of the Dust Bowl of the 1930s. Since 1980, Congress through various Acts and Bills has focused on motivating farmers to participate in crop insurance program in order to mitigate farmers' income risks. The Federal Crop Insurance Reform Act of 1994 is one of such programs passed to incentivize greater participation in crop insurance. In the Act, a basic policy known as Catastrophic (CAT) coverage was created, and farmers were mandated to participate in the insurance program to be eligible for deficiency payments under price support programs, certain loans, and other benefits (Shields, 2015). Since 1996, there have been different changes in legislations to incentivize participation in crop insurance including the Agricultural Risk Protection Act (ARPA) that was passed in 2000, as well as the 2008 and 2014 Farm Bills. By 2022, about 493 million acres of farmland (the equivalent of over 90% of eligible acres) were insured under the U.S. Federal Crop Insurance Program with about 1.2 million policies (U.S. Government Accountability Office, 2023).

Although the U.S. Federal Crop Insurance Program is primarily designed to mitigate farmers' income risks, it might also encourage farmers to make riskier planting decisions (Goodwin & Smith, 2013; Lu *et al*., 2023). For instance, farmers might shift towards cultivating more high-risk crops covered by crop insurance leading to more fertilizer use. The increase in fertilizer use, in turn, can lead to higher nitrogen emissions into the atmosphere as well as increased runoff of soil nutrients that pollute water bodies. Conversely, crop insurance coverage might reduce fertilizer use due to a disruptive behavior exhibited by

insured farmers who take fewer precautions against harm – the moral hazard problem (Horowitz & Lichtenberg, 1993). In this case, the reduction in fertilizer use results in a decrease in nutrient runoff and pollution (Weber, Key & O'Donoghue, 2016; Lu *et al*., 2023). Therefore, considering the contrasting effects of these two economic mechanisms, the overall impact of crop insurance on fertilizer use is an empirical question that may be better addressed by directly estimating the relationship between these two variables. Prior studies find different impacts of crop insurance on fertilizer use. Some of these studies find a reduction in fertilizer use, due to crop insurance participation, and argue that this is due to the moral hazard problem (Horowitz & Lichtenberg, 1993). For example, Smith & Goodwin (1996) find that insured farmers used less chemical input compared to uninsured farmers, while Babcock & Hennessy (1996) find that farmers would reduce the use of nitrogen fertilizer if the coverage levels were at/below 70% of mean yield or revenue. Collectively, the findings from these prior studies provide compelling evidence in support of the moral hazard argument within the context of crop insurance's impact on fertilizer use. Conversely, there are studies that show that the effect of crop insurance on fertilizer use cannot be completely explained by the moral hazard problem as they find that crop insurance leads to increase in fertilizer use (Wu, 1999; Chang & Mishra, 2012; Weber, Key & O'Donoghue, 2016). Wu (1999) finds that farmers with crop insurance on corn would convert hay and pastureland to cultivate corn leading to an increase in total chemical use. Chang & Mishra (2012), on the other hand, argue that crop insurance serves as a substitute for off-farm work, thereby increasing the amount of time and money allocated to agricultural production, including fertilizer use per acre. Weber, Nigel & O'Donoghue (2016) find that expanded coverage has little but positive effect on fertilizer and chemical expenditure.

In revisiting this issue, we focus on the Federal Crop Insurance Reform Act of 1994 (hereinafter referred to as "the Act"). We draw on previous studies that have explored the consequences of this Act. Deryugina & Konar (2017) employed the policy change as a basis for implementing an instrumental variable procedure to assess the influence of crop insurance on irrigation water use. In this study, we exploit the impact of the policy change on county-level crop insurance enrollments to implement both the event

study and difference-in-differences methodologies. These methodologies enable us to investigate the causal effect of the Act on fertilizer use rate. We update the findings by Chang & Mishra (2012) and Weber, Key & O'Donoghue (2016), which examined the impact of crop insurance on fertilizer use by employing farm level data on fertilizer use. We employ a novel dataset on nitrogen fertilizer use rate on corn and soybeans, as well as an identification strategy focused on the Act. We focus on the Act of 1994 for two reasons. First, it motivated one of the highest increases in enrollment of corn and soybeans acres in crop insurance after 1980 (see figure 1). Second, the changes in crop insurance enrolment, as a result of the Act, is assumed to be exogenous to fertilizer rate used by crop producers. This assumption is based on the fact that the policy change engendered by the Act is considered unrelated to the decisions made by crop producers regarding their fertilizer use rate.

We address the challenge of identifying the effects of the Act by exploiting the pre-1994 county-level variations in crop insurance participation rates. We define county-level crop insurance participation rates as the ratio of insured acres of a crop type to the maximum insured acreage of the crop type in the county. Our estimation strategy compares counties with low pre-1994 crop insurance participation rates to counties with high pre-1994 insurance rates. The Act should have more "bite" in counties with low pre-1994 crop insurance participation rates. Consistent with our hypothesis, we show that counties with low pre-1994 crop insurance participation rates prior to the Act experience a higher increase in insured acres (and therefore, are referred to as "more treated" counties) compared to counties with high pre-1994 crop insurance participation rates (which are referred to as "less treated" counties). We exploit this differential increase caused by the Act across counties to quantify its effect on fertilizer use rate using the event study and difference-in-differences methodologies. Both methodologies are supported by the fact that the Act is assumed to be exogenous to fertilizer rate used by crop producers (Cornaggia, 2013). Some studies, however, do not support the assumption that crop insurance is exogenous to farm decisions and outcomes (Weber, Key & O'Donoghue, 2016). These studies argue that participation in crop insurance might have some spurious correlation with farm input decisions and could be motivated by other unobserved

characteristics that vary across counties. To address this problem, we account for time and county-level effects within the framework of a two-way fixed effects model in implementing the event study and difference-in-differences methodologies. We further include other control variables, which might confound the impact of crop insurance on fertilizer use rate, in the fixed effects model.

We are able to control for the county fixed effects through the construction of a county level panel data for crop insurance obtained from the Risk Management Agency (RMA) of the U.S. Department of Agriculture (USDA), and a novel dataset on nitrogen fertilizer use rate or manure nitrogen application rate from the paper by Zhang, Cao & Lu (2021). The nitrogen fertilizer data consists of a long-term annual and county level data for eight major crop types from 1970 to 2019. These crops include barley, corn, cotton, durum wheat, spring wheat, winter wheat, sorghum, and rice. A unique feature of the nitrogen fertilizer data is that it evaluates the responses of crop recovered nitrogen, nitrogen use efficiency and nitrogen surplus in comparison to nitrogen inputs over space and time. The data further reflects cross-crop variations in nitrogen fertilizer use rates and was updated to 2019 based on emerging survey conducted by the USDA-NASS in line with the methods used by Cao *et al*. (2018) and Lu *et al.* (2019). In this study, we focus on the following crops: corn and soybeans. The justification for focusing on these crop types is that they are major farm crops in the U.S. and account for over 70% of total acres allocated to crop insurance (Shields, 2015).

Our results reveal that crop insurance significantly increased fertilizer use rate for corn. The event study results show that the differential increase in fertilizer use rate began precisely two years following the Act. Moreover, fertilizer use rate was uncorrelated with the insured rates prior to the Act: both the levels and trends in fertilizer use were nearly identical between “less treated” and “more treated” counties before 1994. The difference-in-differences results suggest that compared to “less treated” counties, “more treated” counties experienced relatively short-and-medium-run increase in fertilizer use rate on corn after the implementation of the Federal Crop Insurance Reform Act of 1994. Our estimates indicate that a percentage point increase in insured acres for the “more treated” counties relative to the “less treated”

counties leads to a 1.466% and 1.377% rise in fertilizer use rate for corn in the short term and medium term, respectively. However, we neither find a long-term effects of the Act on fertilizer use rate for corn nor any significant impact of fertilizer use rate for soybeans. Linking the impacts of the Act on the natural environment through the fertilizer use rate effects, we find that a percentage point increase in insured acres in the short and medium term is associated with about 1.5% nitrogen oxide emission increase per unit area of corn planted as well as median of 17.45% increase in crop nitrogen surplus.

This paper contributes to the existing literature on risk management in the U.S. agricultural industry. It helps explain how a key policy change causes variations in fertilizer use outcomes. These outcomes are a matter of public policy because fertilizer use has a significant impact on air and water quality. For example, overutilization of fertilizer has been identified as a threat to climate change and consumer health, and has been associated with an increase in the incidence of cancer among farmers (Zhang *et al.*, 2017; Hamid *et al.*, 2020).

The rest of this paper is organized as follows. Section 2.0 describes the data and variables used for the analysis. Section 3.0 focuses on the empirical methodology employed in the study. Section 4.0 discusses the results while section 5.0 draws conclusions based on the outcomes of the study.

2.0 Data and Variables

To examine the impact of the Federal Crop Insurance Reform Act of 1994 on fertilizer use rate, we would ideally have farm-level data (Weber, Nigel & O'Donoghue, 2016). However, due to limited access to such data, we employ county-level data, which has been the focus of previous studies (see Cornaggia, 2013; Deryugina & Konar, 2017; Annan *et al.*, 2013). The focus of our empirical analysis includes 293 counties from Illinois, Indiana and Iowa, which we refer to as the "I" states – a subset of the Midwestern states popularly known as the "corn belt." The "I" states have also been the focus of a few previous studies (see Babcock & Hennessy, 1996). Additionally, we observe geographic variations for the county-level percentage change in crop insurance participation for corn and soybeans (Figures 2 and 3) as well as the

percentage change in fertilizer use rates for corn and soybeans (Figure 4 and 5) in the "I" states. Table 1 provides the summary statistics for the outcome and control variables used in the analysis section. The sources of data, variable definitions as well as their descriptive statistics are explained in the following sections.

2.1 Fertilizer use

Fertilizer use rate dataset was obtained from a paper by Zhang, Cao, & Lu (2021) and can be accessed here: https://doi.org/10.6084/m9.figshare.13030436. The dataset entails annual and county-level total nitrogen fertilizer use rate or manure application rate of several crops including corn and soybeans. The unit of measurement for the fertilizer variables is fertilizer or manure use/hectare. Fertilizer use rate was calculated through a combination of state level crop specific fertilizer use rate (Cao, Lu & Zu, 2018; Lu *et al.*, 2019) and county level nitrogen fertilizer consumption amount from the Nutrient Geographic Information System (NuGIS, https://nugis.tfi.org/). This calculation addresses measurement error problems due to crop specific attributes by characterizing the variations in fertilizer use rate across crop types at the county level. Therefore, the crop-specific nitrogen use rate was extrapolated from the state to county level using the following (Zhang, Cao & Lu, 2021):

$$N\ rate_i^c = \frac{N\ cons_c}{\sum_{i=1}^{10} N\ rate_i^s \times Area_i^c} \times N\ rate_i^s$$

where $N\ rate_i^c$ represents nitrogen fertilizer use rate or manure application rate of crop type i in county c; $N\ cons_c$ represents county level nitrogen/manure fertilizer consumption, $N\ rate_i^s$ represents fertilizer use/manure nitrogen rate of crop type i in state s, and $Area_i^c$ represents county level planting area for crop type i. Total manure consumption in each county was obtained from the NuGIS while state level crop specific manure was obtained from the USDA-ERS (https://data.ers.usda.gov/reports.aspx?ID=17883). Table 1 shows that the mean fertilizer or manure use rate/hectare for corn and soybeans is 16.619$\frac{g}{m^2}$ and 0.397$\frac{g}{m^2}$ respectively. The county level missing data were gap-filled for the periods, 1970 – 1986 and 2015 – 2019, using the inter-annual variations for the

existing dataset. While we suspect that this could lead to a systematic measurement error, we do not worry too much about this because the dataset extracted for this paper is for the period 1980 – 2010 due to limited access to the crop insurance dataset.

2.2 Crop insurance variables

The data for crop insurance was obtained from USDA's Risk Management Agency (RMA) for the period 1980 – 2010. The dataset entails total catastrophic coverage (CAT) and "buy-up" coverage for county-level insured acres. For CAT, the premium is completely subsidized by the federal government. The "buy-up" coverage is an add-on where the producer pays a premium (which is about 30-35%) for an insurable crop as well as its level of coverage, while the federal government covers the rest (Shields, 2015). In the event of a loss, insured producers are indemnified against agricultural risks. We combine both the catastrophic coverage (CAT) and "buy-up" coverage for county-level insured acres. To ease the comparison between counties and allocate them to the "more treated" versus "less treated" groups, we normalize total acres insured for a crop type in a county by the maximum insured acreage for that crop type in the same county. Specifically, we normalize total acres insured by taking the ratio of the acres insured per crop type in a county to the maximum insured acres for the crop type in the same county. For studies on DD design, it is quite popular to normalize the level of outcome variables for assignment into treatment and control groups in the pre-treatment period (Ganong *et al.*, 2021). Table 1 shows that the mean insured acres for corn and soybeans are 34,952 and 30,859 respectively.

2.3 Other control variables

We account for the variation in precipitation and temperature across counties. Weather factors generally affect fertilizer use in agriculture. Insufficient rainfall may prevent fertilizer from reaching plant roots while heavy rainfall can result in the runoff of fertilizers. These precipitation patterns may lead farmers to adjust their production practices, including adapting their fertilizer application rates to align with the prevailing rainfall conditions. (Masiza *et al.*, 2021). Furthermore, the rate of fertilizer use is associated with specific range of temperature thresholds. Warmer temperatures generally promote rapid plant growth

thereby increasing the demand for nutrients including fertilizer. Conversely, colder temperatures tend to decelerate nutrient absorption. As a result, farmers generally need to adjust fertilizer use rates to match temperature conditions and crop growth stages. (Schlenker & Roberts, 2009; Miao, Khanna & Huang, 2016). We, therefore, include precipitation during the growing season as well as growing degree days (GDD) and overheat degree days (ODD) to capture the effect of precipitation and temperature respectively.

3.0 Empirical Strategy: Difference-in-Differences and the 1994 Crop Insurance Act

We estimate the causal impact of the Federal Crop Insurance Reform Act of 1994 on fertilizer use rate by exploiting variations in the take-up level of crop insurance across different counties. We examine whether counties with relatively low level of crop insurance prior to the Act experience a higher increase in insured acres ("more treated" counties) compared to counties with a relatively high level of crop insurance ("less treated" counties). Intuitively, we exploit this heterogeneity to estimate the effect of the Act on fertilizer use rate using the DD approach.

Furthermore, we use the period prior to the Act to account for the underlying heterogeneity between the "more treated" and "less treated" counties. To show this, we first provide qualitative, graphical evidence to show that the effects of the Act on different counties vary with jumps in the crop insurance rates after treatment. We also describe the assumptions that underlie the causal effect of the Act on the treated group, and finally provide quantitative estimates using the event study methodology.

3.1 Identification and Estimation

In this section, we present the identification assumption as well as a layout of the estimation technique. With respect to the estimation technique, we commence the analysis with the simple two-group/two-period difference-in-differences (2 x 2 DD) approach to evaluate the impact of the Federal Crop Insurance Reform Act of 1994. The DD methodology compares changes in outcomes before and after treatment in 1994 for the "more treated" versus "less treated" counties (Angrist & Pischke, 2009; Angrist & Pischke,

2015). The "more-treated" counties will have outcomes prior to treatment, $\underline{y}_k^{PRE(k)}$ and after treatment, $\underline{y}_k^{POST(k)}$. Similarly, the "less-treated" counties will have outcomes prior to treatment, $\underline{y}_l^{PRE(k)}$ and after treatment, $\underline{y}_l^{POST(k)}$. The DD method is effective in pinpointing the average treatment on the treated (ATT) as follows (Goodman-Bacon, 2021):

$$\hat{\beta} = \left(\underline{y}_k^{PRE(k)} - \underline{y}_k^{POST(k)}\right) - \left(\underline{y}_l^{PRE(k)} - \underline{y}_l^{POST(k)}\right) \tag{1}$$

where $\hat{\beta}$ represents the estimated ATT for counties k, and $\underline{y}$ indicates the sample mean for the counties at different times before and after treatment. According to Goodman-Bacon (2021), the DD estimate can be derived as the coefficient on the interaction of a treatment group dummy and a post-treatment period dummy as follows:

$$y_{ct} = \gamma_0 + \alpha_c Treat_c + \gamma_t Post_t + \delta(Treat_c \times Post_t) + \mu_{ct} \tag{2}$$

where y_{ct} is the average county-level fertilizer use rate before and after treatment in county c and year t. $Treat$ is the pre-1994 crop insurance participation rates, which makes the treatment a continuous variable. $Treat$ is interacted with a full set of year fixed effects denoted as $Post$, which takes a value of one for counties in the post-treatment period and zero otherwise. Furthermore, μ_{ct} represents the error term while γ_0 represents the intercept of the equation. Since the DD framework allows for covariates as well as a more straightforward interpretation when estimating the short-run (SR), medium-run (MR) and long-run (LR) impacts of crop insurance of fertilizer use rate, we employ the two-way fixed effects specification as follows (Evans, Harris & Kessler, 2020):

$$y_{ct} = \gamma_0 + \alpha_c Treat_c + \gamma_t Post_t + \delta_1[Pre_t \times Treat_c] + \delta_2[(SR\ post_t) \times Treat_c] + \delta_3[(MR\ post_t) \times Treat_c] + \delta_4[(LR\ post_t) \times Treat_c] + \tau X'_{ct} + \omega_c + \mu_{ct} \tag{3}$$

In implementing the above model, we estimate a trend-break specification limiting the analysis sample to the years 1991 – 2003 to focus on the period closest to the enactment of the Federal Crop Insurance

Reform Act of 1994. Pre is an indicator variable that takes the value of one (and zero otherwise) for the pre-treatment years, 1991 to 1993. The variable $SR\ post_t$ takes a value of one (and zero otherwise) for the first three post-treatment years, 1995 to 1997. $MR\ post_t$ denotes the years 1998 to 2000 while $LR\ post_t$ denotes the years 2001 to 2003, several years post-1994 Crop Insurance Act. X_{ct} represents control variables such as precipitation and growing degree days (GDD). We control for county fixed effects ω_i to account for fixed cross-sectional differences across counties.

In the section for results, we simply present estimates from equations (2) and (3) to demonstrate how the fixed effects model changes with and without control variables, including the impact of crop insurance on fertilizer use rate in the different runs (short, medium, and long-term). Standard errors are clustered at the county level to account for serial correlation.

Identification in the DD design is underscored by two assumptions. First, there is the orthogonality assumption, which posits that there should be no systematic relationship between the error term and three key factors in equation (2) as follows: (i) the absence of treatment for the "more treated" group; (ii) the absence of a post-treatment period, and (iii) the joint absence of treatment and a post-treatment period. Specifically, this means that the covariance between the error term and these factors should all be equal to zero as follows: $Cov\ (\mu_{ct}\ , Treat_c = 0)\ Cov\ (\mu_{ct}\ , Post_t = 0)$ and $Cov\ (\mu_{ct}\ , Treat_c\ , Post_t = 0)$. The last expression also known as the parallel trend assumption is the most crucial and it implies that pre-treatment trends for the "more treated" and "less treated" counties would be the same (Ganong *et. al*, 2021). This assumption can be tested using parallel trends prior to the Act and we do so in the following section.

Second, we ensure that the DD model is correctly specified, and the additive structure is correctly imposed (Khandker, Koolwal & Samad, 2010). This means that the potential outcomes of raising the insurance rates in counties with low and high insurance rates will be the same, so that the causal effect of the Act is homogenous for the "more treated" counties versus "less treated" counties. This assumption is essential for identification in the DD approach (de Chaisemartin & D'HaultfŒuille, 2018). To validate

this assumption, Figure 6 illustrates how the Federal Crop Insurance Reform Act of 1994 led to increased crop insurance participation rates in both "more treated" and "less treated" counties.

3.2 Event Study

This paper employs the event study methodology to check for evidence of pre-trends before treatment. The event study methodology focuses on the narrow event timeframe that surrounds the 1994 Crop Insurance Act, which includes a few years before and after the Act. Following the approach by Alpert, Powell & Pacula (2018) and Kim (2018), we specify a simple DD in the event study, where the two differences include: the "more treated" counties versus "less treated" counties, and the pre-treatment years versus all other post-treatment years. To do this, we observe the same counties over time so that pre-treatment outcomes can serve as controls before the Federal Crop Insurance Reform Act of 1994. To implement this, we estimate a version of (3):

$$(4)\quad y_{ct} = \gamma_c Treat_c + \sum_{m=-3}^{m=9} \delta_t I_{ct}(m = t - t^*) + \sum_{m=-3}^{m=9} \varphi_t I_{ct}(m = t - t^*) * Treat_c + \tau X'_{ct} + \omega_c + v_{ct}$$

where t^* is the treatment year (in this case, 1994). Thus, $I_{it}(m = t - t^*)$ entails a set of dummy variables that indicate the timing of each county relative to the treatment year. With the trend-break specification that limits the analysis sample to the years 1991 – 2003, m ranges from three years *before* (-3) to nine years *after* (+9) the treatment year. Standard errors are clustered at the county level to account for serial correlation. The main variables of interest are the full sets of φ_t estimates, which maps the time path of changes in outcomes relative to the period before treatment. The estimates identify the differences in fertilizer use rates across "more-treated" versus "less-treated" counties in each year. For fertilizer use rate, we expect the estimates φ_t to increase beginning after 1995 if higher crop insurance rates in the counties predicts a larger increase in fertilizer use rate after the enactment of the Federal Crop Insurance Reform Act of 1994. This follows the identifying assumption that in the absence of the Act, differences across counties would have continued along the same trends.

4.0 Results

Our analysis proceeds in three steps. The first step revolves around providing evidence for our key underlying assumption that the increase in average acres insured was higher in the "more treated" counties relative to "less treated" counties after the Federal Crop Insurance Reform Act of 1994. Second, we estimate the causal impact of this additional increase in average acres insured due to the Act on fertilizer use rate. Third, we investigate alternative channels for the observed changes in fertilizer use rates across counties, such as the implementation of the 1996 Federal Agriculture Improvement Reform (FAIR) Act as well as the introduction of genetically engineered (GE) crops in the mid-1990s.

4.1 First-Stage Effects of the Federal Crop Insurance Reform Act of 1994 on Insured Acres

We begin by showing graphically that the insurance rates in a county is strongly predictive of the differential changes in average acres insured after the Federal Crop Insurance Reform Act of 1994. This relationship helps to explain how variations in the average acres insured can be used to identify the impact of the Act. Figure 6 shows the "first stage" relationship between the pre-1994 insurance rates and the change in average acres insured between 1980 – 2020. We observe that prior to the Act, the "more treated" counties had a higher jump in the treatment year compared to the "less treated" counties. This jump was clearer for corn than soybeans.

Figure 7 shows an analogous event study version of the first stage by estimating equation (4) with average acres insured as the outcome variable. The event study model includes time-varying controls such as precipitation and growing degree days (GDD). We observe a high jump between 1994 – 1995 for corn. Compared to corn, we do not observe as much jump for soybeans after treatment. In line with the figure 7, table 2 shows the event study coefficients, where we find a very weak relationship between the average acres insured for the "more treated" versus "less treated" counties before 1994. After the Federal Crop Insurance Reform Act of 1994, we observe an additional increase in average acres insured for the "more treated" counties compared to the "less treated" counties. The magnitude of the impact of the Act on average acres insured generally grows larger after the treatment year. As complimentary evidence, we

present the state-by-state event study graphs in figures 8 and 9 to show evidence of pre-trends between "more treated" and "less treated" counties in each state.

4.2 The Impact of the Federal Crop Insurance Reform Act of 1994 on Fertilizer Use

Next, we examine whether the differential increase among "more treated" counties led to changes in fertilizer use rate. In figure 10, we start by analyzing the variations in fertilizer use rates for the "more treated" versus "less treated" counties without accounting for changes in average insured acres. The graphs in figure 10 do not show any noticeable pattern in the "more treated" versus "less treated counties. In contrast, figure 11 presents full sets of coefficients from estimating our baseline event-study specification in equation (4) for fertilizer use rate. The graphs in figure 11 show the point estimates and 95 percent confidence intervals. The effect of the Federal Crop Insurance Reform Act of 1994 on fertilizer use rate for corn and soybeans is obvious: the event study coefficients are close to zero and statistically insignificant in the years preceding the Act. We further find that, on the one hand, the effect of the Act on fertilizer use rate for corn is noticeable in the immediate post-treatment year up to four years after treatment. On the other hand, we observe an increase in fertilizer use for soybeans only after 1995. This increase continues until 1997, after which we observe a decline.

Table 3 indicates the coefficients that identify the differences in fertilizer use across "more-treated" versus "less-treated" counties in each year. The results in table 3 shows no difference in fertilizer use for corn or soybeans between the "more-treated" versus "less-treated" counties prior to the 1994 Federal Crop Insurance Reform Act. After the Act, there is a statistically significant increase in the fertilizer use for corn with the initial relative increase in average acres insured for the "more treated" counties. We, however, do not find any statistically significant result in the fertilizer use for soybeans despite the initial relative increase in average acres insured for the "more treated" counties. The magnitude of the differential effect of the Act on fertilizer use for corn grows larger up to 4 years after the Act. The timing of this effect coincides precisely with the 1994 Federal Crop Insurance Reform Act, and the fact that this effect is concentrated in "more treated" counties with the higher increase in insured acres strongly

suggests a causal relationship between the Act and the increase in fertilizer use. We further explore the causality of this relationship by discussing the DD regression results.

As regards the DD regression results, we start with the non-parametric DD analysis in table 4. The results suggest that the impact of the Act on fertilizer use is negative for corn and positive for soybeans. We find the same result for the fixed effects specification in equation (1) as shown in columns 1 and 3 of table 4 for corn and soybeans respectively. We control for covariates and focus on the fixed effects specification in equation (2). We present the parametrized estimates from equations (3) to quantify the total magnitude of the impacts of the 1994 Federal Crop Insurance Reform Act on fertilizer use rate. We report the "short-run" (i.e., the effect for 3 post-treatment years) and "medium-run" (i.e., the effect for 3 consecutive post-treatment years after the "short-run" period) impacts of the Act on fertilizer use rate for corn. However, we do not find any "long-run" (i.e., the effect for 9 post-treatment years after the "medium-run" period) impact of the Act on fertilizer use rate. Standard errors in table 5 are clustered by county.

In columns 2 of table 5, we report an effect of 1.466 and 1.377 for the short and medium runs respectively. This implies that in the short run, a percentage point increase in insured acres leads to a 1.466% additional increase in fertilizer use rate within the "more treated" counties compared to the "less treated" counties. Similarly, in the medium term, a percentage point increase in insured acres leads to a 1.377% additional increase in fertilizer use rate within the "more treated" counties compared to the "less treated" counties. These results are statistically significant at 5%. These effects disappear in the long run as the impact Act on fertilizer use rate for corn becomes statistically insignificant. Column 4 of table 5 presents the results for the impacts of the 1994 Federal Crop Insurance Reform Act on fertilizer use rate for soybeans. We do not find any statistically significant result for the short, medium, or long run impact of Act on fertilizer use rate on soybeans.

The result for corn is consistent with farm-level cross-sectional findings of Horowitz & Lichtenberg (1993) and Chang & Mishra (2012) as well as the county-level panel data findings from Goodwin, Vandeveer & Deal (2004), all of which suggest a positive relationship between crop insurance and fertilizer use.

Additionally, the disparity in the results for corn and soybeans might be explained by Lin *et al.* (1995), which found that in the 1900's, corn was the leading user of nitrogen fertilizer while soybeans acreage fertilized by nitrogen trended downward. In 1992, for example, the percentage of corn acreage fertilized with nitrogen fertilizer was around 97% while the nitrogen fertilizer use on soybeans dropped to a paltry 1% in the same year (Lin *et al.*, 1995; Zhang, Cao & Lu, 2021). This might explain why we do not find statistically significant results for soybeans.

Furthermore, some of the precipitation and temperature controls also have significant effects on fertilizer use for both corn and soybeans. This suggests that farm input decisions are impacted by weather factors. For example, we find that for the most part, the growing degree days in July has a negative effect on fertilizer use. Therefore, an increase temperature in July is associated with less fertilizer use for com and soybeans.

4.3 Alternative Explanations

We consider alternative explanations for the impact of the 1994 Federal crop Insurance Reform Act on fertilizer use rate. One of the explanations that we focus on is the Federal Agriculture Improvement Reform (FAIR) Act of 1996, which coincides with the period during which we find significant results for the impact of the 1994 Federal crop Insurance Reform Act on fertilizer use rate. The FAIR Act was enacted with the aim of discontinuing the mandatory link between government deficiency payments and the U.S. crop insurance program, including the Federal Crop Insurance Reform Act of 1994. Critics argued that these payments were costly and hindered efforts to promote higher levels of participation in crop insurance since payments were made irrespective of whether the producer held an active crop insurance policy (Congressional Research Service, 1996). Figure 12 shows that despite the decline in government deficiency payments for the post-treatment years, the trends for producers in the "more treated" counties and "less treated" counties were fairly the same. Additionally, we employ the event study estimation in equation (4) using government deficiency payments as the outcome variable. The result of this estimation, presented in table 6, indicate that government deficiency payments are lower in the "more treated" counties for the pre-

treatment period as well as one year after the treatment compared to the "less treated" counties. For the following post-treatment years, the event study coefficients are not statistically significant. This implies that changes in government deficiency payments resulting from the FAIR Act are not affected by shifts in insurance rates attributed to the Federal Crop Insurance Reform Act of 1994. Overall, the estimated relationship between the Federal crop Insurance Reform Act of 1994 and fertilizer use rate does not appear to be driven by the FAIR Act of 1996.

Another example of an alternative explanation for the observed effect of the 1994 Federal Crop Insurance Reform Act on fertilizer use rate is the introduction of genetically engineered (GE) crops in the mid-1990s. GE crops have direct effects on chemical input need and therefore, can provide an alternative explanation for the change in fertilizer use rate attributed to crop insurance (Xu *et al.*, 2013; Qaim, 2016). To find the relationship between GE crops and fertilizer use rate, we repeat the event study specification in equation (4) for fertilizer use rate using both the percentage increase in GE adoption between 2000 and 2005 as well as the level of GE adoption in 2000 as our treatment respectively. The event study results are presented in the tables 7 and 8. Table 7 reveals that the percentage increase in GE adoption between 2000 and 2005 is associated to a reduction in fertilizer use rates in 1995 and 1996. Similarly, in Table 8, we observe comparable result in 1997 for fertilizer use rate when we use the level of GE adoption in 2000 as the treatment variable. Overall, the findings in tables 7 and 8 suggest that an increase in GE adoption is associated with a decrease in fertilizer use rates. We also show the graphs for these results in figures 14 and 15. These findings stand in contrast to our earlier results regarding the positive impact of crop insurance on fertilizer utilization rates in the short term and medium term. Consequently, it appears that the relationship between the Federal Crop Insurance Reform Act of 1994 and fertilizer use rates is not influenced by the adoption of GE crops.

4.4 Indirect Environmental Impact of Crop Insurance

Following the results that a percentage point increase in insured acres of counties with low below median pre-1994 level of participation leads to 1.466% increase in fertilizer use rate for corn (in the short-run)

and 1.377% increase in fertilizer use rate for corn (in the medium-run) within the “more treated" counties compared to the "less treated" counties, we calculate the indirect environmental impact of crop insurance as follows:

(a) Impact of crop insurance on Emission Factor (EF) values through fertilizer use rate effects

We measure the impact of crop insurance on Emission Factor (EF) values through fertilizer use rate effects following the data from Zhang *et al.* (2021) and the paper by Lu *et al.* (2021). We employ the formular for measuring EF values (Lu *et al.,* 2021):

$$Emission\ Factor\ (EF)\ values = \frac{Fertilizer\ induced\ N_2O\ emission\ per\ crop\ type\ per\ year}{crop-specific\ fertilizer\ use\ amount}$$

where $EF\ Values$ is measured in N_2O-N emitted per unit fertilizer input). We assume that the relationship between fertilizer induced N_2O emission and fertilizer use rate is linear. $Crop-specific\ fertilizer\ use\ amount$ is measured in g/m^2. $Fertilizer\ induced\ N_2O\ emission$ is measured per unit area. Therefore:

$$Fertilizer\ induced\ N_2O\ emission\ per\ crop\ type\ per\ year = EF\ values\ *\ crop-specific\ fertilizer\ use\ amount$$

Since we find short-run and medium-run impact of crop insurance on fertilizer use rate, we employ the formular above in calculating the short-run and medium-run impacts of crop insurance on Emission Factor (EF) values through fertilizer use rate effects as follows:

(i) The short-run impact of crop insurance on Emission Factor (EF) values through fertilizer use rate effects

The fertilizer induced N_2O emission per crop type per year is a fixed coefficient in the IPCC tier-1 approach, so since there are linear responses between N_2O emission and fertilizer use rate, a 1% insurance rate increase corresponds to a 1.466% increase in fertilizer use rate. This will in turn lead to a 1.466%

N_2O emission increase per unit area. Thus, the short run impact of crop insurance on Emission Factor (EF) values through fertilizer use rate effects a 1.466% N_2O emission increase per unit area or corn planted.

(ii) The medium-run impact of crop insurance on Emission Factor (EF) values through fertilizer use rate effects

The fertilizer induced N_2O emission per crop type per year is a fixed coefficient in the IPCC tier-1 approach, so since there are linear responses between N_2O emission and fertilizer use rate, a 1% insurance rate increase corresponds to a 1.377% increase in fertilizer use rate. This will in turn lead to a 1.377% N_2O emission increase per unit area.

Thus, the medium run impact of crop insurance on Emission Factor (EF) values through fertilizer use rate effects a 1.466% N_2O emission increase per unit area or corn planted.

(b) Impact of crop insurance on Nitrogen (N) surplus through fertilizer use effects

We measure this impact following the data from Zhang *et al.* (2021) and the paper by Lu *et al.* (2021). Crop Nitrogen (N) surplus indicates how much unused N in croplands that ends up as N_2O emission (Lu *et al.,* 2021). For corn, the N_2O emissions in cornfields account for 8.4% (median) of annual crop N surplus, with the IQR of 2.9%.

Since we find short-run and medium-run impact of crop insurance on fertilizer use rate, we employ the parameters from the paper by Lu *et al.* (2021) in calculating the short-run and medium-run impacts of crop insurance on Nitrogen (N) surplus through fertilizer use effects as follows:

(i) For the short-run impact of crop insurance on Emission Factor (EF) values through fertilizer use rate effects

From section (a), 1.466% N_2O emission increase per unit area will lead to a median increase in $\left(\frac{1.466*100}{8.4}\right)$ of annual crop N surplus = Median of 17.45%. Therefore, the short run impact of crop

insurance on N_2O emission through fertilizer use rate effect leads to a median of 17.45% increase in Crop Nitrogen (N) surplus.

(ii) For the medium-run impact of crop insurance on Emission Factor (EF) values through fertilizer use rate effects

For the medium-run impact, a 1.377%% increase in N_2O emission increase per unit area will lead to a median increase in $\left(\frac{1.377*100}{8.4}\right)$ of annual crop N surplus = Median of 16.39%.

Thus, the medium run impact of crop insurance on N_2O emission through fertilizer use rate effect leads to a median of 16.39% increase in Crop Nitrogen (N) surplus.

(c) Implications of our estimates

The effects of crop insurance on N_2O emissions through fertilizer use rate suggest that U.S. corn-soybean cropping system has significant impact on greenhouse gas emissions and climate warming. Lu *et al.* (2021) recommends that N_2O emission in the U.S. can be mitigated with adequate management of farm input to enhance nitrogen use efficiency as well as decrease the level of unused nitrogen in crop production. Findings from our paper consolidates the position held by Lu *et al.* (2021) we demonstrate that unintended consequences of crop insurance on fertilizer entail increased levels of N_2O emissions and nitrogen surplus up to the medium term. Therefore, we find indirect environmental impact of crop insurance through fertilizer use effects.

5.0 Conclusion

This paper examines how crop insurance participation affects the risk profile of U.S. agricultural production. To date, the Federal Crop Insurance Reform Act of 1994 motivated one of the highest increases in the enrolment of crop insurance. However, the consequences of any policy may unravel as farm producers respond to exogenous shock through changes in farm practices as well as variations in the intensity of farm inputs. In this paper, we empirically analyze how the Federal Crop Insurance Reform

Act of 1994 affects fertilizer use rate. For the empirical analysis, we employ county level panel dataset on crop insurance from the RMA, and a novel dataset on nitrogen fertilizer use rate or manure nitrogen application rate from Zhang, Cao & Lu (2021).

Prior literature has relied on farm-level cross-sectional and county-level panel data findings with methodologies such as the fixed effects or instrumental variable approaches. This paper focuses on the differential effects across "more treated" versus "less treated" counties in the "I" states (namely Illinois, Indiana, and Iowa) based on the pre-treatment levels of average insured acres. We estimate that average insured acres are predictive of statistically significant increase in fertilizer use rate for corn. This increase begins precisely two years following the Federal Crop Insurance Reform Act of 1994. A percentage point increase in insured acres for the "more treated" counties relative to the "less treated" counties leads to a 1.466% and 1.377% rise in fertilizer use rate for corn in the short term and medium term, respectively (see table 5, column 2 estimates). This effect disappears in the long run as the impact Act on fertilizer use rate for corn becomes statistically insignificant. Additionally, we do not find any statistically significant impact of the Act on fertilizer use rate for soybeans. The lack of impact might be due to a documented massive decline in soybeans acreage fertilized by nitrogen in the 1900's as opposed to corn, which was found to be the leading user of nitrogen fertilizer in the same year (Lin *et al.*, 1995).

The findings from this study demonstrates how a policy change can result in unintended consequences on the intensity of farm inputs – in this case nitrogen fertilizer use rate. This is demonstrated by the increase in fertilizer use rate following the Federal Crop Insurance Reform Act of 1994. This evidence is consistent with farm-level cross-sectional findings of Horowitz & Lichtenberg (1993) and Chang & Mishra (2012) as well as the county-level panel data findings from Goodwin, Vandeveer & Deal (2004), all of which suggest a positive relationship between crop insurance and fertilizer use. These findings are useful for policy prescription on how a key policy change causes variations in fertilizer use outcomes in the U.S. agricultural industry. For example, the increase in fertilizer use on corn amongst the "more treated" counties in the corn belt region suggests that crop insurance participation in the region might in

the short and medium term constitute harmful effects to farmers and the general public at large via polluted air and water.

Figures: The Impact of Crop Insurance Program on Fertilizer Use in U.S. Agriculture

Figure 1.1 Insured Acres: Corn & Soybeans

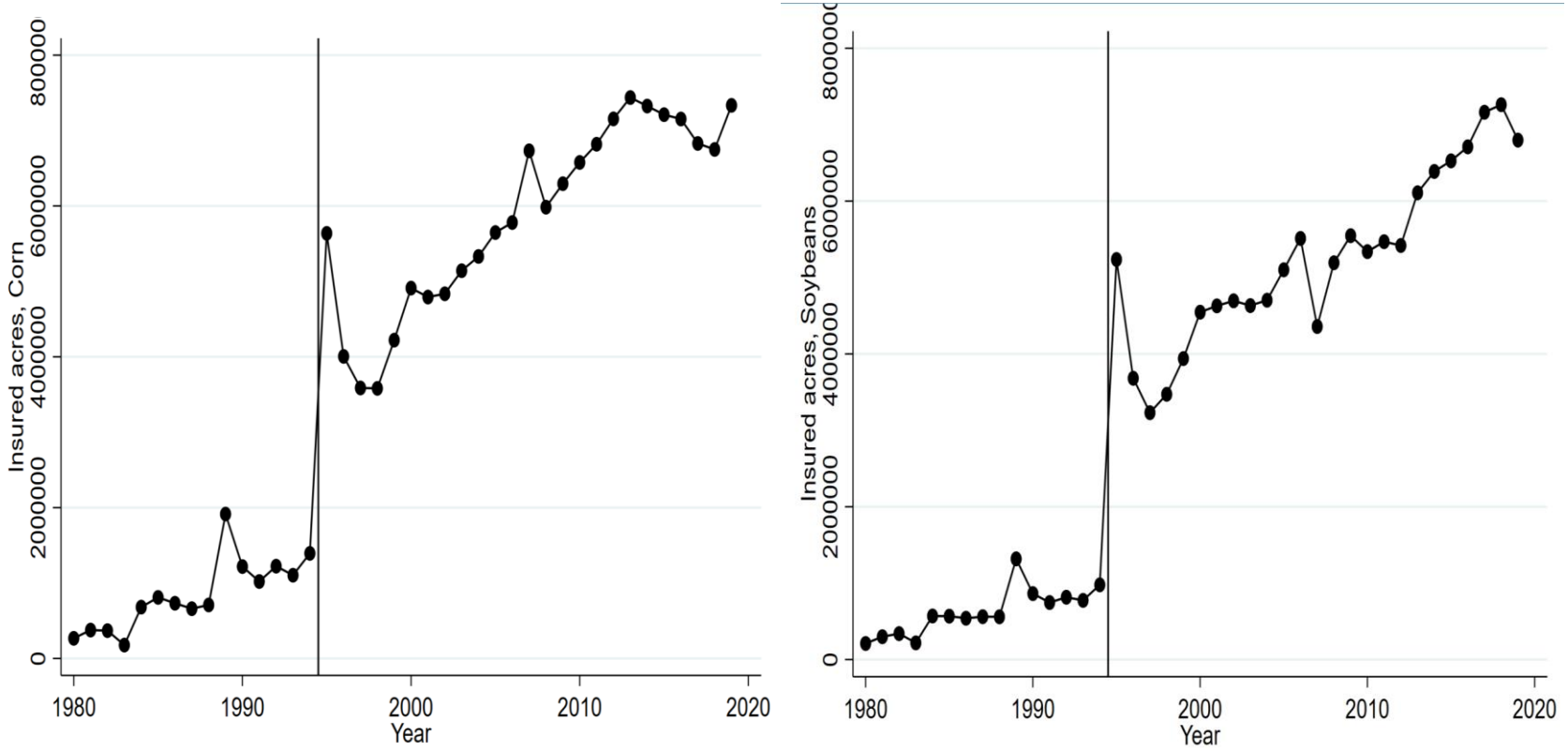


Figure 1.2 Percentage Change in Crop Insurance Rates for Corn (1993 – 1996)

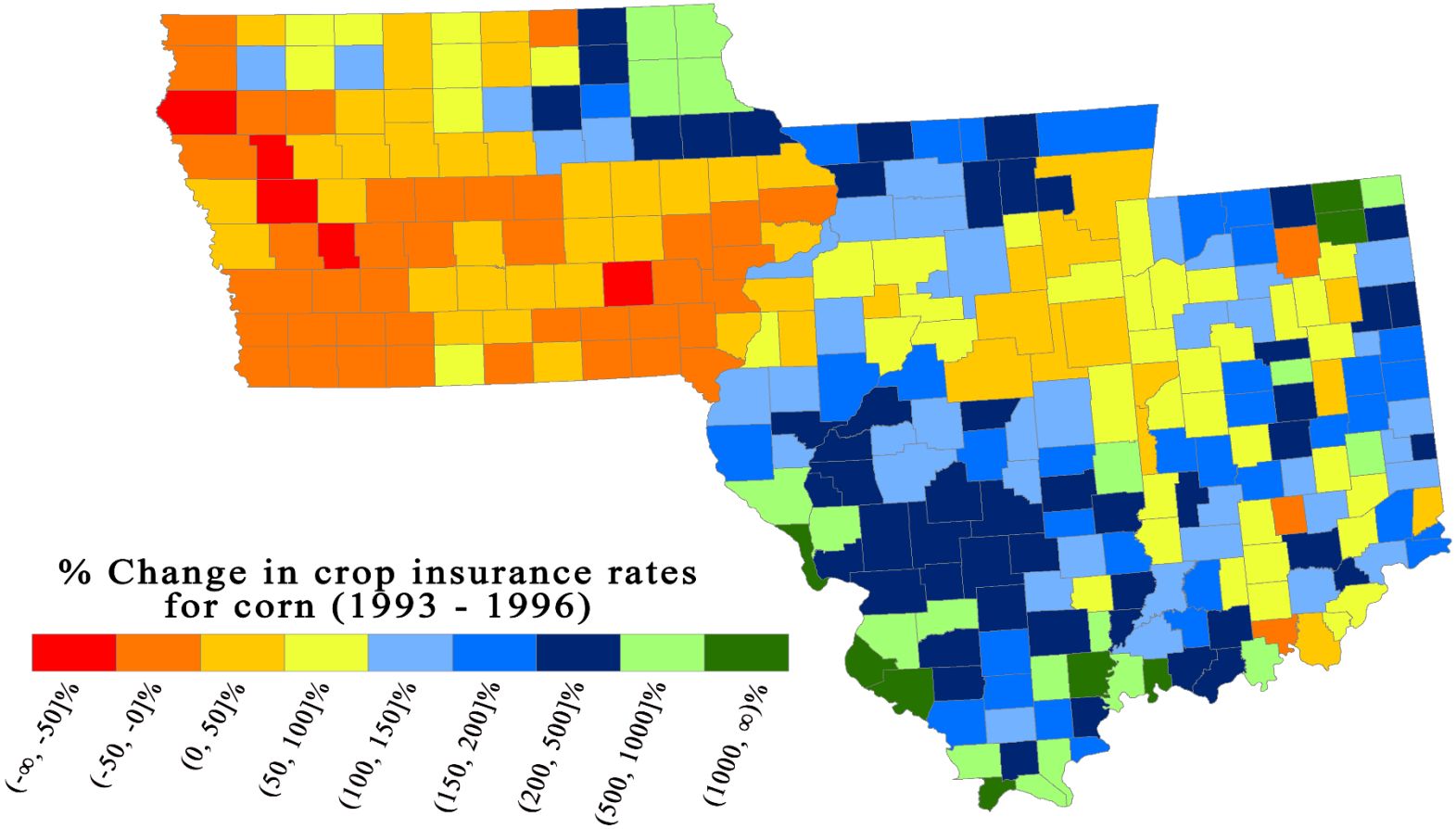


Figure 1.3 Percentage Change in Crop Insurance Rates for Soybeans (1993 – 1996)

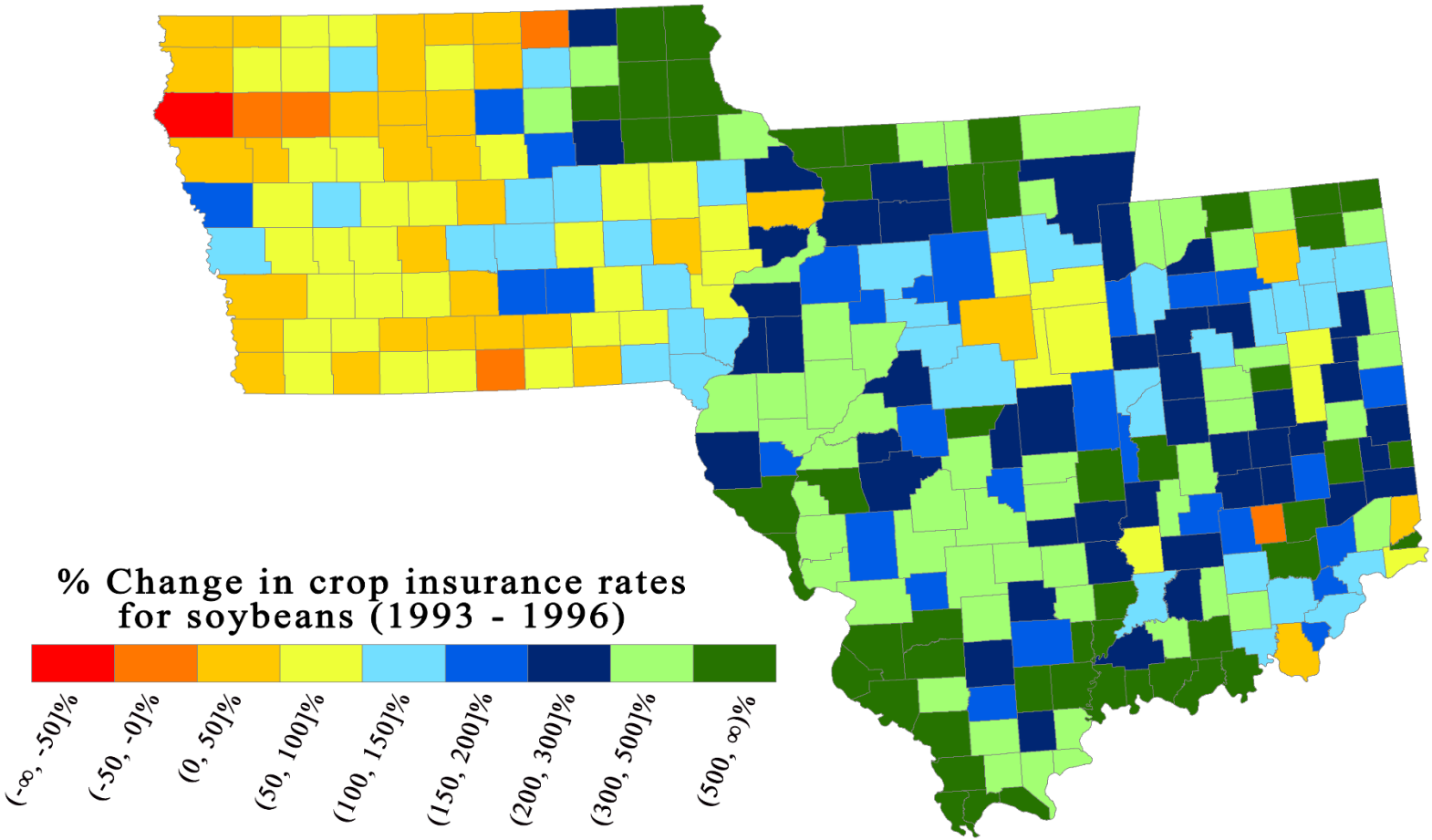


Figure 1.4 Percentage Change in County Level Fertilizer Use Rates for Corn (1993 – 1996)

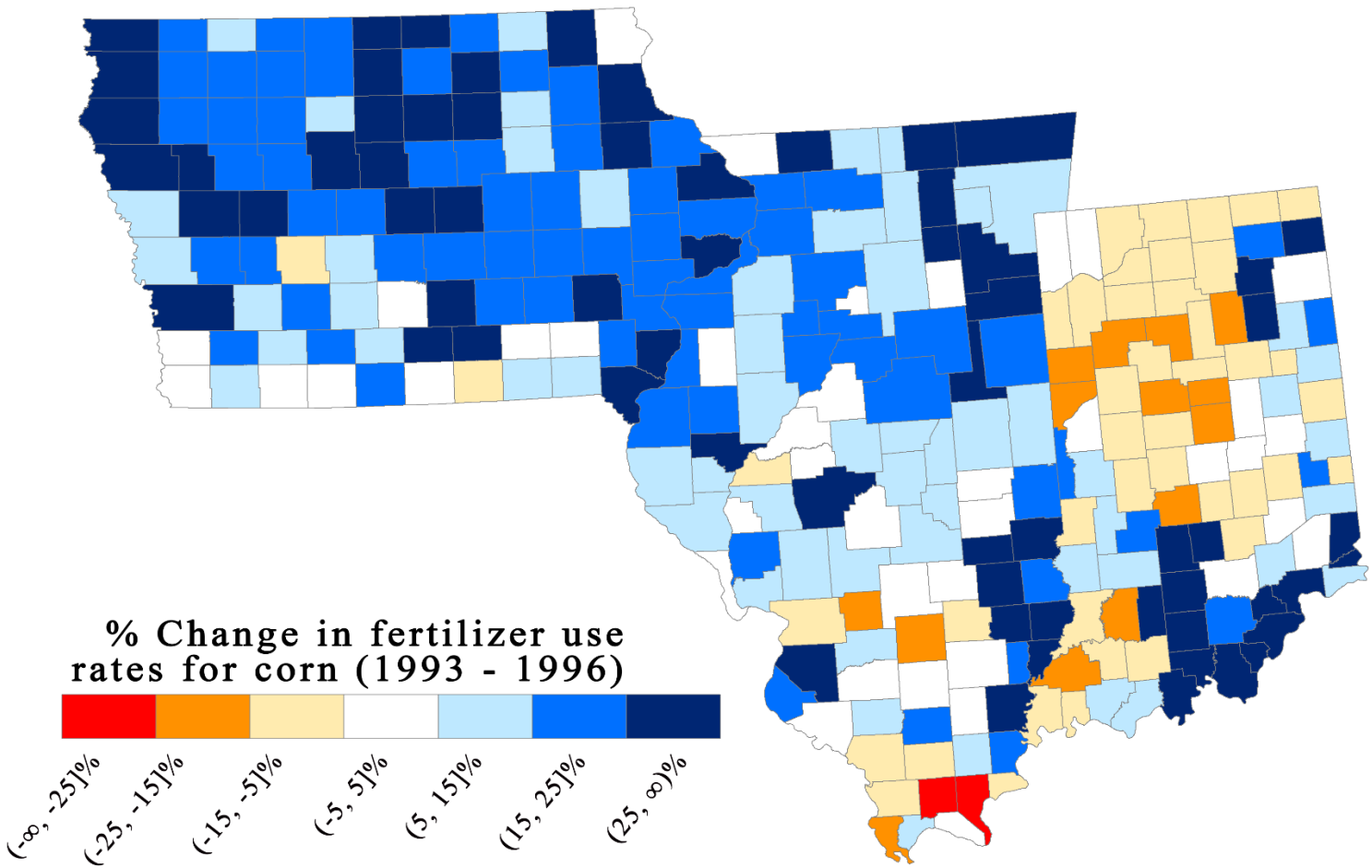


Figure 1.5 Percentage Change in County Level Fertilizer Use Rates for Soybeans (1993 – 1996)

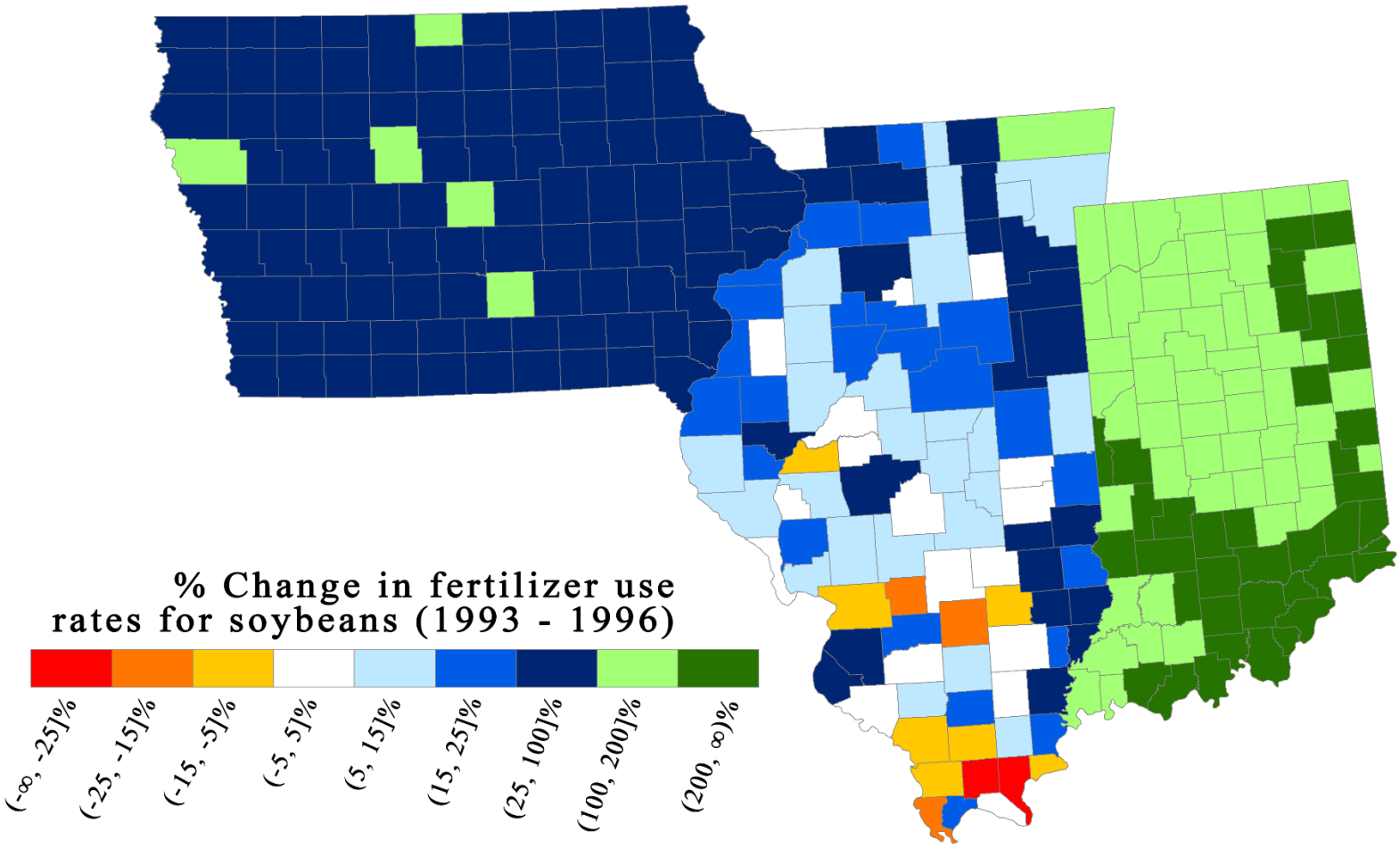
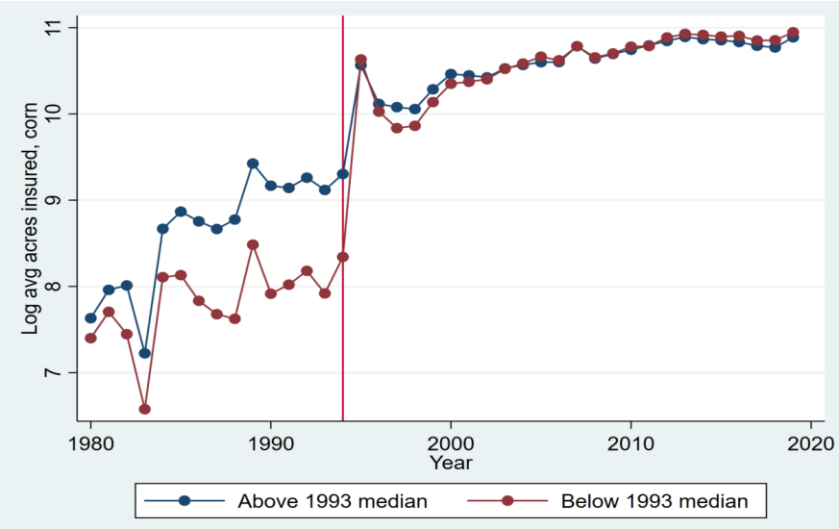


Figure 1.6 Parallel trends for the log of average insured acres



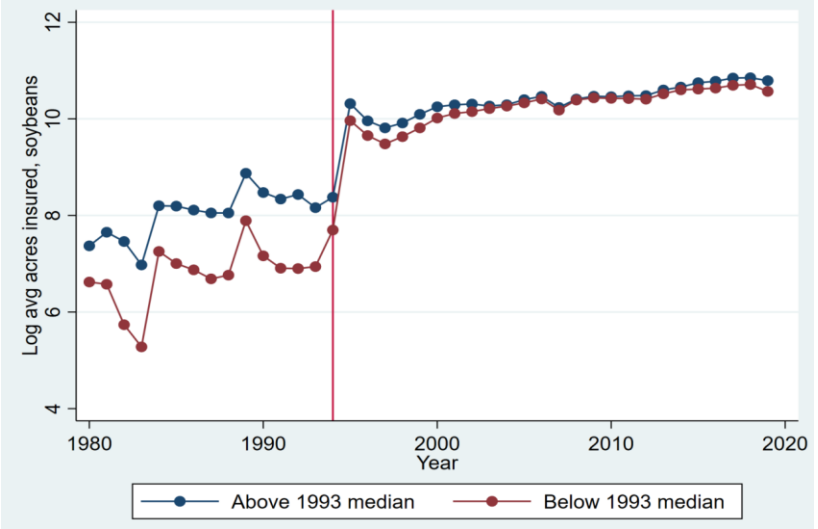
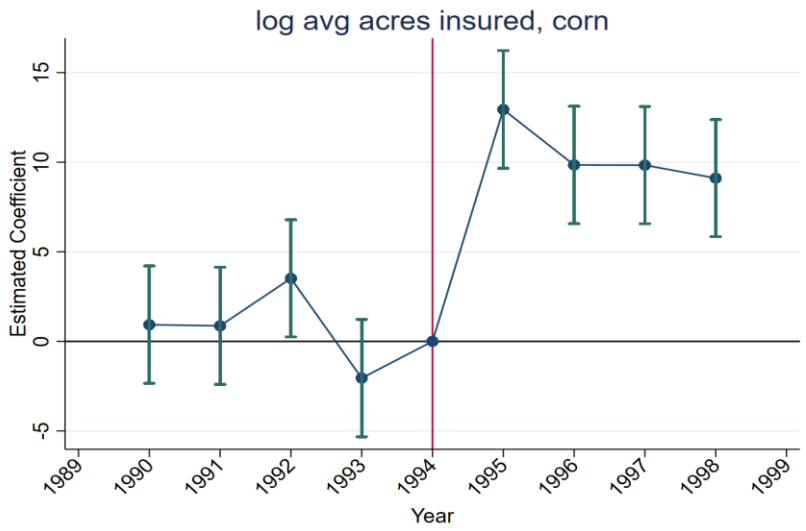


Figure 1.7 Event study graphs for the log of average insured acres



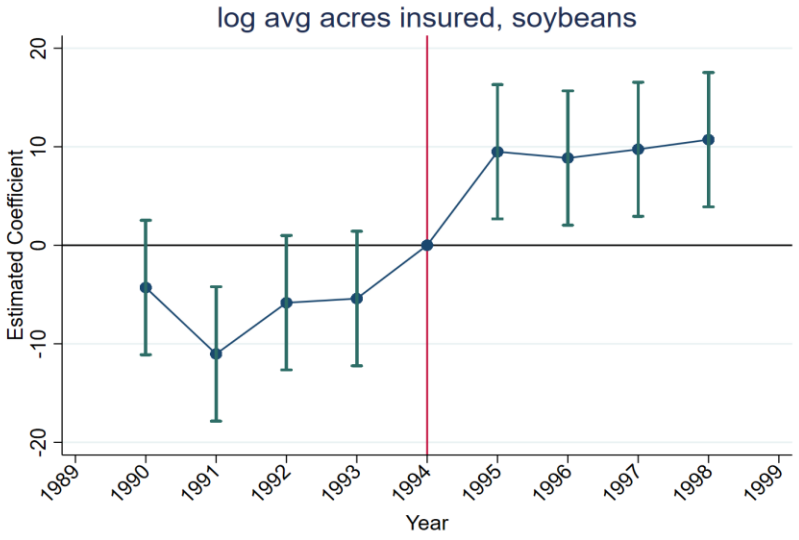


Figure 1.8 State by state event study graphs for the log of average insured acres of Corn

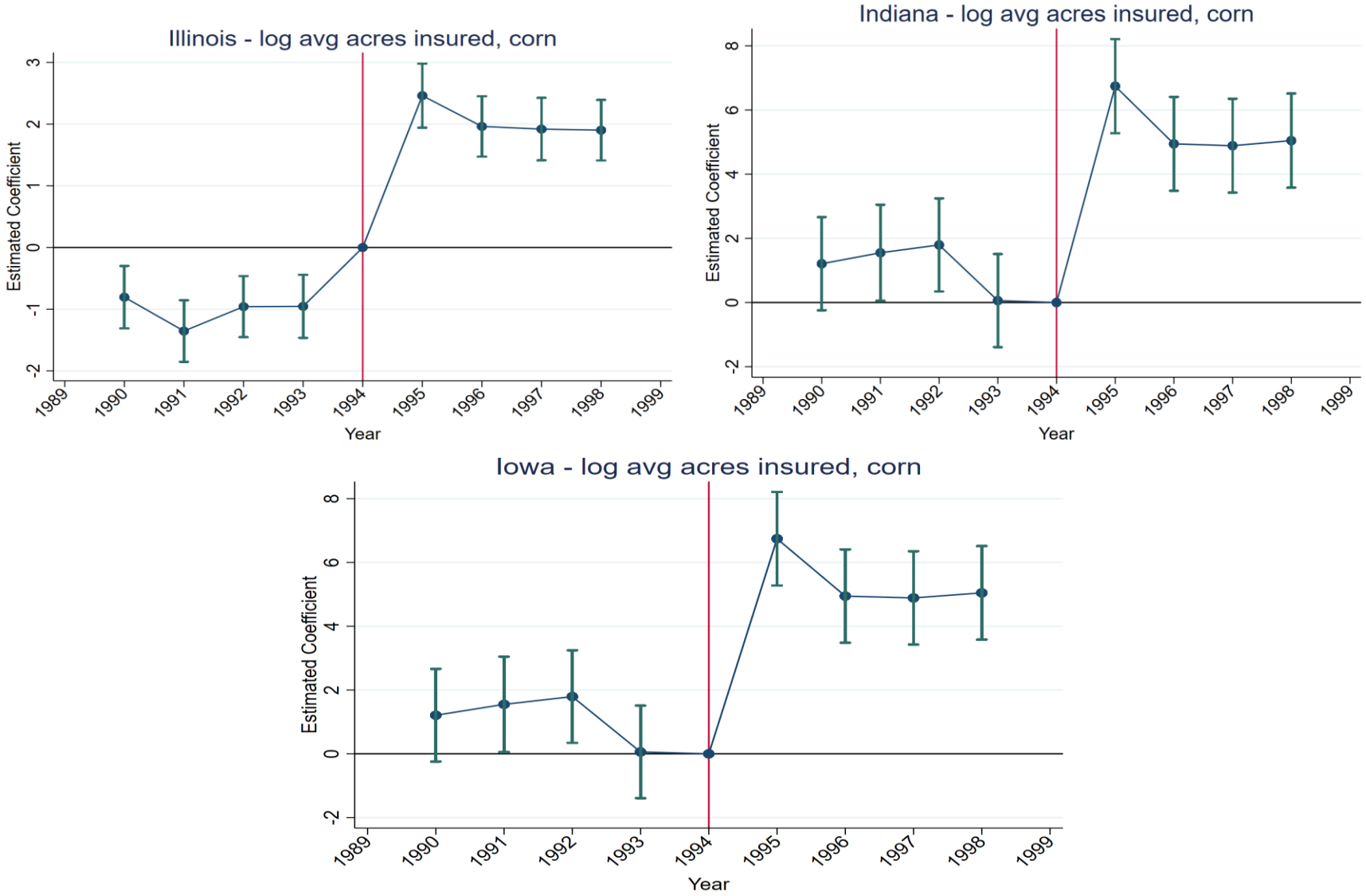


Figure 1.9 State by state event study graphs for the log of average insured acres of Soybeans

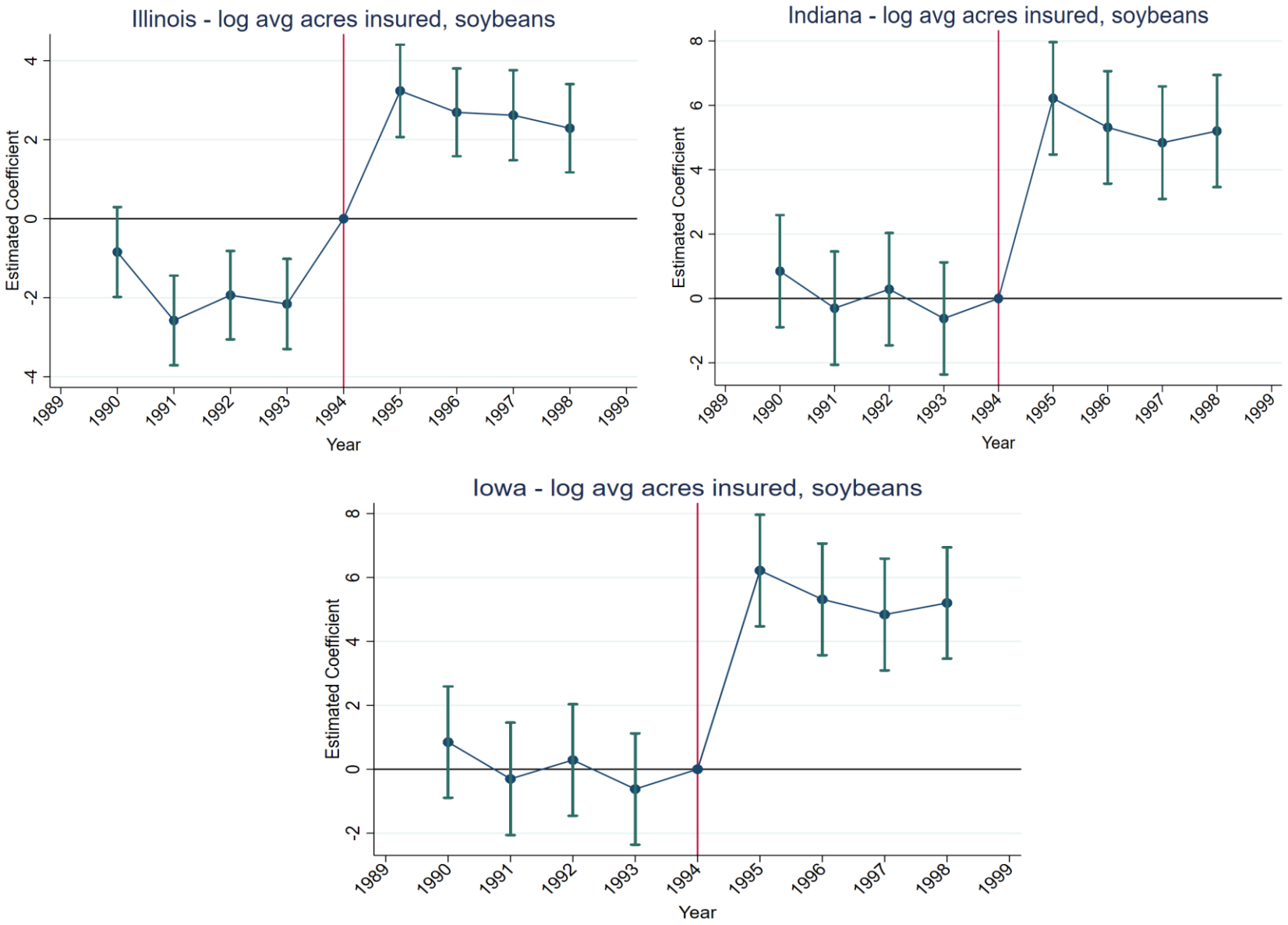


Figure 1.10 Log of fertilizer use on Corn and Soybean over time ("more treated" vs "less treated" counties)

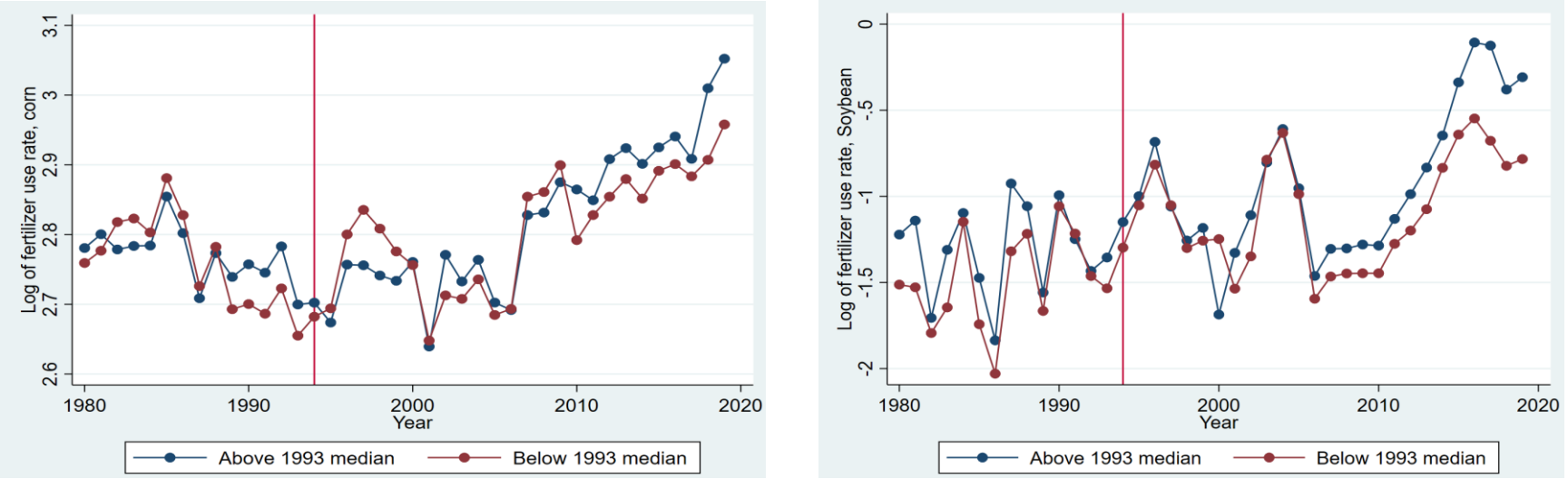


Figure 1.11 Event study graphs for the log of fertilizer use

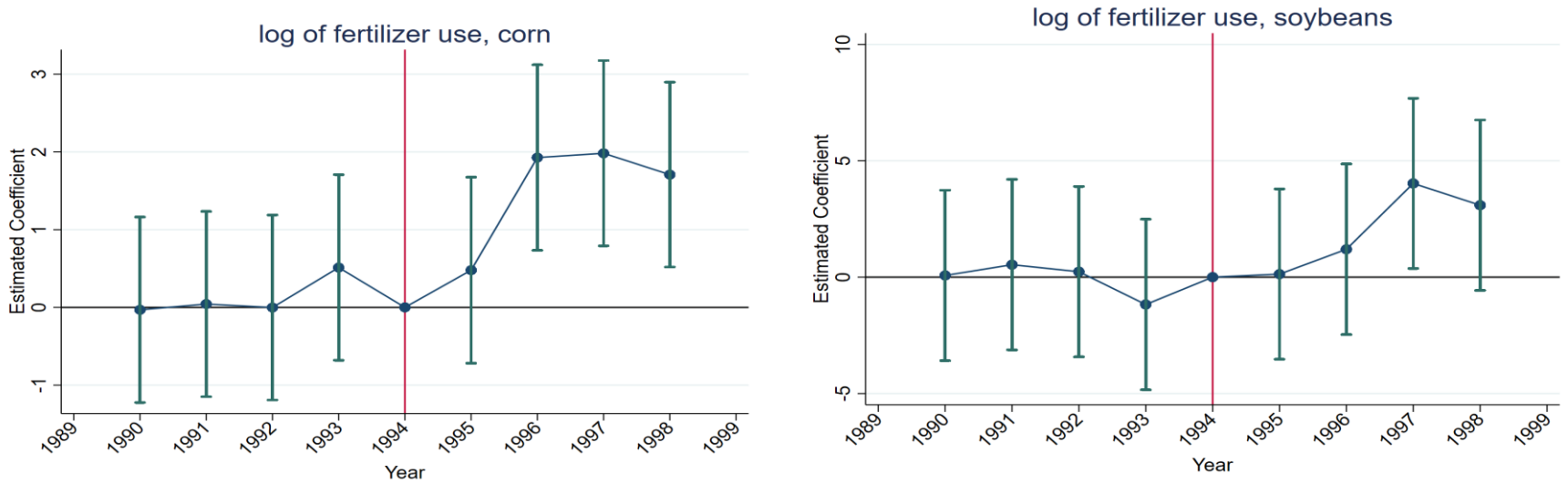
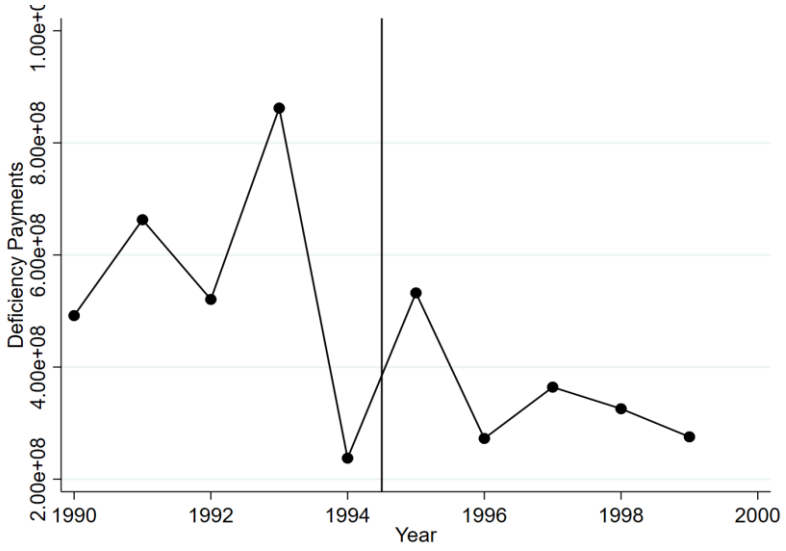


Figure 1.12 Government Deficiency Payments over time (Time series over the years || "more treated" vs "less treated" counties)



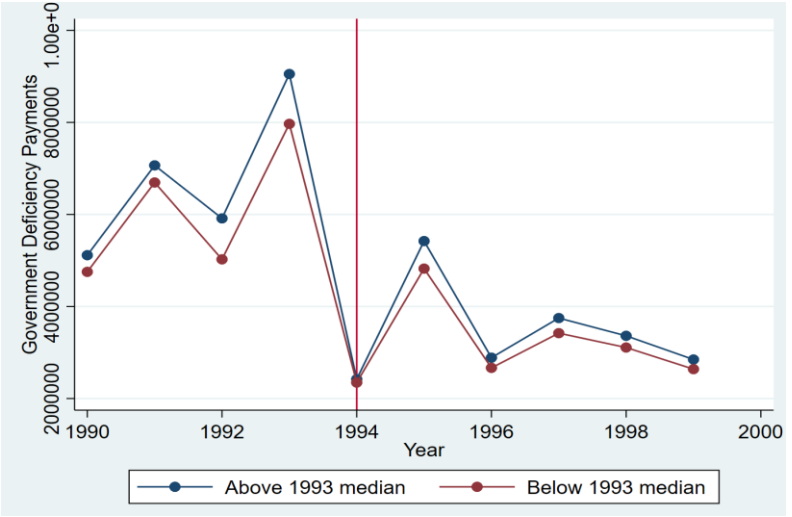


Figure 1.13 Event study graphs for Government Deficiency Payments

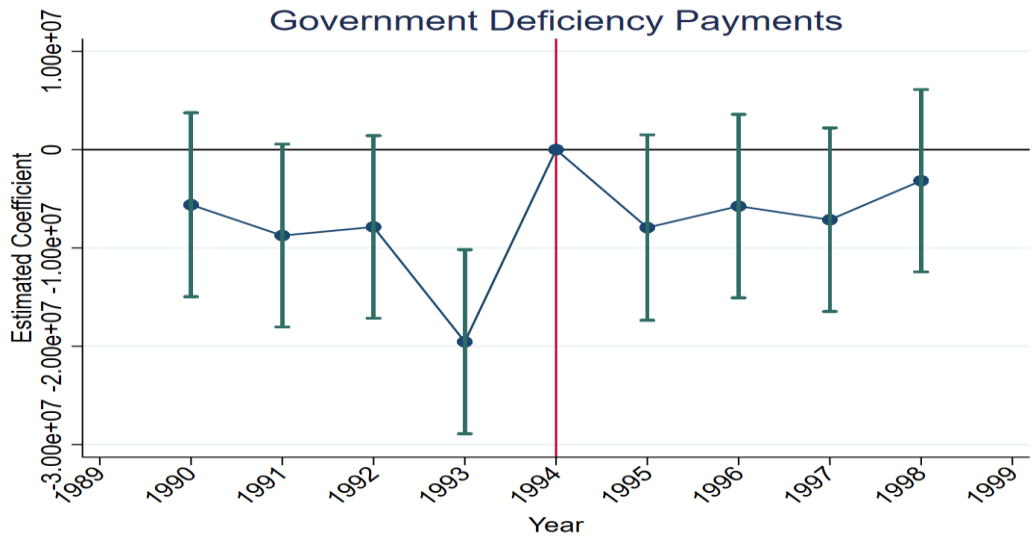


Figure 1.14 Event study graph: Fertilizer Use Rate vs Percentage Increase in GE Adoption (2000 – 2005)

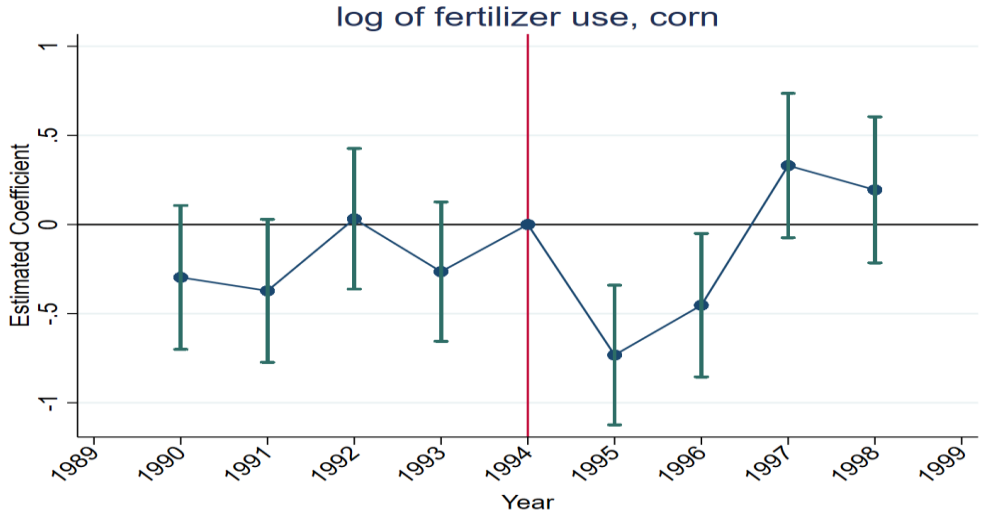
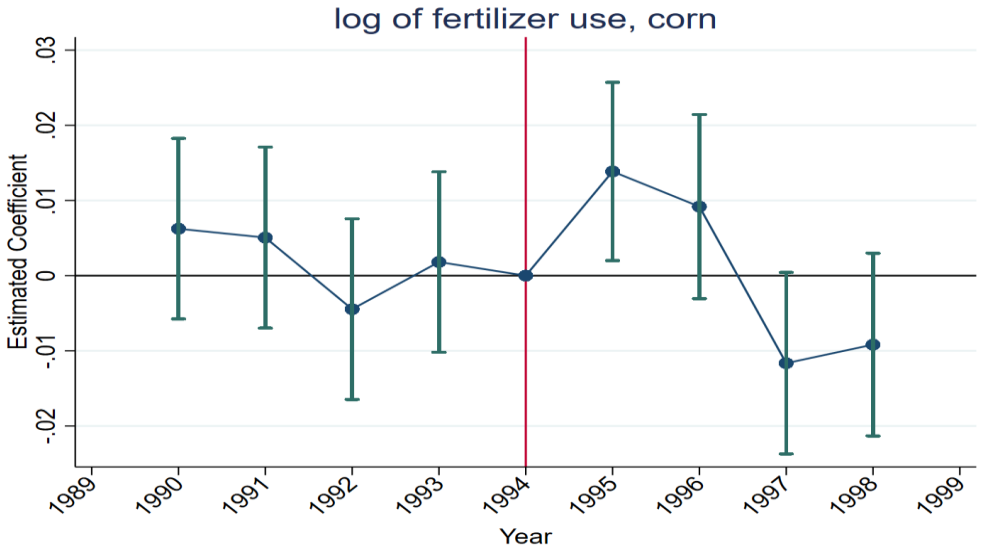


Figure 1.15 Event study graph: Fertilizer Use Rate vs GE Adoption Level in 2000



Tables: The Impact of Crop Insurance Program on Fertilizer Use in U.S. Agriculture

Table 1.1 Summary Statistics of Variables

Variables	Mean	SD	Min	Max
Dependent variables				
Fertilizer use rate:				
Corn (fertilizer or manure use rate/hectare in $\frac{g}{m^2}$)	16.619	4.552	1.283	40
Soybeans (fertilizer or manure use rate/hectare in $\frac{g}{m^2}$)	0.397	0.247	0.025	2.220
Crop insurance variables				
Corn (insured acres)	34,952	37,979	0	204,546
Soybeans (insured acres)	30,859	31,282	0	159,031
Pre-1994 Fertilizer use rate				
Corn	15.757	3.659	2.396	28.788
Soybeans	0.295	0.133	0.025	0.817
Post-1994 Fertilizer use rate				
Corn	17.137	4.942	1.283	40
Soybeans	0.458	0.278	0.027	2.220
Pre-1994 Percentage of insured acres				
Corn (% of insured acres)	0.085	0.067	0	0.630
Soybeans (% of insured acres)	0.067	0.051	0	0.383
Post-1994 Percentage of insured acres				
Corn (% of insured acres)	0.539	0.179	0.036	1
Soybeans (% of insured acres)	0.567	0.186	0.027	1

Other controls				
March Precipitation (mm)	89.015	43.558	5.891	368.404
April Precipitation (mm)	111.270	52.081	13.747	447.258
May Precipitation (mm)	125.700	55.371	13.539	390.656
June Precipitation (mm)	116.127	53.783	8.316	381.833
July Precipitation (mm)	107.991	47.499	12.644	348.396
August Precipitation (mm)	91.953	43.786	10.737	406.155
Maximum temperature in April (^{0}C)	0.0004	0.010	0	0.396
Maximum temperature in May (^{0}C)	0.044	0.157	0	2.217
Maximum temperature in June (^{0}C)	0.992	1.724	0	16.148
Maximum temperature in July (^{0}C)	3.154	4.939	0	44.312
Maximum temperature in August (^{0}C)	2.235	4.077	0	32.764
Government Deficiency Payment (US$)	4,331,272	3,745,840	86,456	2.94e+07
Genetically engineered (GE) variables				
Adoption rate for GE corn varieties	55.536	30.198	11	95
Adoption rate for GE soybeans varieties	85.460	11.249	44	97

Table 1.2 Event Study for Insured Acres Coefficients

Variables	(1) **log of average insured acres for corn**	(2) **log of average insured acres for soybean**
$t = -4$	35.96*	-8.013
	(19.80)	(10.67)
$t = -3$	26.80*	2.167
	(14.89)	(8.227)
$t = -2$	15.54	-0.585
	(9.963)	(5.848)
$t = -1$	10.33**	1.852
	(5.141)	(3.758)
$t = 1$	-19.10***	-3.085
	(5.121)	(3.683)
$t = 2$	-25.73**	-2.099
	(10.01)	(5.762)
$t = 3$	-35.47**	-0.0119
	(14.88)	(8.086)
$t = 4$	-45.07**	3.022
	(19.80)	(10.62)
$t = 5$	-55.22**	7.659
	(24.70)	(13.14)
$t = 6$	-65.01**	10.53
	(29.62)	(15.70)
$t = 7$	-74.13**	13.54
	(34.56)	(18.26)
$t = 8$	-84.01**	15.80
	(39.50)	(20.80)
$t = 9$	-93.19**	16.11
	(44.47)	(23.32)
treatment*$(t = -4)$	1.472	-3.643
	(1.536)	(2.851)
treatment*$(t = -3)$	1.070	-11.65***
	(1.532)	(2.849)
treatment*$(t = -2)$	3.329**	-5.337*
	(1.530)	(2.850)
treatment*$(t = -1)$	-1.797	-4.846*
	(1.539)	(2.859)
treatment*$(t = 1)$	12.65***	9.532***
	(1.545)	(2.841)
treatment*$(t = 2)$	9.953***	9.913***
	(1.543)	(2.856)
treatment*$(t = 3)$	9.737***	10.03***
	(1.535)	(2.840)
treatment*$(t = 4)$	9.705***	10.94***
	(1.528)	(2.846)

treatment*($t = 5$)	10.71***	11.27***
	(1.534)	(2.848)
treatment*($t = 6$)	10.97***	11.61***
	(1.528)	(2.847)
treatment*($t = 7$)	10.76***	11.91***
	(1.528)	(2.849)
treatment*($t = 8$)	11.61***	12.93***
	(1.544)	(2.848)
treatment*($t = 9$)	11.64***	14.40***
	(1.534)	(2.863)
prec_3	0.000842	0.000694
	(0.000585)	(0.000709)
prec_4	-0.000379	-6.09e-05
	(0.000441)	(0.000538)
prec_5	-0.00115***	-0.000422
	(0.000392)	(0.000491)
prec_6	0.000147	0.000865
	(0.000433)	(0.000532)
prec_7	0.000665*	0.000632
	(0.000363)	(0.000434)
prec_8	0.000481	-0.000469
	(0.000486)	(0.000600)
GDD_32_4	-5.539	-66.50
	(127.4)	(154.7)
GDD_32_5	-0.369	-0.903**
	(0.298)	(0.354)
GDD_32_6	0.00661	-0.0147
	(0.0329)	(0.0388)
GDD_32_7	-0.0275**	-0.0295**
	(0.0119)	(0.0141)
GDD_32_8	0.0106	0.00903
	(0.0132)	(0.0156)
yh	85.93*	-28.18
	(45.37)	(24.12)
l.price_corn	-0.748	
	(0.513)	
l.price_soybeans		1.015**
		(0.399)
Constant	-769.2*	236.8
	(412.0)	(201.0)
Observations	1,610	1,484
R-squared	0.895	0.876

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 1.3 Event Study for Log of Fertilizer Use Rate

Variables	(1) **log of fertilizer use rate for corn**	(2) **log of fertilizer use rate for soybean**
$t = -4$	10.18***	4.523**
	(1.430)	(2.227)
$t = -3$	7.590***	2.892
	(1.131)	(2.090)
$t = -2$	5.226***	1.878
	(0.855)	(2.011)
$t = -1$	2.185***	1.823
	(0.628)	(1.954)
$t = 1$	-2.913***	-1.284
	(0.627)	(1.940)
$t = 2$	-6.985***	-1.438
	(0.869)	(2.014)
$t = 3$	-9.320***	-4.581**
	(1.133)	(2.138)
$t = 4$	-11.68***	-6.746***
	(1.448)	(2.224)
$t = 5$	-13.19***	-8.780***
	(1.759)	(2.408)
$t = 6$	-16.16***	-12.94***
	(2.089)	(2.575)
$t = 7$	-18.35***	-8.149***
	(2.410)	(2.778)
$t = 8$	-20.72***	-10.40***
	(2.738)	(2.981)
$t = 9$	-23.47***	-11.70***
	(3.055)	(3.183)
treatment*($t = -4$)	-0.0267	-0.544
	(0.590)	(2.030)
treatment*($t = -3$)	0.0376	-0.376
	(0.589)	(2.029)
treatment*($t = -2$)	-0.0487	-0.632
	(0.588)	(2.031)
treatment*($t = -1$)	0.548	-1.965
	(0.591)	(2.037)
treatment*($t = 1$)	0.487	-0.991
	(0.594)	(2.025)
treatment*($t = 2$)	1.956***	0.208
	(0.593)	(2.036)
treatment*($t = 3$)	1.979***	3.087
	(0.590)	(2.025)
treatment*($t = 4$)	1.854***	2.417

	(0.587)	(2.028)
treatment*($t = 5$)	0.923	1.453
	(0.589)	(2.030)
treatment*($t = 6$)	1.568***	3.760*
	(0.587)	(2.029)
treatment*($t = 7$)	1.068*	-2.462
	(0.587)	(2.030)
treatment*($t = 8$)	0.843	-1.686
	(0.593)	(2.029)
treatment*($t = 9$)	1.086*	0.854
	(0.589)	(2.039)
prec_3	0.000680***	0.00202***
	(0.000224)	(0.000505)
prec_4	0.000505***	0.000852**
	(0.000169)	(0.000383)
prec_5	0.000240	0.000476
	(0.000151)	(0.000350)
prec_6	-8.34e-05	0.000134
	(0.000167)	(0.000379)
prec_7	-0.000290**	-0.000553*
	(0.000140)	(0.000311)
prec_8	0.000108	-5.57e-05
	(0.000190)	(0.000420)
GDD_32_4	-69.51	144.7
	(48.98)	(110.2)
GDD_32_5	0.0766	-0.122
	(0.115)	(0.252)
GDD_32_6	0.000121	0.0824***
	(0.0128)	(0.0275)
GDD_32_7	-0.00101	-0.0308***
	(0.00461)	(0.0100)
GDD_32_8	0.00194	0.0739***
	(0.00508)	(0.0111)
yh	-299.7***	106.6***
	(39.58)	(26.31)
l.price_corn	0.326*	
	(0.196)	
l.price_soybeans		-1.417***
		(0.285)
Constant	800.5***	146.3***
	(105.5)	(34.12)
Observations	1,610	1,484
R-squared	0.657	0.457

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 1.4 Non-Parametric DD: Sample means for the Log of Fertilizer Use Rate

Group	**More treated**		**Less treated**	
Treatment	**Pre-1994**	**Post-1994**	**Pre-1994**	**Post-1994**
Corn	2.598	2.653	3.737	3.921
Soybeans	-1.533	-1.142	0.933	1.102
		Within group difference after treatment		
Corn	0.055		0.184	
Soybeans	0.391		0.169	
		Difference-in-differences (DD)		
Corn	-0.130			
Soybeans	0.221			

Table 1.5 Impact of 1994 Crop Insurance Act on Fertilizer Use

	Dependent variable: log (fertilizer use rate)			
	Corn		Soybeans	
Variables	**(1)**	**(2)**	**(1)**	**(2)**
time	0.185	-0.487	0.169	0.0643
	(0.222)	(0.568)	(0.365)	(0.774)
Pre-1994 crop insurance Act	-1.139***	0.268	-2.466***	-0.360
	(0.183)	(0.278)	(0.292)	(0.317)
Short-run post-1994 crop insurance Act		**1.466****		**-0.0493**
		(0.567)		**(1.015)**
Medium-run post-1994 crop insurance Act		**1.377****		**0.969**
		(0.607)		**(1.162)**
Long-run post-1994 crop insurance Act	**-0.130**	**0.928**	**0.223**	**0.163**
	(0.254)	**(0.674)**	**(0.400)**	**(0.925)**
March Precipitation		0.000585		0.00276***
		(0.000383)		(0.000636)
April Precipitation		0.000460**		0.000637
		(0.000228)		(0.000432)
May Precipitation		0.000275*		0.000926***
		(0.000155)		(0.000324)
June Precipitation		-0.000137		0.000216
		(0.000173)		(0.000435)
July Precipitation		-0.000162		-0.000191
		(0.000121)		(0.000264)
August Precipitation		-0.000213		0.000301
		(0.000194)		(0.000455)
Growing Degree days for April		-83.12***		89.65
		(28.97)		(60.13)
Growing Degree days for May		0.134		0.0547
		(0.0874)		(0.202)
Growing Degree days for June		0.0138		0.0810***
		(0.0104)		(0.0199)
Growing Degree days for July		-0.00852**		-0.0561***
		(0.00332)		(0.0108)
Growing Degree days for August		0.000904		0.0877***
		(0.00605)		(0.0148)
Constant	3.737***	2.342***	0.933***	-1.515***
	(0.159)	(0.267)	(0.266)	(0.288)
N	4,589	1,495	4,589	1,495
R^2	0.034	0.629	0.116	0.476
# of counties	115	115	115	115

Robust standard errors in parentheses
***** p<0.01, ** p<0.05, * p<0.1**

Table 1.6 Event Study for Government Deficiency Payments

Variables	**Government Deficiency Payments**
$t = -4$	1.104e+08***
	(1.908e+07)
$t = -3$	8.972e+07***
	(1.457e+07)
$t = -2$	6.064e+07***
	(1.027e+07)
$t = -1$	5.086e+07***
	(6.168e+06)
$t = 1$	-1.425e+07**
	(6.496e+06)
$t = 2$	-5.162e+07***
	(1.014e+07)
$t = 3$	-7.159e+07***
	(1.449e+07)
$t = 4$	-9.987e+07***
	(1.915e+07)
$t = 5$	-1.248e+08***
	(2.388e+07)
treatment*($t = -4$)	-5.605e+06
	(4.773e+06)
treatment*($t = -3$)	-8.740e+06*
	(4.744e+06)
treatment*($t = -2$)	-7.864e+06*
	(4.737e+06)
treatment*($t = -1$)	-1.954e+07***
	(4.779e+06)
treatment*($t = 1$)	-7.932e+06*
	(4.814e+06)
treatment*($t = 2$)	-5.746e+06
	(4.762e+06)
treatment*($t = 3$)	-7.133e+06
	(4.767e+06)
treatment*($t = 4$)	-3.161e+06
	(4.733e+06)
treatment*($t = 5$)	-1.066e+06
	(4.751e+06)
prec_3	6,962***
	(2,122)
prec_4	3,701**
	(1,562)
prec_5	-1,664
	(1,443)

prec_6	700.5
	(1,621)
prec_7	6,209***
	(1,413)
prec_8	516.4
	(1,970)
GDD_32_5	3.920e+06***
	(1.003e+06)
GDD_32_6	-176,023
	(112,556)
GDD_32_7	47,637
	(43,133)
GDD_32_8	-97,422*
	(54,856)
yh	-3.052e+09***
	(5.524e+08)
l.price_corn	6.175e+06***
	(1.836e+06)
Constant	8.120e+09***
	(1.473e+09)
Observations	1,110
R-squared	0.860

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 1.7 Event study: Fertilizer Use Rate for Corn using Percentage Increase in GE adoption (2000-2005) as Treatment Variable

Variables	**log of fertilizer use rate for corn**
$t = -4$	12.56***
	(3.220)
$t = -3$	9.583***
	(2.425)
$t = -2$	6.135***
	(1.628)
$t = -1$	3.387***
	(0.830)
$t = 1$	-2.105**
	(0.851)
$t = 2$	-5.403***
	(1.628)
$t = 3$	-9.368***
	(2.431)
$t = 4$	-12.28***
	(3.227)
$t = 5$	-15.11***
	(4.044)
$t = 6$	-17.80***
	(4.834)
$t = 7$	-20.11***
	(5.637)
$t = 8$	-23.58***
	(6.447)
$t = 9$	-27.16***
	(7.236)
treatment*$(t = -4)$	-0.297
	(0.206)
treatment*$(t = -3)$	-0.372*
	(0.205)
treatment*$(t = -2)$	0.0318
	(0.201)
treatment*$(t = -1)$	-0.265
	(0.200)
treatment*$(t = 1)$	-0.732***
	(0.200)
treatment*$(t = 2)$	-0.453**
	(0.205)
treatment*$(t = 3)$	0.331
	(0.207)

treatment*($t = 4$)	0.194
	(0.209)
treatment*($t = 5$)	0.0601
	(0.214)
treatment*($t = 6$)	-0.156
	(0.219)
treatment*($t = 7$)	-0.812***
	(0.226)
treatment*($t = 8$)	-0.451*
	(0.235)
treatment*($t = 9$)	0.0710
	(0.250)
prec_3	0.000557**
	(0.000229)
prec_4	0.000612***
	(0.000175)
prec_5	8.74e-05
	(0.000155)
prec_6	-6.37e-05
	(0.000173)
prec_7	-0.000275*
	(0.000156)
prec_8	-1.57e-05
	(0.000193)
GDD_32_4	-78.10
	(48.40)
GDD_32_5	-0.0331
	(0.121)
GDD_32_6	-0.000488
	(0.0131)
GDD_32_7	-0.00257
	(0.00491)
GDD_32_8	-0.00374
	(0.00527)
yh	-201.6***
	(54.84)
Constant	534.4***
	(144.7)
Observations	1,610
R-squared	0.664

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 1.8 Event study for Fertilizer Use Rate using GE Adoption Level in 2000 as Treatment Variable

Variables	**log of fertilizer use rate for corn**
$t = -4$	12.31***
	(2.104)
$t = -3$	9.198***
	(1.577)
$t = -2$	6.340***
	(1.053)
$t = -1$	3.070***
	(0.530)
$t = 1$	-3.313***
	(0.543)
$t = 2$	-6.240***
	(1.062)
$t = 3$	-8.989***
	(1.593)
$t = 4$	-12.16***
	(2.115)
$t = 5$	-15.29***
	(2.643)
$t = 6$	-18.38***
	(3.170)
$t = 7$	-21.78***
	(3.694)
$t = 8$	-24.77***
	(4.221)
$t = 9$	-27.61***
	(4.749)
treatment*$(t = -4)$	0.00624
	(0.00612)
treatment*$(t = -3)$	0.00506
	(0.00614)
treatment*$(t = -2)$	-0.00446
	(0.00613)
treatment*$(t = -1)$	0.00181
	(0.00612)
treatment*$(t = 1)$	0.0139**
	(0.00605)
treatment*$(t = 2)$	0.00919
	(0.00625)
treatment*$(t = 3)$	-0.0116*
	(0.00616)

treatment*($t = 4$)	-0.00918
	(0.00620)
treatment*($t = 5$)	-0.00417
	(0.00621)
treatment*($t = 6$)	0.000893
	(0.00619)
treatment*($t = 7$)	0.0152**
	(0.00627)
treatment*($t = 8$)	0.00850
	(0.00631)
treatment*($t = 9$)	-0.00237
	(0.00658)
prec_3	0.000602***
	(0.000231)
prec_4	0.000591***
	(0.000175)
prec_5	0.000179
	(0.000155)
prec_6	-9.95e-05
	(0.000173)
prec_7	-0.000190
	(0.000156)
prec_8	6.64e-05
	(0.000196)
GDD_32_4	-74.05
	(48.69)
GDD_32_5	0.0485
	(0.116)
GDD_32_6	-0.00251
	(0.0129)
GDD_32_7	-0.00200
	(0.00467)
GDD_32_8	-0.000104
	(0.00511)
yh	-205.6***
	(34.91)
Constant	544.9***
	(92.10)
Observations	1,610
R-squared	0.658

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Chapter 2 Willingness-to-pay a Premium on Beef: Supermarket versus Direct-to-consumer Valuation in Alabama

1.0 Introduction

The outbreak of the novel coronavirus (COVID-19) pandemic in the spring of 2020 caused an unprecedented shock in the supply chain of the U.S. beef market, leading to beef shortages (Lusk *et al.*, 2021). While these shortages increased the price of retail beef, the prices of livestock fell, resulting in a huge bump in the farm-to-retail supply chain margin (Martinez et al.,2021). The divergence between farm-level livestock prices and retail beef prices is a problem that existed prior to the COVID-19 pandemic (Lusk *et al.*, 2021). While the COVID-19 pandemic further exacerbated this divergence, it was initially attributed to the fire incident in the Tyson beef-packing plant in Kansas on August 9, 2019, and the alleged anticompetitive behavior of the four largest beef packers (the "Big Four"), which includes Cargill, JBS, National Beef, and Tyson (Benavidez & Anderson, 2021). At the time of writing, we continue to see disruptions in the livestock and beef markets caused largely by the discrepancy between producers and packers, leading to record-level farm-to-retail supply chain margins. These issues prompted the U.S. Department of Agriculture (USDA) and the U.S. Department of Justice (USDoJ) to launch investigations into the fire incident in Kansas as well as the potential anticompetitive behavior of the "Big Four," especially because more than three federal civil lawsuits have been brought against them (Lusk *et al.*, 2021). Moreover, members of the U.S. Congress continue to call for policy proposals to better understand the supply chain issues facing the beef industry, therefore highlighting the need for further research on the problem. This paper revisits the problem by applying an innovative behavioral economics valuation method to a popular econometric approach in analyzing the demand side of the beef supply chain, with a view to delineating consumer preference for niche products.

Supply chain problems caused by the discrepancies between beef producers and packers have been prevalent for over a century. At the turn of the 20th century, the "Big Four" meat packers included Armour, Swift, Cudahy, and Wilson (Peel *et al.*, 2002). On the heels of the boxed beef revolution in the 1980s, these companies birthed the current "Big Four" meat packers through the systematic propagation of the benefits of economics of scale, cost efficiencies, and product innovations associated with the industry. It is documented that the market concentration of the current "Big Four" meat packers increased from below 30% in the late 1970s to more than 80% in the 1980s as a result of a number of mergers and acquisitions by the largest firms in the industry (Ward, 2002). The market concentration of these firms has remained stable to date, as they averaged a concentration ratio of above 80% in the last two decades (Peel *et al.*, 2002). The increased concentration of these firms has raised concerns about the negative price impact of their market power as well as their ability to structurally weaken the position of smaller firms and producers, who largely exist within the purview of the direct-to-consumer (DTC) market in the beef supply chain (Peel *et al.*, 2002). The negative price impact of the big firms is evident in the farm-to-retail supply chain margins, with supermarkets at the tail end of the downstream sector of the beef packing industry. This is because most case-ready products from major packing companies are received by supermarkets that typically process them through cutting, packaging, and labeling for retail to meet the downstream consumer demands for beef products (Peel, 2021; Schroeder *et al.*, 2021).

Brick-and-mortar supermarkets, therefore, are generally responsible for a large high percentage of beef sales and have been recognized as the main drivers of total domestic beef sales. However, the need for a more sustainable beef supply chain has called into question the distribution of beef through supermarkets as producers are increasingly leaning towards the DTC distribution channels (Peel, 2021). Such channels include farm stands, farmers' markets, farm-to-school, farm-to-restaurants, fundraising dinners, fairs and festivals, and mail orders (Goodsell *et al.*, 2010). These DTC channels rely heavily on consumer interest in niche products and continue to gain significant traction because they present producers with opportunity for increased profits through the elimination of middlemen (Linea, 2021). For example, while

grass-fed beef constitutes the largest niche market of retail beef with a sales record of $480 million in 2019, a majority of grass-fed beef producers currently engage in DTC sales and are exploring other retail alternatives (Gillepsie *et al.*, 2016). Additionally, beef producers are making concerted efforts to market their products online and via social media platforms, thereby enabling consumers to shop for local beef from the comfort of their home and direct from the cattle producer, with the added benefit of purchasing freezer beef. Freezer beef also known as bulk beef or locker beef, represents a substantial portion or quantity of meat from a single animal specially processed, packaged, and sold directly to consumers. Typically offered through DTC marketing, freezer beef allows consumers to buy beef in larger, more cost-effective quantities and store it in their freezers for future use, ensuring a constant supply of high-quality beef over an extended period. Despite the significant growth in DTC marketing, these channels continue to be confronted by peculiar challenges such as limited access to farmers in remote areas, shorter operational hours of DTC stores, and other transaction costs (Ohara & Low, 2020). These challenges, however, do not deter the growth of the DTC markets as they not only address the trending supply chain problems, but promote trust in the relations between producers and consumers (Arnot *et al.*, 2016).

Prior studies have identified different reasons for the emergence and sustainability of DTC marketing for retail beef. Here, we classify the studies based on their methodologies and whether they follow the one-part versus two-part models. Studies that employ one-part models (such as the probit and logit models, among other methods) find that consumers' willingness to pay for beef through DTC marketing is largely associated with product price, location-specific labels or brands, and other niche product characteristics such as grass-fed or organic certifications, specialty cuts and unique flavor profiles (Thilmany *et al.*, 2003; Loureiro & Umberger, 2003; Feldkamp *et al.*, 2005; Fields *et al.*, 2006; Hobbs *et al.*, 2006; Umberger *et al.*, 2009; Chang *et al.*, 2013; Dobbs *et al.*, 2016; Griffith *et al.*, 2017; Merritt *et al.*, 2018; McKay *et al.*, 2019; DeLong *et al.*, 2019). Studies that follow the two-part model mainly employ the double hurdle (DH) model. These studies find that in the first equation model, the willingness to consider beef is associated with price, age, race, education level of the consumer, and consumer's trust in the

quality and label of the beef. They find that in the second equation model, the willingness to pay for beef is associated with price of other meat products, gender, age, race, quality, and label of beef (Jones & Yen, 2000; Lusk *et al.*, 2001; Maynard *et al.*, 2004; Verbeke *et al.*, 2013).

In this paper, we analyze survey data of beef consumers in Alabama who are randomly assigned to different hypothetical experimental choice problems. For each choice problem, respondents complete three Multiple Price Lists (MPL) tasks with 13 choice sets in each. The MPL tasks require participants to select from two price options associated with the supermarkets and DTC markets, with a third "neither" option indicating a preference at those price points for a choice outside of those given. In each MPL, we maintain a constant price for supermarket option while we exogenously vary the prices allocated to DTC markets across choice sets by decreasing (increasing) the price by $0.50. We use the MPL elicitations to determine the willingness to pay a premium for ground beef, steak, and freezer beef between two markets such as supermarkets versus (vs.) DTC markets, as well as a comparison of options in the DTC market. Using ground beef purchased from a supermarket vs. a DTC market as an example, the WTP a premium is defined as the monetary value representing the difference between consumers' utility for ground beef purchased from a supermarket over a DTC market offering of ground beef or freezer beef. On the flip side, a negative premium implies that the consumer requires a discount to compensate their utility for ground beef purchased from a supermarket over the DTC market product. The third option, "neither choice," represents the preference for some other product not offered, also known as the "outside good" option. To our knowledge, this is the first study that incorporates the "neither" option in an MPL framework.

The focus of this paper is twofold. First, we delineate consumers' valuation for different labels and production practices for beef from supermarkets compared to DTC markets. We do so by incorporating the following treatments in the questionnaire: the "no information" treatment, "information" treatment, "information and organic" treatment, "information and hormone-free" treatment, and "information and Sweet Grown Alabama (SGA)" treatment. Second, we analyze the data collected using the procedure by

Lusk & Shrogen (2007) and employ the DH model for the comparison between supermarkets vs. DTC markets. Conversely, we employ the tobit model for comparison between options in the DTC markets.

Our results reveal that the “no information” and “information and hormone-free” treatments primarily have the highest premiums for ground beef and steak across all the choice problems. In comparing supermarkets and DTC markets, consumers' age and race were found to influence the first and second stages of the DH model. The first-stage willingness to consider (WTC) DTC beef is influenced by household characteristics such as income, household size, age, gender, race, ownership of freezer, and understanding of the definition of freezer beef. The second-stage willingness to pay (WTP) a premium is influenced by the "no information" and "information and hormone-free" treatments, as well as gender and race. In comparing options in the DTC markets, the tobit model indicates that the WTP a premium is influenced by the "no information" and "information and hormone-free" treatments as well as household characteristics such as age, race, ownership of freezer beef, and an understanding of the correct definition of freezer beef.

This paper contributes to ongoing developments in the meat and livestock markets. It provides producers and other stakeholders in the DTC market with insights on consumer preferences for niche products such as locally produced beef and steak. The application of the MPL procedure and the WTP frameworks coupled with double hurdle and tobit models demonstrate an innovation in methodology that adds value to previous studies; in particular, it provides insight on both the participation (willingness to consider purchasing beef) and market decisions (willingness to pay a premium) of the beef consumer.

The rest of this paper is organized as follows. Section 2.0 focuses on the sampling design and methods. Section 3.0 focuses on the empirical model of the paper. Section 4.0 discusses the regression results while section 5.0 draws conclusions from the study.

2.0 Sampling Design and Methods

2.1 Participants and Sampling Design

We employ an experimental market method to elicit consumer WTP a premium for beef purchased through brick-and-mortar supermarkets compared to DTC markets. In the DTC markets, we also compare different choice questions. Previous studies have employed non-hypothetical experiments due to their advantage and flexibility in delineating meat attributes applied to experimental valuation (Shrogen *et al.*, 1994; Hayes *et al.*, 1995; Melton et al., 1996; Fox et al., 1998; Lusk et al., 2001; Maynard et al., 2004). While these studies were mostly conducted in laboratory settings or in grocery stores, we focus on a wide range of Alabama residents through a questionnaire administered using the Qualtrics web-based survey platform. We employ a web-based platform because it offers cost-efficiency, wider geographic reach, participant convenience, data collection efficiency, quick turnaround, and enhanced response anonymity, all of which contribute to the validity and comprehensiveness of our research on consumer preferences in the beef market. The first part of the questionnaire (questions 1–17) includes questions on the demographic characteristics of participants as well as their interests related to beef. Example survey questions include: *(i) Have you purchased meat in the last 12 months? (ii) What type(s) of meat have you purchased in the last 12 months?* These questions revolve around meat types (such as beef, chicken, pork, turkey, goat, sheep/lamb, game, seafood and other) and was used to filter out beef consumers, who made up our target respondents.

The second section of the questionnaire, which was developed using the MPL approach, includes questions about consumers' valuation for different labels and production methods of beef purchased from DTC markets compared to supermarkets. See Figure 1 for the framework used in implementing the MPL procedure. On the one hand, the MPL compares prices of beef from supermarkets with prices from the DTC markets. On the other hand, we compare prices of beef within the DTC markets, where we have beef from “other markets” as well as freezer beef. Beef from “other markets” is defined as individual cuts from outlets such as farm stands, farmers’ markets, or meat markets. Freezer beef is defined as

bulk/bundle purchases from farmers. In all the elicitations, consumers are required to make a choice between different markets using the MPL procedure. The MPL procedure will be further explained in Section III.B. of this paper.

The final section of the questionnaire entails follow-up questions to the MPL procedure such as *(i) why did you purchase freezer beef? (ii) what characteristics do you associate with locally grown food?* These follow-up questions help clarify the responses provided by consumers in the experiment.

The sample design is shown in Figure 2. A total of 1,001 responses were received from consumers. Of the 1,001 responses, 36 responses were excluded as a result of the initial screening questions. Therefore, we were able to analyze 965 responses in this study. We provide further details about these responses in the descriptive analysis of survey participants (section 4.1) in the results section.

2.2 Products and Treatments

Respondents were randomized across five treatment options to indicate their preference for different beef (all USDA Choice) products. The products offered include ground beef, steak, and freezer beef. With respect to the different treatments, respondents were presented with the following scenarios:

Base – This is the "no information" treatment, which includes the options below:

(i) Beef from supermarket versus beef from other markets (such as a farmstand, farmers' market, or meat market) in individual packages ranging in size from 1–3 pounds (lbs.) per package. Purchases are made in a single package or multiple packages during each shopping trip.

(ii) Freezer beef directly from the producer, which entails a quarter (1/4) of the animal processed in assorted cuts.

Expanded Information – This is the "information" treatment. Here, in addition to the base scenario, respondents are provided with more details about the beef products as follows:

(iii) The beef from (i) is individually packaged and constitutes a variety of cuts and sizes depending on the meat. Cuts of meat may include steaks, ground beef, and roasts. Respondents must purchase the full portion to be delivered or picked up at one time. *This will require approximately 4.5 cu. ft. of chest freezer space or 5.5 cu. ft. of upright freezer space*.

(iv) Freezer beef directly from the producer is a portion of the entire animal. Each portion consists of a quarter (1/4) of the animal, which yields approximately 120–150 lbs. of processed beef.

Expanded information was also supplemented with other product or marketing characteristics: This entails the "information and organic," "information and hormone-free," and the "information and Sweet Grown Alabama (SGA)" treatments. The "information and organic" treatment closely follows the information treatment, except that respondents are provided with organically produced beef for all cases (that is, beef from supermarkets and other markets as well as freezer beef). The "information and hormone-free" treatment is similar to the information treatment, except that respondents are provided with hormone-free beef for all cases (that is, beef from supermarkets and other markets as well as freezer beef). Lastly, the "information and Sweet Grown Alabama (SGA)" treatment is also similar to the information treatment, except that beef is packaged with the SGA logo and the producer of the freezer beef is a member of SGA.

3.0 Empirical Model

3.1 Willingness to Pay (WTP) Premium Approach

A consumer will choose to buy beef from a local market (local beef) rather than a supermarket (supermarket beef) when the utility derived from the local beef is greater than the utility from the supermarket beef. To model this decision, we employ McFadden's (1974) random utility model to discern the WTP for local beef over supermarket beef. We extend McFadden's random utility framework to the customer's purchasing decision by assuming that the customer aims to maximize their utility subject to their budget constraint. Within this framework, we assume a consumer utility function with three

arguments: (y, x, m), where y represents a unique product identity or label, x represents consumer characteristics that may affect their preference, and m represents consumer income. Additionally, we assume that the supermarket beef (products A) and local beef (product B) are represented by two labels (y_A, y_B) so that the consumer's willingness to select one product over another depends on the magnitude of change in their utility subject to their budget constraint. This change can be measured monetarily by the consumer's willingness to pay a premium or accept a discount for one product over another. In the absence of a change in utility, the monetary value equals zero and implies that the consumer is indifferent to the price of the two products. When the consumer is willing to pay a premium for product B (y_B) over product A (y_A), we represent this decision as follows:

(1) $$U\ (y_A\ , x_A\ , m) \leq U\ (y_B\ , x_B\ , m - c)$$

This means that the consumer is willing to pay an additional c dollar amount so that their utility for y_B is at least as good as it is for y_A. The willingness to pay a negative premium for product B (y_B) over product A (y_A) implies that the consumer requires a discount of d dollar amount so that their utility for y_B is at least as good as it is for y_A. Within this framework, indifference to the price of the two products would leave the utility for y_A and y_B unchanged. We further extend this framework to the MPL procedure in the next section.

3.2 Multiple Price Lists (MPL) Procedure

The MPL is a popular procedure widely used in the experimental economics literature. The procedure entails presenting an array of ordered prices in a table, one per row, where each respondent is asked to reveal their preferences (by indicating "yes" or "no") for each price (Andersen et al.,2006). In applying the MPL procedure to the WTP methodology, we follow Kahneman *et al.* (1990) and Huseynov *et al.* (2022). In each choice question, respondents have three preferences. These preferences are based on two prices, with a third "neither" option. To the best of our knowledge, this is the first study that incorporates the "neither" option in an MPL procedure. We include the "neither" option in the MPL procedure because

it enhances the authenticity of the experiment by capturing real-world consumer choices where individuals can opt out of purchasing a product. This ensures that respondents do not feel obligated to make selections that does not align with their true preferences, thereby reducing the potential for bias in the results. The detailed representation of the MPL in the survey instrument is shown in Tables 8, 9, 10 and 11 of the MPL tasks in Appendix A.

In Table 1, we summarize all of the MPL questions employed in this study. While we do not indicate the "neither" option in Table 1, it exists for all questions displayed in the table. Panel A of Table 1, for example, represents the choice questions on supermarket versus other markets preferences for ground beef, where other markets include farmstand, farmers' market, and meat market. In the first-choice question of Panel A, ground beef from a supermarket costs $4/lb. while the ground beef from other markets costs $8/lb. If a consumer switches from the former to the latter, it shows that they are willing to pay $8/lb. to buy ground beef from other markets instead of paying $4/lb. to buy ground beef from a supermarket. It also suggests that the consumer is willing to pay a premium of $4 on every pound of beef purchased from other markets. If the converse were the case, then the consumer requires a discount of $4 on every pound of beef purchased from supermarkets. Additionally, there is the "neither" option. We further extend this framework to the second question, where ground beef from a supermarket costs $4/lb. while ground beef from other markets costs $7.50/lb. In this case, if the consumer switches from supermarket ground beef to ground beef from other markets, then they are willing to pay a premium of $3.50 on every pound of beef purchased from other markets and vice versa. Any switch made in the ninth-choice question, where the prices of supermarket and other markets ground beef are identical ($4/lb.), represents zero discount/premium and shows that the consumer prefers to buy ground beef from either market for a reason other than price. The consumer, however, still retains the option to choose "neither" option. The ninth-choice question of the MPL reveals the agent's true preference when the price attribute does not affect the purchase decision. Furthermore, the tenth-choice question suggests that the consumer

is willing to pay a premium of $0.50 on every pound of beef purchased from the supermarket, probably for reasons such as convenience, the lack of need for storage, and brand/known entity.

We repeat the procedure implemented in Panel A for the different products and supply chain options in Panels B, C, D, E and F. We also do this for the four treatments described in section 2.2.

3.3 Choice of Model

In the literature on beef consumption, different functional forms have been employed to model an agent's decision to consume beef (Froehlich et al.,2009; Umberger et al.,2009; Naptolitano et al.,2010; Li et al.,2016). The choice to consume beef is typically dichotomous and is represented by the latent observed variable y^*, which assumes values on the real line. Because the decision to consume beef is a dichotomous one, binary response models (like probit or logit models) have been used in previous studies to analyze this decision (Loureiro & Umberger, 2003; Umberger *et al.*, 2009; Dobbs *et al.*, 2016; Risius & Hamm, 2017). In cases where the choice is between more than two alternatives, ordered probit/logit (Verbeke & Ward, 2006; Umberger et al.,2009; Yoo & Yoo, 2018), multinomial probit/logit (Lusk et al.,, 2001; Li et al., 2016) and mixed logit models (Alfnes, 2004) have been employed. Very few studies have employed the tobit (Tonsor et al.,2022) and the DH models (Lusk *et al.*, 2001; Froehlich *et al.*, 2009).

The choice of model is informed by the data generating process of the WTP premium from the MPL framework for the different choice questions. If we omit consumers who exclusively maintain the "neither" options in Panels A–D of the MPL, then we are left with either ground beef/steak consumers who switch from supermarkets to other markets/freezer beef or consumers who prefer to buy beef and steak exclusively from supermarkets. Because of the switches along the MPL, we have consumers whose premium is greater than zero. Consumers that choose the supermarket option exclusively have a premium of zero and account for about one-third or a quarter of the responses received, as indicated in Figures 6 and 7 as well as in Tables 17 and 18 of Appendix B. The same reasoning applies to Panels E and F of the MPL, where we have the "neither" option as well as the "other markets" option in the DTC market, leading to no premiums (see Figure 8 and Table 19 of the Appendix B). The zero premium in all choice

problems leads to the left censoring of the dataset. The premium values are also right censored because we placed a cap on the maximum premium consumers can pay on the right-hand side of the MPL. The tobit model is one way to analyze the data collected for this study due to the censored observations (Tobin, 1958). Given that the observed value y is both left and right censored, we employ the tobit model as follows:

$$y_i^* = x_i\beta + \varepsilon_i \quad (2)$$

where x_i represents the matrix of explanatory variables hypothesized to influence the decision to pay a premium. These variables include treatment identifiers (that is, information treatment, information and organic treatment, information and no organic treatment, and information and SGA treatment) and demographic variables (that is, household size, household income, age, gender, educational level, location, whether the respondent is the primary purchaser of beef, ownership of freezer, and an understanding of the correct definition of beef). β is the vector of coefficients and ε_i is an error term assumed to be normally distributed with mean zero and variance, σ^2.

The censoring in the dataset can also be addressed by decomposing the consumption model into two phases (Zhu et al.,2021). The first phase entails the participation model between supermarket and DTC markets. The second phase concerns the determinant of how much premium consumers are willing to pay if they select DTC markets instead of supermarkets (Wooldridge, 2002). The decomposition also applies to comparisons between the two market options within the DTC market. The first and second phases are analyzed using the DH model, which employs a different mechanism in modeling the decisions to participate as well as pay a premium for the different choice problems (Cragg, 1971). We call the participation model the WTC, as opposed to the WTP model, which focuses on the determinant of how much premium consumers are willing to pay. The WTP premium model is conditional on the WTC model. Since different explanatory variables can affect the decision in each model, the two models are not treated equally (Cragg, 1971). We model the DH procedure as follows (Garcia, 2013):

(3) $$y^* = \begin{cases} x_i\beta + \epsilon_i & if \min(x_i\beta+\epsilon_i, z_i\gamma+\mu_i)>0 \\ 0, & otherwise \end{cases}$$

where $x_i\beta + \epsilon_i$ represents the WTP model and $z_i\gamma + \mu_i$ represents WTC model. x_i represents the matrix of explanatory variables hypothesized to influence the WTP model, while z_i represents the matrix of explanatory variables hypothesized to influence the WTC model. Accordingly, β and γ are the vectors of coefficients in the WTP and WTC models respectively, and ϵ_i and μ_i represent their respective error terms.

It is clear from the foregoing that both the DH and tobit models can be used to analyze the dataset collected for this study. However, the likelihood ratio (LR) statistic below by Lusk & Shrogen (2007) determines the model that will be used for the different choice problems in this study:

$$LR = -2\left[lnLF_{Tobit} - lnLF_{Probit} - lnLF_{Truncated\ Regression}\right] \quad (4)$$

where LF represents the value of the likelihood function. The null (H_0) and alternative (H_A) hypotheses are as follows:

$$H_0: The\ tobit\ model\ is\ the\ appropriate\ specification$$

$$H_A: The\ double\ hurdle\ model\ is\ the\ appropriate\ specification$$

The decision rule states that if the LR calculated is greater than the chi-square critical value, we reject the tobit model in favor of the DH model. In contrast, we do not reject the tobit model in favor of the DH model if the LR calculated is less than the chi-square critical value. The degree of freedom for the chi-squared critical value is the number of independent variables. We show the results of this test in the next section (see Table 7). We choose between the DH and tobit models for different choice problems, but we analyze and interpret the DH regressions using Cragg's (1971) model. This is because the Cragg (1971) model presupposes that, subject to the explanatory factors, the errors between hurdles 1 and 2 are

independent, normally distributed, and that their covariance is equal to zero (Ricker-Gilbert *et al.*, 2010). There are studies that relax the independent error assumption in the DH model (Jones & Yen, 2000; Garcia, 2013). However, these studies find similar results even if the assumption was maintained. Additionally, we find that the results from Cragg's (1971) model and the separate probit/truncated regressions are similar and identical. This paper, however, follows Cragg's assumption.

We employ the average marginal effects (AME) rather than the marginal effects at mean (MEM) when reporting all results because the sample means obtained when computing MEM may denote nonexistent or characteristically nonsensical observations. This problem frequently arises when regressors are dummy variables (Wooldridge, 2016). In this study, the AME, which is favored by common practice, is preferred because it is simple, straightforward, and represents marginal effects across individuals when the sample is large enough (Bartus, 2005; Wooldridge, 2016).

4.0 Results

4.1 Descriptive Analysis: General Demography of Survey Participants

Table 2 shows summary statistics for all the variables (which include constitute consumers that select the "neither" option as well as the in-market option). We also provide the average for some of the variables from the 2021 American Community Survey (ACS) data for Alabama in the last column of Table 2. Table 2 generally shows that averages of the variables from the survey fairly represent the averages in the ACS data for 2021. The average household size is three with a standard deviation of two. The median income is about $57,000 with a standard deviation of about $41,000. The survey captured more middle-aged people (between 25 – 54 years old) than young (between 18 – 24 years old) and old (55 years and older) people. Additionally, there are more women included in the sample at over 60% compared to men at about 40%, which was an intentional oversampling because women are more likely to be primary food shoppers for the household. Most of the respondents have some level of college education and are evenly distributed across rural, suburban, and urban locations. Over 60% of respondents are the primary

purchasers of food in their households. Regarding the race of respondents, about 75% of the respondents are Caucasian while the other 25% are non-Caucasian.

Some key highlights of the demographic information include the ownership of a freezer and the definition of freezer beef. The demographic information shows that while about 40% of households own a freezer, less than 30% of them understand the correct definition of freezer beef. To further elicit more information on the definition of freezer beef, we asked respondents to provide the first word they think of when they hear the term freezer beef. We display these responses in a word cloud, shown in Figure 3, where the larger words are the more common responses consumers used to identify freezer beef.

We find that the term "freezer beef" is not a common phrase to consumers. Only 26% of respondents correctly identified the term as "purchasing beef in bulk quantity directly from a cattle producers, usually as a whole, half, or quarter of the animal." The majority of the respondents indicated that freezer beef is beef purchased from the freezer section of the supermarket. We further elicit information on the reasons consumers purchase freezer beef from those who correctly defined the term. Figure 4 displays reasons consumers purchase freezer beef.

We see that consumers knowledgeable about freezer beef prefer to buy it because of its price, value, and quality. A less common reason is that it's local. On the flip side, we also elicit information on the factors that influence the decisions of consumers who do not purchase freezer beef.

Figure 5 shows that consumers who do not purchase freezer beef do so mainly because of a lack of interest, concerns about quality, and not being familiar with the product.

4.1.1 Distribution of Consumers that select the "Neither" option vs. In-market options

Table 3 depicts the distribution of respondents for all the samples of the "neither" and in-market options. The distribution of respondents for all the samples of the "neither" and in-market options are 733 and 5,057 respectively. However, the sample size for the different market comparisons (Supermarket vs. Other Markets, Supermarket vs. Freezer Beef and Other Markets vs. Freezer Beef) is 965.

4.1.2 Summary Statistics for Consumers that select only the "Neither" option

Summary statistics for consumers that select only the "Neither" option are provided in Tables 4. The summary statistics highlighted in Table 4 are relatively similar to the summary statistics of the total sample in Table 2, except for median income, which is relatively lower for the "Neither" option sample (at about $42,000).

4.1.3 Summary Statistics for the In-market Sample

The summary statistics for the in-market sample is decomposed in two tables. Table 5 depicts the summary statistics for the different treatments across the choice problems while table 6 shows the summary statistics for the demographic variables for all the choice problems captured by the in-markets sample. The summary statistics of the in-market sample are relatively similar to the summary statistics of the total sample in Table 2 except for median income, which is slightly higher for the in-market sample (at about $57,000).

4.2 Proportion of Consumer Across the Different Premium Values for the In-market Samples

We present Figures 6–9 to show the proportion of consumers across the different premiums for the in-market samples. To create the bar charts, we shift the premium that consumers are willing to pay for each choice problem proportionately upward in order to transform negative WTP values (discounts) into positive WTP values. This is to maintain clarity and consistency in the visual depiction of consumer WTP as negative WTP values might not intuitively convey information in a clear and meaningful way. We also use the data with the rescaled premium in fitting the data to the DH and tobit models.

We find the distribution of consumers across the different premium values of the six choice problems demonstrate that the highest proportion of consumers corresponds to the zero and maximum premium values. Between the zero and maximum premiums, we see a variation in the proportion of consumers across the different premium values. The use of models that allow left and right censoring, such as the DH and tobit models, is further justified by the fact that the zero and maximum premium values represent the decisions of the highest proportion of consumers.

4.3 Comparison between Average Premiums across Treatments (or Information Conditions)

We conduct a pairwise comparison between the average premiums that consumers are willing to pay across the different treatments. We do this by comparing consumers' valuation for the different treatments to the "information" treatment. Based on Figures 6–8, we do not observe a normal distribution of consumers across the different premiums. As a result, we employ the non-parametric Wilcoxon test, which allows for a comparison of the average premium in an unknown distribution (Ramsey & Schafer, 2013). The results of the Wilcoxon test are presented in Tables 20–25. For completeness, we also employ the two-sample t-test, and the results are presented in Tables 26–31. For both tests, we find comparable results; the WTP premium for the "information and hormone-free" treatment compared to the "information" treatment, in the ground beef from supermarket vs. freezer beef market, is statistically different at 10% level of significance (see Tables 22 and 28 in Appendix C and Appendix D respectively). Additionally, we find that in the ground beef from other market vs. freezer beef market, the premium for the "no information" treatment compared to the "information" treatment is statistically different at the 10% level of significance (see Tables 24 and 30 in Appendix C and Appendix D respectively). Apart from these results, we do not find any other comparable statistically significant difference between treatments in the Wilcoxon test and the two-sample t-test. Our findings largely align with Froehlich et al. (2009), which employed a nonparametric Wilcoxon-Mann-Whitney test and found no statistically significant difference for various brands of steak.

We present the average WTP premium for various treatments across all markets examined in Figures 9–11. For the choice problem on Ground Beef/Steak vs. Other Markets in Figure 9, we find that the "no information" treatment has the highest WTP premiums at $3.14 and $3.34 for the ground beef and steak markets, respectively. This is followed by the "information and no hormone" treatments at $3.13 and $3.22 for the ground beef and steak markets, respectively. The lowest WTP premium is obtained for the "information and SGA" treatments at $2.81 and $2.92 for the ground beef and steak markets, respectively.

For the choice problem on Ground Beef/Steak vs. Freezer Beef in Figure 10, we find that the "information and hormone-free" treatment has the highest WTP premium for Ground Beef from Supermarket vs. Freezer Beef at $3.17, while the "information" treatment has the highest premium for the choice problem on Steak from Supermarket vs. Freezer Beef at $4.31. The lowest premium for the choice problem on Ground Beef/Steak from Supermarket vs. Freezer Beef is the "information and organic" treatment at $2.70 and $3.87 for ground beef and steak, respectively.

For the choice problem on Other Markets vs Freezer Beef in Figure 11, we find that the "no information" treatment has the highest premiums at $6.55 and $8.05 for the ground beef and steak, respectively. On the other hand, the lowest premium for choice problem on Ground Beef from Other Market vs. Freezer Beef is the "information" treatment at $5.70, while the lowest premium for choice problem on Steak from Other Market vs. Freezer Beef is the "information and organic" treatment at $6.95.

4.4 Choice of Model Specification

We follow the procedure by Lusk & Shrogen (2007), which employs the LR statistic in equation (4) as well as the accompanying test of hypothesis that surrounds the procedure. Accordingly, we derive the LR statistics estimates from the tobit, probit, and truncated regressions for each choice problem (in Tables 32, 33 and 34 in Appendix E). We compare the LR statistics estimates with the 95% critical chi-square for a degree of freedom of 14, which is 23.685.

In Table 7, we report and compare the results for the LR statistics estimates with the chi-square values for each choice problem. Since the truncated regression forms part of the DH model, we report both the LR statistic for both the full and truncated regressions. Based on the decision rule of the hypothesis testing procedure, we reject H_0 in favor of H_A and adopt the DH model for the choice problems that compare supermarkets to DTC markets (which include the market for freezer beef and other markets). However, we fail to reject H_0 in favor of H_A and adopt the tobit model for choice problems that compare the options in DTC markets (such as the market for freezer beef and other markets). In section IV.E, we interpret the coefficient estimates of the DH and tobit models

4.5 DH and Tobit Regression Results

In analyzing supermarket and DTC market choice problems, we report the AME results of the DH model in Tables 8 and 9 for the first and second hurdle respectively. In analyzing the options in the DTC market, we report the AME results of the tobit models in Table 10. Regarding the results of the DH model, the first stage focuses on the drivers of DTC market participation as opposed to supermarkets, which is why we refer to the first hurdle model as the WTC model. The second stage model focuses on the premium for the DTC option which we call the WTP model. We estimate the WTC and WTP models using similar sets of variables. However, in the WTC models, we include household size, ownership of freezer beef, whether respondents are the primary purchaser of beef, and whether respondents correctly understand the definition of freezer beef. We include these variables in the WTC models because previous studies have shown that they are appropriate for the participation model rather than the consumption model (Lusk *et al.*, 2001; Umberger *et al.*, 2009). Accordingly, results from the DH model suggest that the WTC decision primarily depends on the household characteristics of beef consumers. In contrast, the WTP decision depends on both treatment effects and household characteristics.

Both the WTC and WTP decisions are mainly influenced by two common factors, the age and race of consumers. Older consumers (55 years and older) are less likely to consider and pay more premium on ground beef and steak when compared to younger consumers (between 18–24 years of age) in all choice problems that compare supermarkets to DTC markets (except for the case of steak from supermarket vs. freezer beef). This finding is consistent with Jones and Yen (2000) as older people are generally more likely to consume less beef compared to other age groups.

The second common factor associated with WTC and WTP decisions is the race of respondents. Non-Caucasian consumers are likely to consider and pay more premium on ground beef and steak than Caucasian consumers in all choice problems that compare supermarkets and DTC markets (except for the case of steak from supermarket vs. freezer beef). Concerning the steak from supermarket vs. freezer beef choice problem, we find that female consumers are less likely to consider and pay more premium on steak

than male consumers. This finding contradicts Lusk *et al.* (2001), where female consumers who consider more premium are also more likely to pay more premium on beef than their male counterpart.

4.5.1 Willingness-to-consider (WTC) Decision from the Cragg (1971) Double Hurdle Model

The results from the WTC model in Table 8 suggest that the attributes that motivate the participation decision of consumers generally include household size, median income, age, gender, race, ownership of freezer, and whether or not consumers correctly understand the definition of freezer beef.

In the *Ground Beef from Supermarket vs. Other Markets* choice problem, an additional household member increases the WTC DTC beef from other markets over supermarkets by about 12%. Similarly, in the *Ground Beef/Steak from Supermarket vs. Other Markets* choice problem, an increase in household median income is associated with higher WTC DTC beef and steak respectively.

Regarding age, the results indicate that middle-aged consumers are less likely to consider a premium when compared to young consumers by 62%, 69%, and 57% in the *Ground Beef from Supermarket vs. Other Markets*, *Steak from Supermarket vs. Other Markets,* and *Ground Beef from Supermarket vs. Freezer Beef* choice problems, respectively. Furthermore, older consumers are also less likely to consider DTC when compared to young consumers by about 130%, 150%, and 153% in the in *Ground Beef from Supermarket vs. Other Markets*; *Steak from Supermarket vs. Other Markets,* and *Ground Beef from Supermarket vs. Freezer Beef* choice problems, respectively. Previous studies (Lusk et al., 2001; Maynard et al.,2007), however, do not find that age is associated with the first hurdle estimation of the DH model on beef and steak.

On gender, we find that female consumers are less likely to consider DTC than male consumers by about 30%, 37%, and 75% in the *Ground Beef from Supermarket vs. Other Markets*; *Ground Beef from Supermarket vs. Freezer Beef*; and the *Steak from Supermarket vs. Freezer Beef* choice problems, respectively. These results contradict previous literature (Lusk et al., 2001; Maynard et al., 2004; Umberger et al., 2009). For example, Maynard et al. (2004) finds that male consumers, when compared

to female consumers, are less likely to consider purchasing beef, while Lusk et al. (2001) and Umberger et al. (2009) did not find that gender affects consumers' WTC meat in the first hurdle model.

On race, the results indicate that non-Caucasian consumers are more likely to consider a premium than Caucasian consumers by about 50% for choice problems *Ground Beef and Steak from Supermarket vs. Other Markets* as well as the *Ground Beef from Supermarket vs. Freezer Beef* choice problems, respectively. The results on race contradict Lusk et al. (2001), which did not find any association between race and consumers' WTC meat in the first hurdle model.

On ownership of a freezer and the correct definition of beef, our results suggest that both factors are associated with an increase in the likelihood that consumers consider DTC beef. The ownership of a freezer increases the likelihood to consider DTC by about 50%, 35%, 65%, and 40% in all the choice problems in the supermarket vs. the DTC markets (which includes the *Ground Beef from Supermarket vs. Other Markets*; *Steak from Supermarket vs. Other Markets*; *Ground Beef from Supermarket vs. Freezer Beef*; and *Steak from Supermarket vs. Freezer Beef* choice problems, respectively). A correct understanding of the definition of increases the likelihood to consider DTC beef by about 46%, 55%, 50%, and 76% in supermarket vs. the DTC markets (which includes the *Ground Beef from Supermarket vs. Other Markets*; *Steak from Supermarket vs. Other Markets*; *Ground Beef from Supermarket vs. Freezer Beef*; and *Steak from Supermarket vs. Freezer Beef* choice problems respectively).

4.5.2 Willingness-to-pay (WTP) Decision from the Cragg (1971) Double Hurdle Model

Unlike the WTC model, we find that the WTP models in Table 9 are influenced by some of the treatment effects. Using the information treatment as the reference variable, consumers, when offered the "no information" treatment, are likely to pay more premium on beef by about 41%, 43%, and 146% in the *Ground Beef from Supermarket vs. Other Markets*; *Ground Beef from Supermarket vs. Freezer Beef*; and *Steak from Supermarket vs. Freezer Beef* choice problems, respectively. According to these findings, consumers want to pay less money per pound when they purchase these meat products in bulk or when they are better informed about the varieties of these meat products. Two implications of these findings are

worth emphasizing. The first is that consumers are less likely to buy freezer beef when they have a better understanding of what it is. The second is that the inclination to pay less premium when they are more informed about the variety of these meat products might be due to the nudge about outside options. This means that consumers might favor other meat characteristics that were not captured in this study, which makes them more inclined to stick with meat attributes in the base treatment.

Additionally, we find that when consumers are offered the "information and hormone-free" treatment, they are more likely to pay a premium by about 52%, 77%, 51%, and 110% in all the supermarket vs. DTC market choice problems (which includes the *Ground Beef from Supermarket vs. Other Markets*; *Steak from Supermarket vs. Other Markets*; *Ground Beef from Supermarket vs. Freezer Beef*; and *Steak from Supermarket vs. Freezer Beef* choice problems, respectively). These results imply that consumers are more likely to pay a premium when they are informed that the meats are hormone-free. In this context, the term "hormone-free" means that these meat products did not come from livestock that are cultivated using added hormones, but it does not rule out the fact that they are cultivated using naturally occurring hormones, also known as endogenous hormones. We find consistent results for consumers in the information and hormone-free treatment group in previous literature (Fields et al.,2006; Hobbs et al.,2006; Umberger et al., 2009) as consumers generally have a higher preference for beef from animals that are not exposed to added hormones.

On age, we find that older consumers are less likely to pay a premium on beef when compared to young consumers by about 113%, 157%, 160%, and 223% in all the supermarket vs. DTC market choice problems (which includes the *Ground Beef from Supermarket vs. Other Markets*; *Steak from Supermarket vs. Other Markets*; *Ground Beef from Supermarket vs. Freezer Beef*; and *Steak from Supermarket vs. Freezer Beef* choice problems, respectively). In the *Steak from Supermarket vs. Freezer Beef* choice problem, we find similar results for female consumers (when compared to their male counterparts), where female consumers are less likely to pay a premium on beef by 70%. Lusk et al. (2000), Umberger et al. (2009) and Verbeke et al. (2013) corroborate our findings on age and gender. These studies find that as

people get older, they are less likely to pay a premium on meat products, while women are more likely to pay a premium on meat than their male counterpart in the second hurdle model.

On race, the results suggest that non-Caucasian consumers are more likely to pay a premium than Caucasian consumers by 88%, 114%, and 103% in the *Ground Beef from Supermarket vs. Other Markets*; *Steak from Supermarket vs. Other Markets*; and *Ground Beef from Supermarket vs. Freezer Beef* choice problems, respectively. This finding is consistent with Jones & Yen (2000), where white consumers are less likely to pay for more beef than black consumers.

4.5.3 Tobit Regression Results

In this section, we compare the results for the two DTC markets in Table 10 (that is, *Other Markets vs. Freezer Market*). Based on the procedure by Lusk & Shrogen (2007) in Table 7, we find that these results follow the tobit model, which is a single-stage model. We argue that the analysis on two DTC markets eliminates the need to estimate a WTC the DTC market. This argument is further supported by previous literature, which employ single equation models for the analysis on DTC marketing (McKay et al., 2019).

We find that the *Ground Beef from Other Markets vs. Freezer Beef* and the *Steak from Other Markets vs. Freezer Beef* choice problem is affected by the treatment effects, age, race as well as ownership and definition of freezer. Using the "information treatment" as a reference, we find that when consumers are offered the "no information" treatment, they are more likely to pay premium on freezer beef by about 50%. When they are offered the "information and hormone-free" treatment, they are also more likely to pay premium on freezer beef by about 1%. The fact that we do not find significant results for the SGA treatment can be explained by the fact that all the beef products were from Alabama, therefore consumers might assume that the SGA label is an inconsequential attribute. This finding is not consistent with previous literature, where location-specific labels affect consumers' WTP on locally produced beef (Chang et al., 2013; Griffith et al., 2017; Merritt et al., 2018). Concerning age, we find that older consumers are less likely to pay a premium on ground beef than young consumers by about 97%. On race,

the results suggest that non-Caucasian consumers are more likely to pay a premium than Caucasian consumers by 42%.

We find that the *Steak from Other Markets vs Freezer Beef* choice problem is affected by median income, gender, and ownership of freezer beef. On median income, we find that a decrease in the median income is associated with an increase in the WTP premium on freezer beef. On gender, the result suggests that female consumers are less likely to consider a premium than male consumers by about 79%. Lastly, the ownership of freezer beef affects the *Ground Beef from Other Markets vs. Freezer Beef* and the *Steak from Other Markets vs. Freezer Beef* choice problems. Specifically, ownership of freezer beef increases the WTP a premium for both choice problems by 104%.

5.0 Conclusions

The COVID-19 pandemic exacerbated the divergence between farm-level prices of livestock and retail price of beef, leading to an emerging shift in the beef supply chain. Livestock farmers and beef consumers are taking renewed interest in opportunities to connect outside the traditional farmer-packer-supermarket model, leading to a huge rise in DTC markets for beef. This paper examines consumers' valuation for different characteristics and labels of beef from supermarkets compared to DTC markets. Our findings reveal that the valuation for two niche labels, namely "no information" and "information and hormone-free," labels have the highest premiums for ground beef/steak from other markets compared to supermarkets, freezer beef compared to ground beef/steak from supermarkets as well as freezer beef compared to ground beef/steak from other markets. Based on these findings, we recommend that producers in the DTC markets tailor their offerings to meet consumers' preferences for these niche products by providing clear and transparent information about their beef products, which includes emphasizing hormone-free production.

This study further broadens our understanding of consumers' willingness to pay a premium on beef by comparing the different characteristics and labels for beef from supermarkets vs. DTC markets, as well as options within the DTC markets. Using the procedure by Lusk & Shrogen (2007), we compare different econometrics models such as the tobit, probit, and truncated models and select the DH model for the comparison between supermarkets versus DTC markets. Conversely, we employ the tobit model for comparison between options in the DTC markets. On the comparison between supermarkets versus DTC markets, we find that the first and second stages of the DH model are influenced by consumers' age and race. We find that the first-stage WTC beef is influenced by household characteristics such as income, household size, age, gender, race, ownership of freezer, and a correct understanding of the definition of beef. We find that the second-stage WTP a premium depends on the "no information" and "information and hormone-free" treatments as well as other household characteristics such as gender and race. Regarding options in the DTC markets, we find that results from the tobit model show that the WTP a

premium depends on the “no information” and “information and hormone-free” treatments as well as other household characteristics such as age, race, ownership of freezer beef, and consumers’ understanding of the definition of freezer beef.

The results regarding the “no information” and “information and hormone-free” treatments in virtually all the market comparisons indicate that when consumers buy these meat products in bulk, or when they are more knowledgeable about the varieties of meat products, they prefer to pay less money per pound. The nudge about outside options may account for the inclination to pay less premium when people are more knowledgeable about the variety of meat products. This implies that consumers may prefer other meat attributes not included in this study, making them more inclined to stick with the meat attributes in the base treatment.

Regarding the consumer characteristics that affect the WTP a premium in all the markets compared, a few of them stand out such as the ownership of freezer and consumers’ understanding about the correct definition of freezer beef. To the best of our knowledge, this is the first paper that incorporates both factors in analyzing the WTP for beef. The fact that ownership of a freezer affects the participation decision of consumers in the first stage of the double hurdle model is intuitive because freezers are needed to store freezer beef. It is also intuitive that the ownership of a freezer matters for choice problems in the DTC markets because these are markets where consumers buy beef in bulk, constituting the need for a freezer. On consumers’ understanding of freezer beef, we find that over 70% of beef consumers do not understand what freezer beef means. This highlights a consumer education problem that might explain consumers’ decision to pay less when they become more knowledgeable about meat varieties, or the prospect of bulk purchases offered in the information treatment. This finding generally calls for more consumer education and more emphasis on quality rather than quantity of meat products, as bulk purchases does not drive consumers to pay more for DTC beef. Furthermore, we find that older and middle-aged consumers consider as well as pay a low premium on beef when compared to young consumers in virtually all the market comparisons made. From a marketing perspective, livestock

producers focused on DTC marketing can target young people since young consumers are more likely to consider DTC as well as pay a higher premium on DTC beef.

Figures: Willingness-to-pay a Premium on Beef: Supermarket versus Direct-to-consumer Valuation in Alabama

Figure 1: Markets Where Consumers Purchase Beef

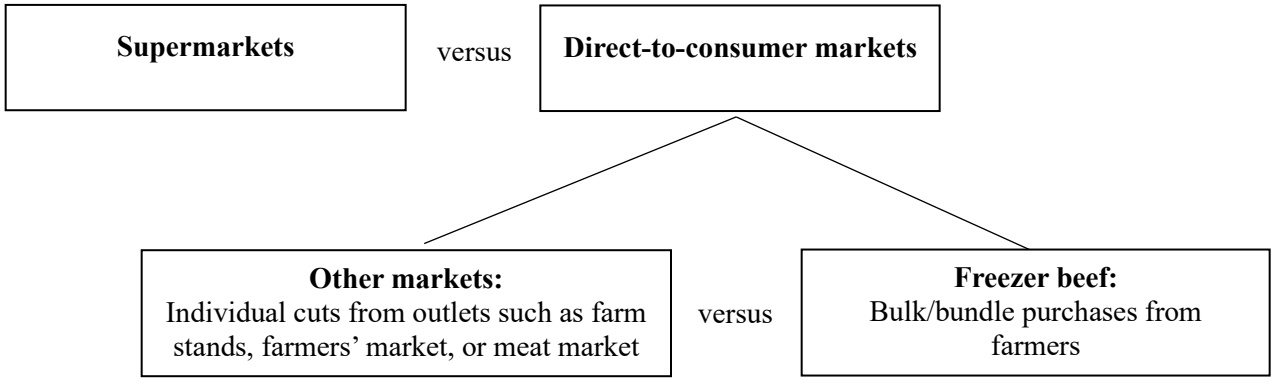


Figure 2: Experimental Design Overview

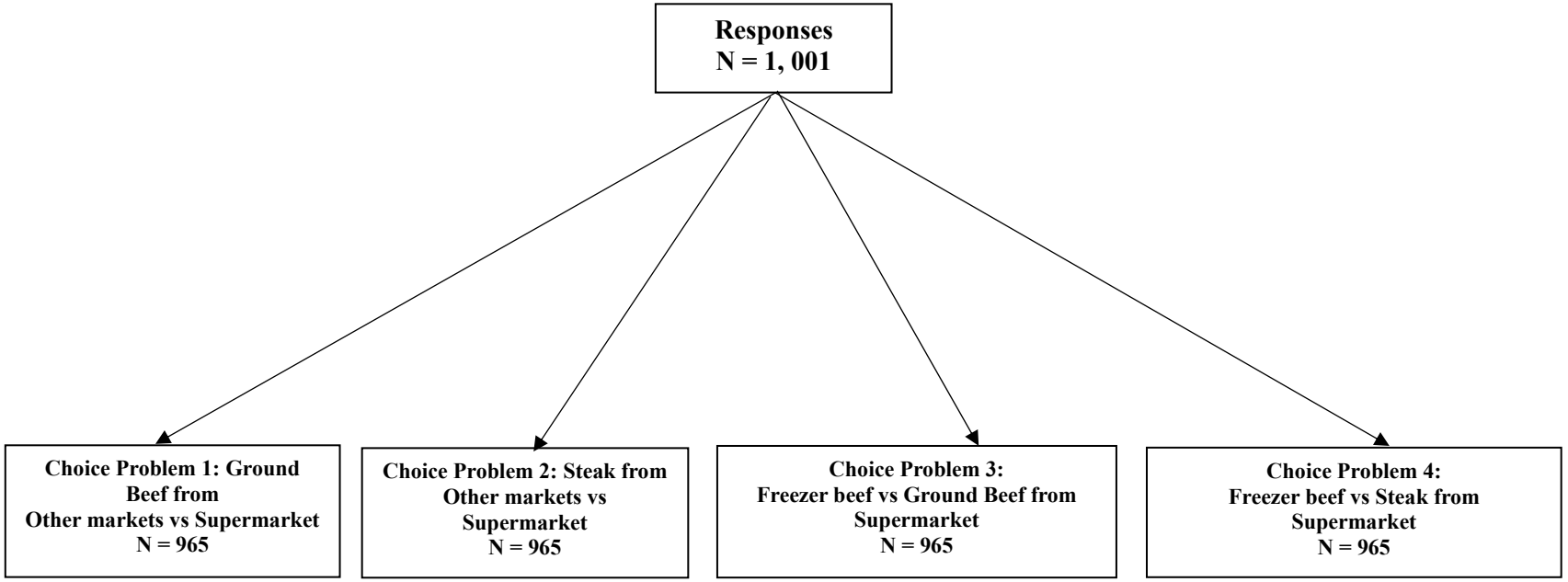


Figure 3: Word Cloud on Common Words Used to Identify Freezer Beef

Figure 4: Reasons Consumers Purchase Freezer Beef

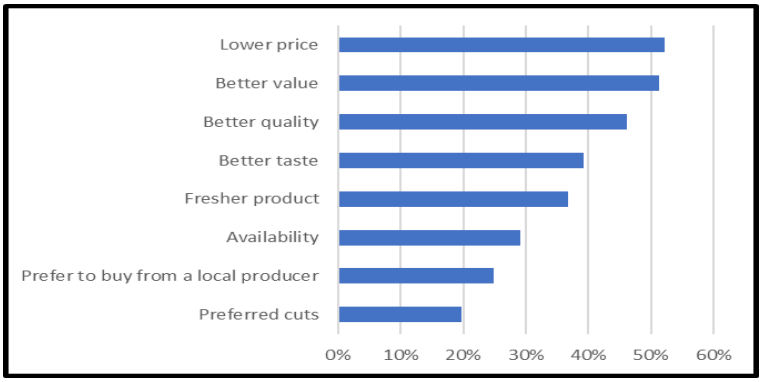


Figure 5: Reasons Consumers Do Not Purchase Freezer Beef

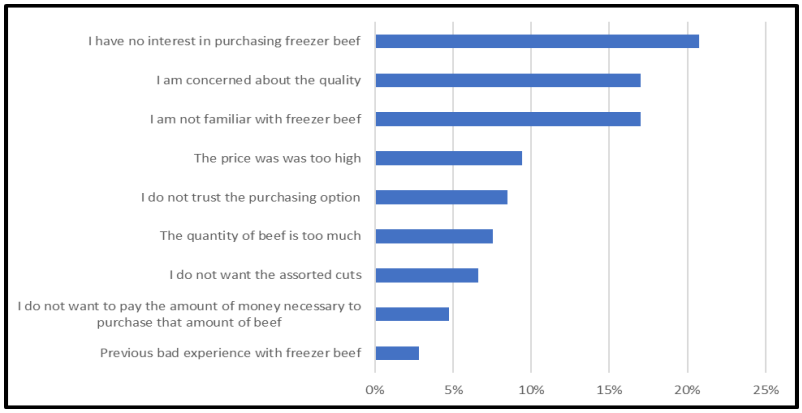
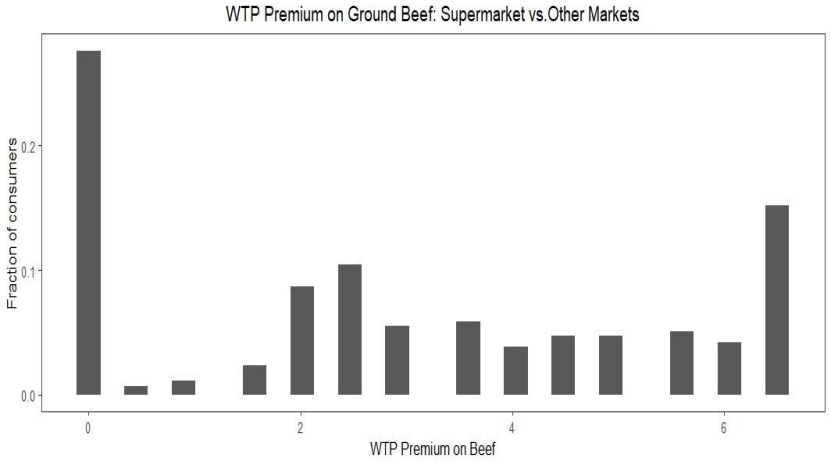


Figure 6: WTP Premium on Beef: Supermarket (Ground Beef/Steak) vs. Other markets (Ground Beef/Steak)



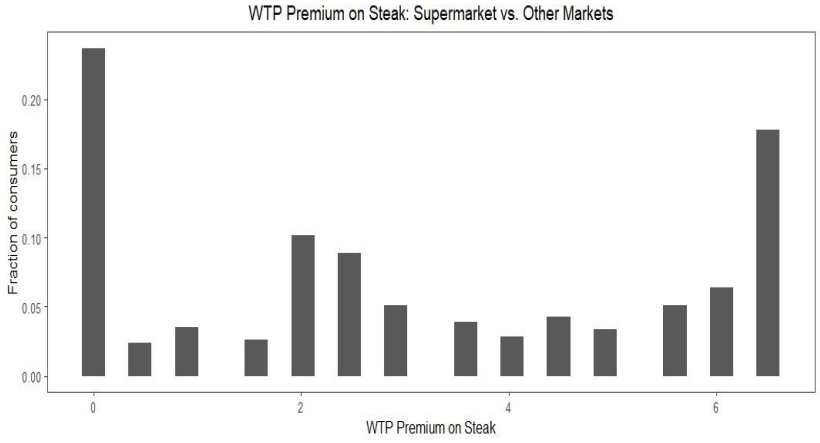
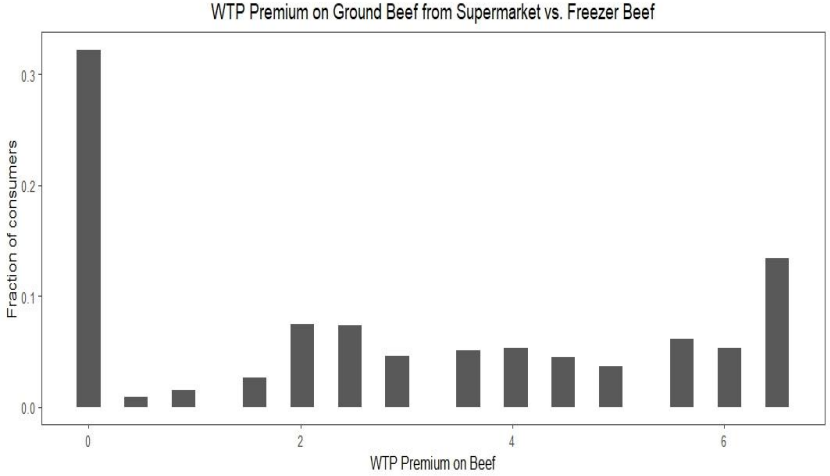


Figure 7: WTP Premium on Supermarket (Ground Beef/Steak) vs. Freezer Beef



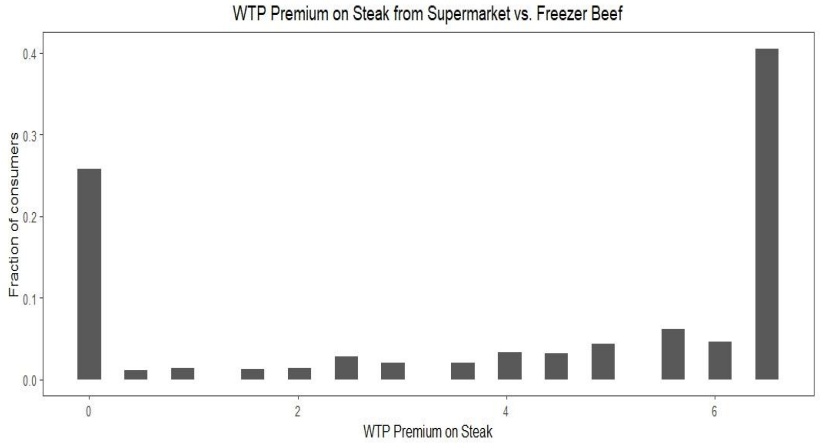


Figure 8: WTP Premium on Freezer Beef vs. Other Markets (Ground Beef/Steak)

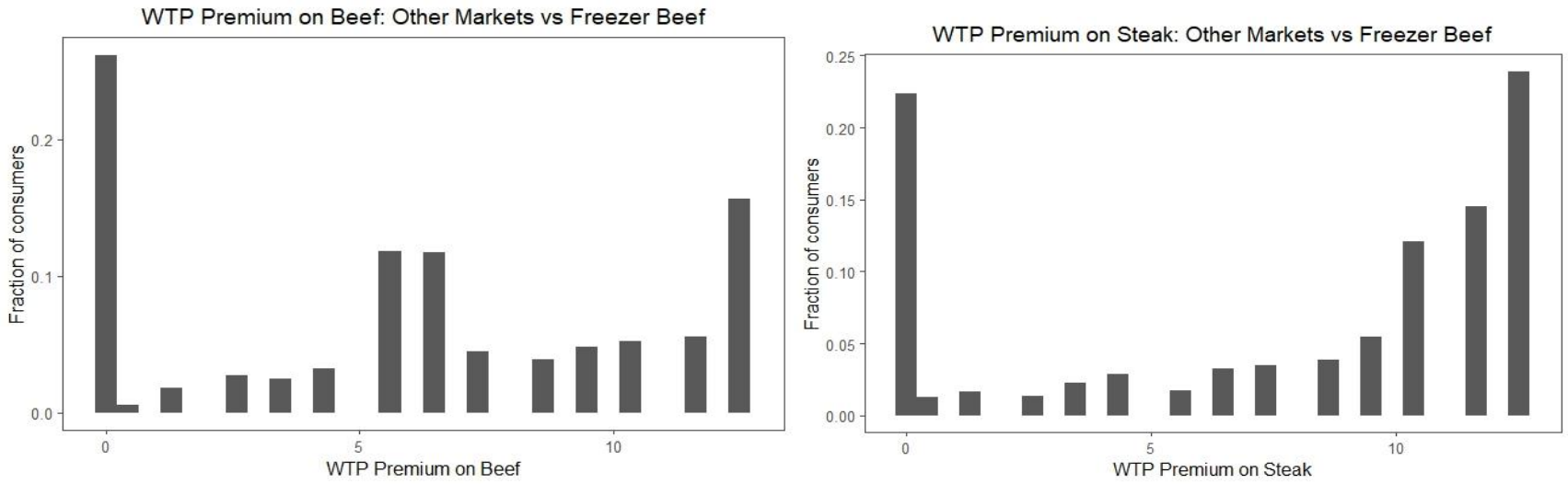


Figure 9: Mean WTP Premiums Across Different Treatments for Ground Beef/Steak – Supermarket vs. Other markets

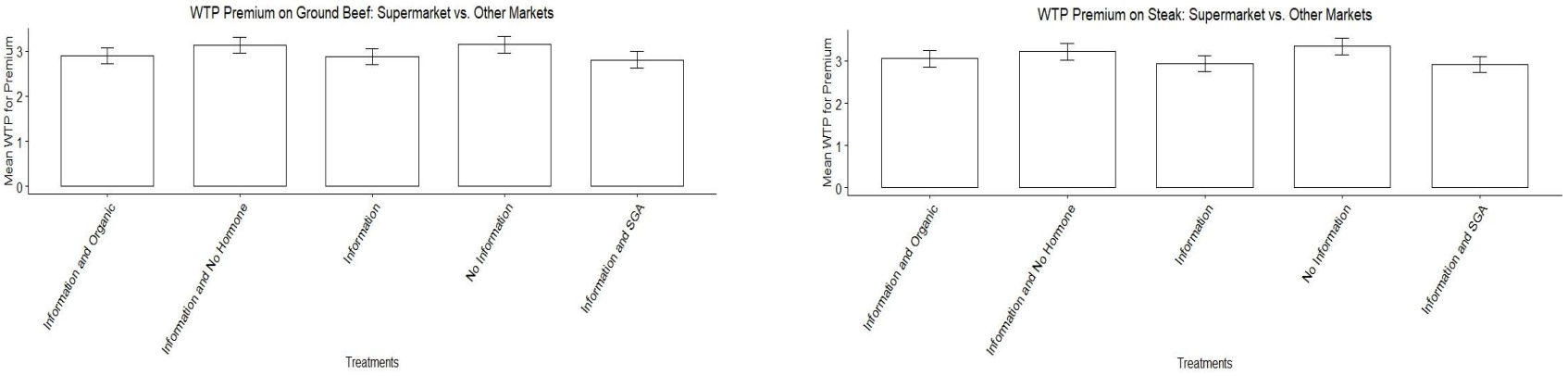
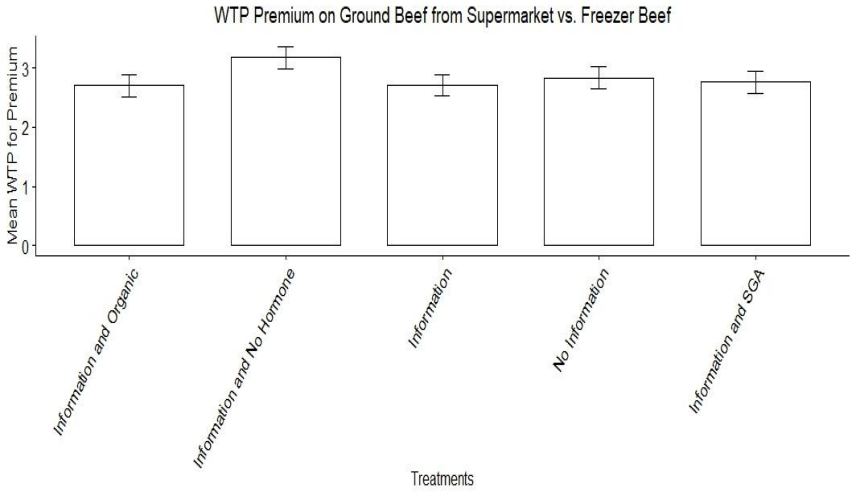


Figure 10: Mean WTP Premiums Across Different Treatments for Ground Beef/Steak – Supermarket vs. Freezer Beef



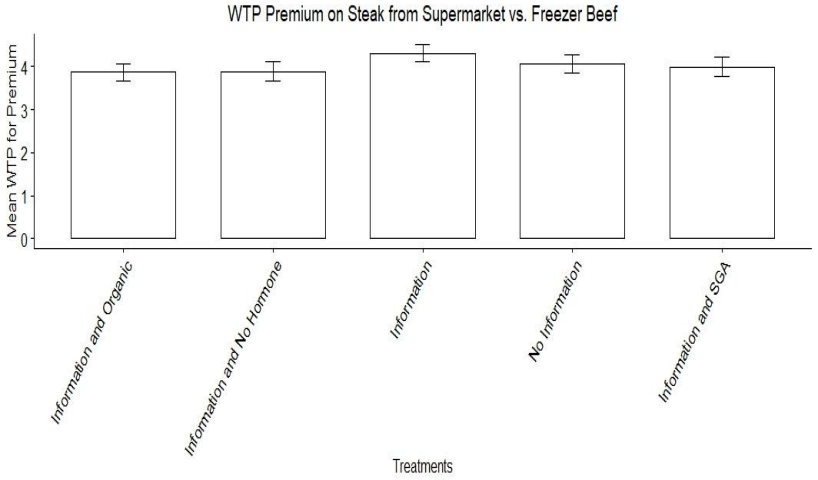
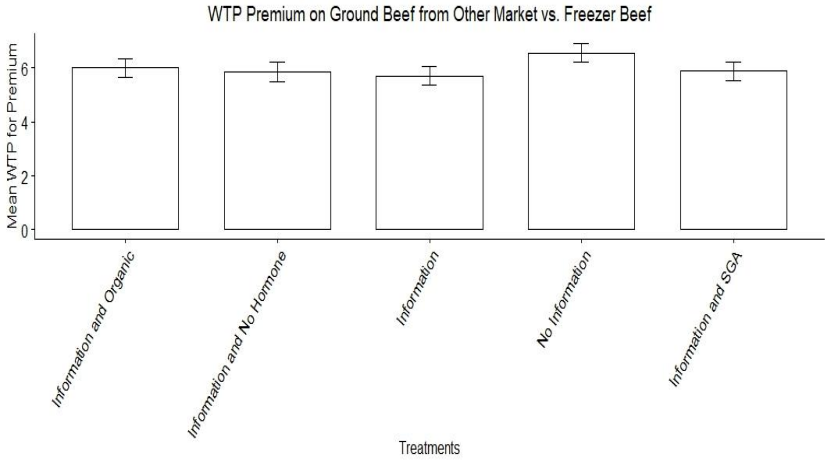
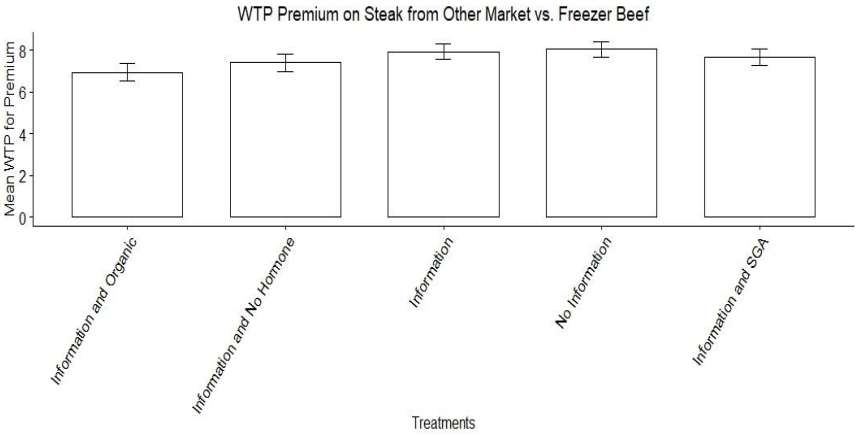


Figure 11: Mean WTP Premiums Across Different Treatments for Ground Beef/Steak – Other Markets vs. Freezer Beef





Tables: Willingness-to-pay a Premium on Beef: Supermarket versus Direct-to-consumer Valuation in Alabama

Table 1: Multiple Price Listing (MPL) for Different Choice Questions

Table 1: Multiple Price List (MPL) for different Choice Questions

Panel A:

Supermarket (Ground Beef – GB) vs. Other markets (GB)

1.	Supermarket (GB) at $4/lb	vs.	Other markets (GB) at $8/lb
2.	Supermarket (GB) at $4/lb	vs.	Other markets (GB) at $7.5/lb
3.	Supermarket (GB) at $4/lb	vs.	Other markets (GB) at $7/lb
4.	Supermarket (GB) at $4/lb	vs.	Other markets (GB) at $6.5/lb
5.	Supermarket (GB) at $4/lb	vs.	Other markets (GB) at $6/lb
6.	Supermarket (GB) at $4/lb	vs.	Other markets (GB) at $5.5/lb
7.	Supermarket (GB) at $4/lb	vs.	Other markets (GB) at $5/lb
8.	Supermarket (GB) at $4/lb	vs.	Other markets (GB) at $4.5/lb
9.	Supermarket (GB) at $4/lb	vs.	Other markets (GB) at $4/lb
10.	Supermarket (GB) at $4/lb	vs.	Other markets (GB) at $3.5/lb
11.	Supermarket (GB) at $4/lb	vs.	Other markets (GB) at $3/lb
12.	Supermarket (GB) at $4/lb	vs.	Other markets (GB) at $2.5/lb
13.	Supermarket (GB) at $4/lb	vs.	Other markets (GB) at $2/lb

Panel B:

Supermarket (Steak) vs. Other markets (Steak)

1.	Supermarket (Steak) at $10/lb	vs.	Other markets (Steak) at $14/lb
2.	Supermarket (Steak) at $10/lb	vs.	Other markets (Steak) at $13.5/lb
3.	Supermarket (Steak) at $10/lb	vs.	Other markets (Steak) at $13/lb
4.	Supermarket (Steak) at $10/lb	vs.	Other markets (Steak) at $12.5/lb
5.	Supermarket (Steak) at $10/lb	vs.	Other markets (Steak) at $12/lb
6.	Supermarket (Steak) at $10/lb	vs.	Other markets (Steak) at $11.5/lb
7.	Supermarket (Steak) at $10/lb	vs.	Other markets (Steak) at $11/lb
8.	Supermarket (Steak) at $10/lb	vs.	Other markets (Steak) at $10.5/lb
9.	Supermarket (Steak) at $10/lb	vs.	Other markets (Steak) at $10/lb
10.	Supermarket (Steak) at $10/lb	vs.	Other markets (Steak) at $9.5/lb
11.	Supermarket (Steak) at $10/lb	vs.	Other markets (Steak) at $9/lb
12.	Supermarket (Steak) at $10/lb	vs.	Other markets (Steak) at $8.5/lb
13.	Supermarket (Steak) at $10/lb	vs.	Other markets (Steak) at $8/lb

Panel C:

Supermarket (GB) vs. Freezer Beef

1.	Supermarket (GB) at $4/lb	vs.	Freezer Beef at $8/lb
2.	Supermarket (GB) at $4/lb	vs.	Freezer Beef at $7.5/lb
3.	Supermarket (GB) at $4/lb	vs.	Freezer Beef at $7/lb
4.	Supermarket (GB) at $4/lb	vs.	Freezer Beef at $6.5/lb
5.	Supermarket (GB) at $4/lb	vs.	Freezer Beef at $6/lb
6.	Supermarket (GB) at $4/lb	vs.	Freezer Beef at $5.5/lb
7.	Supermarket (GB) at $4/lb	vs.	Freezer Beef at $5/lb
8.	Supermarket (GB) at $4/lb	vs.	Freezer Beef at $4.5/lb
9.	Supermarket (GB) at $4/lb	vs.	Freezer Beef at $4/lb
10.	Supermarket (GB) at $4/lb	vs.	Freezer Beef at $3.5/lb
11.	Supermarket (GB) at $4/lb	vs.	Freezer Beef at $3/lb
12.	Supermarket (GB) at $4/lb	vs.	Freezer Beef at $2.5/lb
13.	Supermarket (GB) at $4/lb	vs.	Freezer Beef at $2/lb

Panel D:

Supermarket (Steak) vs. Freezer Beef

1.	Supermarket (Steak) at $10/lb	vs.	Freezer Beef at $8/lb
2.	Supermarket (Steak) at $10/lb	vs.	Freezer Beef at $7.5/lb
3.	Supermarket (Steak) at $10/lb	vs.	Freezer Beef at $7/lb
4.	Supermarket (Steak) at $10/lb	vs.	Freezer Beef at $6.5/lb
5.	Supermarket (Steak) at $10/lb	vs.	Freezer Beef at $6/lb
6.	Supermarket (Steak) at $10/lb	vs.	Freezer Beef at $5.5/lb
7.	Supermarket (Steak) at $10/lb	vs.	Freezer Beef at $5/lb
8.	Supermarket (Steak) at $10/lb	vs.	Freezer Beef at $4.5/lb
9.	Supermarket (Steak) at $10/lb	vs.	Freezer Beef at $4/lb
10.	Supermarket (Steak) at $10/lb	vs.	Freezer Beef at $3.5/lb
11.	Supermarket (Steak) at $10/lb	vs.	Freezer Beef at $3/lb
12.	Supermarket (Steak) at $10/lb	vs.	Freezer Beef at $2.5/lb
13.	Supermarket (Steak) at $10/lb	vs.	Freezer Beef at $2/lb

Panel E:

1.	Other Markets (GB) at $2/lb	vs.	Freezer Beef at $8/lb

Panel F:

1.	Other Markets (Steak) at $8/lb	vs.	Freezer Beef at $8/lb

2.	Other Markets (GB) at $2.50/lb	vs.	Freezer Beef at $7.5/lb	2.	Other Markets (Steak) at $8.50/lb	vs.	Freezer Beef at $7.5/lb
3.	Other Markets (GB) at $3/lb	vs.	Freezer Beef at $7/lb	3.	Other Markets (Steak) at $9/lb	vs.	Freezer Beef at $7/lb
4.	Other Markets (GB) at $3.50/lb	vs.	Freezer Beef at $6.5/lb	4.	Other Markets (Steak) at $9.50/lb	vs.	Freezer Beef at $6.5/lb
5.	Other Markets (GB) at $4/lb	vs.	Freezer Beef at $6/lb	5.	Other Markets (Steak) at $10/lb	vs.	Freezer Beef at $6/lb
6.	Other Markets (GB) at $4.50/lb	vs.	Freezer Beef at $5.5/lb	6.	Other Markets (Steak) at $10.50/lb	vs.	Freezer Beef at $5.5/lb
7.	Other Markets (GB) at $5/lb	vs.	Freezer Beef at $5/lb	7.	Other Markets (Steak) at $11/lb	vs.	Freezer Beef at $5/lb
8.	Other Markets (GB) at $5.50/lb	vs.	Freezer Beef at $4.5/lb	8.	Other Markets (Steak) at $11.50/lb	vs.	Freezer Beef at $4.5/lb
9.	Other Markets (GB) at $6/lb	vs.	Freezer Beef at $4/lb	9.	Other Markets (Steak) at $12/lb	vs.	Freezer Beef at $4/lb
10.	Other Markets (GB) at $6.50/lb	vs.	Freezer Beef at $3.5/lb	10.	Other Markets (Steak) at $12.50/lb	vs.	Freezer Beef at $3.5/lb
11.	Other Markets (GB) at $7/lb	vs.	Freezer Beef at $3/lb	11.	Other Markets (Steak) at $13/lb	vs.	Freezer Beef at $3/lb
12.	Other Markets (GB) at $7.50/lb	vs.	Freezer Beef at $2.5/lb	12.	Other Markets (Steak) at $13.50/lb	vs.	Freezer Beef at $2.5/lb
13.	Other Markets (GB) at $8/lb	vs.	Freezer Beef at $2/lb	13.	Other Markets (Steak) at $14/lb	vs.	Freezer Beef at $2/lb

Table 2: Summary Statistics for all Variables (Full Sample)

Variables		Units	Obs.	Mean	SD	Min	Max	Average from the ACS Data
Demographic variables								
Household size	Numeric	#s	965	2.678	1.554	1	19	2.500
Median income	$USD across different brackets	Ordinal	965	56813.47	41397.29	25,000	225,000	53,913.00
Age:	Young (between 18 – 24 years old)	Dummy	965	0.096	0.295	0	1	0.093
	Middle (between 25 – 54 years old)	Dummy	965	0.585	0.493	0	1	0.375
	Old (55 years and older)	Dummy	965	0.318	0.466	0	1	0.310
Gender:	Female	Dummy	965	0.615	0.487	0	1	0.515
	Male	Dummy	965	0.381	0.486	0	1	0.485
Educational level:	Some/above college education	Dummy	965	0.701	0.458	0	1	0.567
	Some/full high school	Dummy	965	0.299	0.458	0	1	0.433
Location:	Rural	Dummy	965	0.397	0.490	0	1	
	Suburban	Dummy	965	0.389	0.488	0	1	
	Urban	Dummy	965	0.214	0.411	0	1	
Primary purchaser of food:	Yes	Dummy	965	0.618	0.486	0	1	
	No (Others)	Dummy	965	0.382	0.486	0	1	
Ownership of freezer	Yes	Dummy	965	0.400	0.490	0	1	
	No	Dummy	965	0.600	0.490	0	1	
Definition of freezer beef	Correct	Dummy	965	0.264	0.441	0	1	
	Otherwise	Dummy	965	0.736	0.441	0	1	
Race	White	Dummy	965	0.744	0.437	0	1	0.651
	Black	Dummy	965	0.246	0.429	0	1	0.259

Table 3: Distribution of Consumers that select the "Neither" options vs. In-market options

Options	Supermarket vs. Other Markets		Supermarket vs. Freezer Beef		Other Markets vs. Freezer Beef		Total
	Ground beef	Steak	Ground beef	Steak	Ground beef	Steak	
Sample for the "Neither" options	77	166	85	125	119	161	733
In-market sample							
Zero WTP Premium (Supermarket)	245	189	283	216	221	180	1,334
> Zero WTP Premium (Indifferent, Discount or Premium)	643	610	597	624	625	624	3,723
Total for In-market sample	888	799	880	840	846	804	5,057
Gross total ("Neither option and in-market sample)	**965**	**965**	**965**	**965**	**965**	**965**	**5,790**

Table 4: Summary Statistics for Consumer that select the "Neither" option

Variables		Units	Obs.	Mean	SD	Min	Max
Household size	Numeric	#s	733	2.453	1.441	1	10
Median income	$USD across different brackets	Ordinal	733	42,189.63	32,714.42	25000	225000
Age:	Young (between 18 – 24 years old)	Dummy	733	0.082	0.274	0	1
	Middle (between 25 – 54 years old)	Dummy	733	0.516	0.500	0	1
	Old (55 years and older)	Dummy	733	0.402	0.491	0	1
Gender:	Female	Dummy	733	0.674	0.470	0	1
	Male	Dummy	733	0.326	0.468	0	1
Educational level:	Some/above college education	Dummy	733	0.630	0.483	0	1
	Some/full high school	Dummy	733	0.370	0.483	0	1
Location:	Rural	Dummy	733	0.417	0.493	0	1
	Suburban	Dummy	733	0.371	0.483	0	1
	Urban	Dummy	733	0.211	0.409	0	1
Primary purchaser of food:	Yes	Dummy	733	0.603	0.490	0	1
	No (Others)	Dummy	733	0.397	0.490	0	1
Ownership of freezer	Yes	Dummy	733	0.500	0.500	0	1
	No	Dummy	733	0.500	0.500	0	1
Definition of freezer beef	Correct	Dummy	733	0.216	0.411	0	1
	Otherwise	Dummy	733	0.784	0.411	0	1
Race	White	Dummy	733	0.727	0.445	0	1
	Black	Dummy	733	0.273	0.449	0	1

Table 5: Summary Statistics for the Choice Problems

Choice Problems	Treatments	Units	Obs.	Mean	SD	Min	Max
Premium on Ground Beef from Supermarket vs. Other Markets	No information treatment	Dummy	183	3.142	2.503	0	6.5
	Information treatment	Dummy	170	2.883	2.237	0	6.5
	Information and organic treatment	Dummy	180	2.896	2.461	0	6.5
	Information and hormone-free treatment	Dummy	188	3.131	2.374	0	6.5
	Information and SGA treatment	Dummy	167	2.808	2.283	0	6.5
	Total		**888**				
Premium on Steak from Supermarket vs. Other Markets	No information treatment	Dummy	166	3.340	2.514	0	6.5
	Information treatment	Dummy	150	2.937	2.317	0	6.5
	Information and organic treatment	Dummy	162	3.048	2.522	0	6.5
	Information and hormone-free treatment	Dummy	166	3.219	2.481	0	6.5
	Information and SGA treatment	Dummy	155	2.916	2.331	0	6.5
	Total		**799**				
Premium on Ground Beef from Supermarket vs. Freezer Beef	No information treatment	Dummy	184	2.832	2.450	0	6.5
	Information treatment	Dummy	168	2.699	2.269	0	6.5
	Information and organic treatment	Dummy	178	2.698	2.497	0	6.5
	Information and hormone-free treatment	Dummy	184	3.169	2.505	0	6.5
	Information and SGA treatment	Dummy	166	2.759	2.462	0	6.5
	Total		**880**				
Premium on Steak from Supermarket vs. Freezer Beef	No information treatment	Dummy	177	4.053	2.787	0	6.5
	Information treatment	Dummy	159	4.308	2.562	0	6.5
	Information and organic treatment	Dummy	169	3.866	2.859	0	6.5
	Information and hormone-free treatment	Dummy	175	3.885	2.742	0	6.5
	Information and SGA treatment	Dummy	160	3.994	2.742	0	6.5
	Total		**840**				
Premium on Ground Beef from Other Markets vs. Freezer Beef	No information treatment	Dummy	178	6.548	4.669	0	12.5
	Information treatment	Dummy	167	5.701	4.356	0	12.5
	Information and organic treatment	Dummy	164	5.853	4.764	0	12.5
	Information and hormone-free treatment	Dummy	172	5.997	4.506	0	12.5
	Information and SGA treatment	Dummy	165	5.876	4.528	0	12.5
	Total		**846**				

Premium on Steak from Other Markets vs. Freezer Beef	No information treatment	Dummy	168	8.054	4.727	0	12.5
	Information treatment	Dummy	161	7.947	4.808	0	12.5
	Information and organic treatment	Dummy	152	7.418	5.074	0	12.5
	Information and hormone-free treatment	Dummy	165	6.945	5.298	0	12.5
	Information and SGA treatment	Dummy	160	7.684	4-806	0	12.5
	Total		**840**				

Table 6: Summary Statistics for the Demographic Variables in the In-market Sample

Variables		**Units**	**Obs.**	**Mean**	**SD**	**Min**	**Max**
Demographic variables							
Household size	Numeric	#s	5,057	2.710	1.567	1	19
Median income	$USD across different brackets	Ordinal	5,057	58,933.16	42,090.05	25,000	225,000
Age:	Young (between 18 – 24 years old)	Dummy	5,057	0.0985	0.298	0	1
	Middle (between 25 – 54 years old)	Dummy	5,057	0.596	0.491	0	1
	Old (55 years and older)	Dummy	5,057	0.306	0.461	0	1
Gender:	Female	Dummy	5,057	0.606	0.489	0	1
	Male	Dummy	5,057	0.394	0.488	0	1
Educational level:	Some/above college education	Dummy	5,057	0.711	0.453	0	1
	Some/full high school	Dummy	5,057	0.289	0.453	0	1
Location:	Rural	Dummy	5,057	0.394	0.489	0	1
	Suburban	Dummy	5,057	0.392	0.488	0	1
	Urban	Dummy	5,057	0.214	0.411	0	1
Primary purchaser of food:	Yes	Dummy	5,057	0.619	0.486	0	1
	No (Others)	Dummy	5,057	0.381	0.485	0	1
Ownership of freezer	Yes	Dummy	5,057	0.614	0.487	0	1
	No	Dummy	5,057	0.386	0.487	0	1
Definition of freezer beef	Correct	Dummy	5,057	0.271	0.445	0	1
	Otherwise	Dummy	5,057	0.729	0.445	0	1
Race	White	Dummy	5,057	0.747	0.445	0	1
	Black	Dummy	5,057	0.253	0.426	0	1

Table 7: Choice of Model Specification

Choice Problems	LR Statistic	Critical $X^2_{(k,\ 0.05)}$	Decision Rule
1. Ground Beef from Supermarket vs. Other markets	112.2 (122.4)	23.685	Reject H_0 in favor of H_A
2. Steak from vs. Supermarket Other markets	36.7 (59.4)	23.685	Reject H_0 in favor of H_A
3. Ground Beef from Supermarket vs. Freezer Beef	70.3 (83. 9)	23.685	Reject H_0 in favor of H_A
4. Steak from Supermarket vs. Freezer Beef	59.3 (63.2)	23.685	Reject H_0 in favor of H_A
5. Ground Beef from Other markets vs. Freezer beef	14.6 (15.22)	23.685	We do not reject H_0 in favor of H_A
6. Steak Beef from Other markets vs. Freezer beef	9.7 (9.9)	23.685	We do not reject H_0 in favor of H_A

Notes:
Values in parenthesis represent the LR Statistics of the full model.

Table 8: Average Marginal Effects for the First Hurdle (WTC or Participation Model) – Probit Model Estimation

	Dependent variable: WTP Premium			
	Supermarket vs. Other markets		Supermarket vs. Freezer Beef	
Variables	**Ground beef**	**Steak**	**Ground beef**	**Steak**
Treatment (Base: Information treatment)				
No information treatment	0.211	0.342	0.185	-0.295
	(0.237)	(0.261)	(0.244)	(0.296)
Information and organic treatment	-0.0559	0.0232	-0.0409	-0.464
	(0.237)	(0.262)	(0.246)	(0.294)
Information and hormone-free treatment	0.190	0.313	0.423	-0.467
	(0.238)	(0.264)	(0.245)	(0.298)
Information and SGA treatment	-0.131	-0.0468	0.0183	-0.348
	(0.243)	(0.266)	(0.250)	(0.299)
Household level characteristics				
Household size	0.119***	0.0223	0.0280	-0.0141
	(0.0462)	(0.0494)	(0.0477)	(0.0592)
Median income	3.31e-06*	3.71e-06*	-9.67e-07	-2.37e-06
	(1.92e-06)	(2.13e-06)	(2.00e-06)	(2.34e-06)
Age (Base: Young)				
Middle	-0.615**	-0.691**	-0.570**	-0.150
	(0.277)	(0.287)	(0.280)	(0.320)
Old	-1.289***	-1.481***	-1.522***	-0.470
	(0.301)	(0.323)	(0.305)	(0.360)
Location (Base: Rural)				
Suburban	-0.0610	-0.0368	-0.185	0.0540
	(0.175)	(0.194)	(0.181)	(0.218)
Urban	0.328	0.0843	0.157	-0.382
	(0.210)	(0.228)	(0.219)	(0.256)
Gender (Base: Male)				
Female	-0.294*	-0.0877	-0.370**	-0.746***
	(0.160)	(0.175)	(.163)	(0.196)
Educational level (Base: Some/full high school)				
Some/above college education	-0.00890	0.0153	0.141	-0.129
	(0.174)	(0.190)	(0.179)	(0.214)
Primary purchaser of food (Base: No)				
Yes	-0.0186	0.0245	0.0863	-0.0761
	(0.144)	(0.153)	(0.148)	(0.187)
Ownership of freezer (Base: No)				

Yes	0.511***	0.349**	0.639***	0.391**
	(0.140)	(0.151)	(0.144)	(0.184)
Definition of freezer beef (Base: Otherwise)				
Correct	0.464***	0.549***	0.493***	0.767***
	(0.155)	(0.167)	(0.159)	(0.201)
Race (Base: White)				
Black	0.547**	0.504**	0.569***	-0.00607
	(0.191)	(0.209)	(0.200)	(0.233)

Notes:
Standard errors are in parenthesis
One (*), two (**), three (***) asterisks represent 0.10, 0.05, and 0.01 levels of statistical significance, respectively

Table 9: Average Marginal Effects for the Second Hurdle (WTP Model) – Truncated Model Estimation

	Dependent variable: WTP Premium			
	Supermarket vs. Other markets		Supermarket vs. Freezer Beef	
Variables	**Ground beef**	**Steak**	**Ground beef**	**Steak**
Treatment (Base: Information treatment)				
No information treatment	0.406*	0.353	0.433*	1.457**
	(0.213)	(0.313)	(0.252)	(0.607)
Information and organic treatment	0.274	0.369	0.0810	-0.0760
	(0.208)	(0.312)	(0.257)	(0.524)
Information and hormone-free treatment	0.520**	0.772**	0.511**	1.101*
	(0.211)	(0.323)	(0.256)	(0.606)
Information and SGA treatment	0.244	0.186	0.0823	0.407
	(0.207)	(0.305)	(0.254)	(0.538)
Household level characteristics				
Median income	2.02e-06	5.74e-07	-4.84e-07	-2.50e-06
	(1.70e-06)	(2.67e-06)	(2.13e-06)	(4.48e-06)
Age (Base: Young)				
Middle	-0.229	-0.338	-0.602*	-0.452
	(0.263)	(0.361)	(0.311)	(0.610)
Old	-1.128***	-1.588***	-1.586***	-2.233***
	(0.276)	(0.404)	(0.336)	(0.727)
Location (Base: Rural)				
Suburban	0.00805	0.0657	-0.166	0.162
	(0.151)	(0.226)	(0.187)	(0.413)
Urban	0.440**	0.247	0.0995	0.143
	(0.198)	(0.283)	(0.243)	(0.494)
Gender (Base: Male)				
Female	0.101	0.219	0.113	-0.698*
	(0.140)	(0.207)	(0.169)	(0.390)
Educational level (Base: Some/full high school)				
Some/above college education	-0.100	0.120	0.186	-0.214
	(0.163)	(0.236)	(0.196)	(0.406)
Race (Base: White)				
Black	0.880***	1.146***	1.0309***	0.439
	(0.182)	(0.272)	(0.232)	(0.458)

Notes:
Standard errors are in parenthesis
One (*), two (**), three (***) asterisks represent 0.10, 0.05, and 0.01 levels of statistical significance, respectively

Table 10: Average Marginal Effects for Choices in the DTC Market – Tobit Model

	Dependent variable: WTP Premium	
	Other markets vs. Freezer Beef	Other markets vs. Freezer Beef
Variables	**Ground beef**	**Steak**
Treatment (Base: Information treatment)		
No information treatment	0.497*	0.185
	(0.289)	(0.518)
Information and organic treatment	0.265	-0.614
	(0.290)	(0.521)
Information and hormone-free treatment	0.0113**	-0.478
	(0.293)	(0.529)
Information and SGA treatment	0.0696	0.246
	(0.290)	(0.521)
Household level characteristics		
Household size	0.0162	0.0226
	(0.0635)	(0.113)
Median income	-3.64e-06	-7.59e-06*
	(2.37e-06)	(4.25e-06)
Age (Base: Young)		
Middle	-0.554	0.791
	(0.342)	(0.567)
Old	-0.971***	0.270
	(0.376)	(0.640)
Location (Base: Rural)		
Suburban	0.160	0.0280
	(0.218)	(0.391)
Urban	-0.0135	-0.555
	(0.263)	(0.386)
Gender (Base: Male)		
Female	-0.316	-0.794**
	(0.198)	(0.352)
Educational level (Base: Some/full high school)		
Some/above college education	0.135	-0.597
	(0.216)	(0.386)
Primary purchaser of food (Base: No)		
Yes	-0.0722	-0.276
	(0.198)	(0.352)
Ownership of freezer (Base: No)		
Yes	1.041***	1.038***
	(0.186)	(0.348)
Definition of freezer beef (Base: Otherwise)		
Correct	0.393*	0.436
	(0.213)	(0.381)
Race (Base: White)		
Black	0.424*	0.580
	(0.241)	(0.421)

Notes:
Standard errors are in parenthesis
One (*), two (**), three (***) asterisks represent 0.10, 0.05, and 0.01 levels of statistical significance, respectively

Appendices: Willingness-to-pay a Premium on Beef:

Supermarket versus Direct-to-consumer Valuation in Alabama

Appendix A: The Multiple Price Lists (MPL) Tasks

Table 11: Supermarket Ground Beef vs. Ground Beef from Other Markets

	Supermarket Choice (on left)	Neither Choice (middle)	Freezer Beef Choice (on right)	
	1 (1)	2 (2)	3 (3)	
Supermarket Ground Beef at $4/lb	○	○	○	Farmstand, Farmer's Market, or Meat Market Ground Beef at $8/lb
Supermarket Ground Beef at $4/lb	○	○	○	Farmstand, Farmer's Market, or Meat Market Ground Beef at $7.50/lb
Supermarket Ground Beef at $4/lb	○	○	○	Farmstand, Farmer's Market, or Meat Market Ground Beef at $7/lb
Supermarket Ground Beef at $4/lb	○	○	○	Farmstand, Farmer's Market, or Meat Market Ground Beef at $6.50/lb
Supermarket Ground Beef at $4/lb	○	○	○	Farmstand, Farmer's Market, or Meat Market Ground Beef at $6/lb
Supermarket Ground Beef at $4/lb	○	○	○	Farmstand, Farmer's Market, or Meat Market at $5.50/lb
Supermarket Ground Beef at $4/lb	○	○	○	Farmstand, Farmer's Market, or Meat Market at $5/lb
Supermarket Ground Beef at $4/lb	○	○	○	Farmstand, Farmer's Market, or Meat Market at $4.50/lb
Supermarket Ground Beef at $4/lb	○	○	○	Farmstand, Farmer's Market, or Meat Market at $4/lb
Supermarket Ground Beef at $4/lb	○	○	○	Farmstand, Farmer's Market, or Meat Market at $3.50/lb
Supermarket Ground Beef at $4/lb	○	○	○	Farmstand, Farmer's Market, or Meat Market at $3/lb
Supermarket Ground Beef at $4/lb	○	○	○	Farmstand, Farmer's Market, or Meat Market at $2.50/lb
Supermarket Ground Beef at $4/lb	○	○	○	Farmstand, Farmer's Market, or Meat Market at $2/lb

Table 12: Supermarket Steak vs. Steak from Other Markets

	Supermarket Choice (on left)	Neither Choice (middle)	Freezer Beef Choice (on right)	
	1 (1)	2 (2)	3 (3)	
Supermarket Ground Steak at $10/lb	○	○	○	Farmstand, Farmer's Market, or Meat Market Steak at $14/lb
Supermarket Ground Steak at $10/lb	○	○	○	Farmstand, Farmer's Market, or Meat Market Steak at $13.50/lb
Supermarket Ground Steak at $10/lb	○	○	○	Farmstand, Farmer's Market, or Meat Market Steak at $13/lb
Supermarket Ground Steak at $10/lb	○	○	○	Farmstand, Farmer's Market, or Meat Market Steak at $12.50/lb
Supermarket Ground Steak at $10/lb	○	○	○	Farmstand, Farmer's Market, or Meat Market Steak at $12/lb
Supermarket Ground Steak at $10/lb	○	○	○	Farmstand, Farmer's Market, or Meat Market Steak at $11.5/lb
Supermarket Ground Steak at $10/lb	○	○	○	Farmstand, Farmer's Market, or Meat Market at $11/lb
Supermarket Ground Steak at $10/lb	○	○	○	Farmstand, Farmer's Market, or Meat Market at $10.50/lb
Supermarket Ground Steak at $10/lb	○	○	○	Farmstand, Farmer's Market, or Meat Market at $10/lb
Supermarket Ground Steak at $10/lb	○	○	○	Farmstand, Farmer's Market, or Meat Market at $9.50/lb
Supermarket Ground Steak at $10/lb	○	○	○	Farmstand, Farmer's Market, or Meat Market at $9/lb
Supermarket Ground Steak at $10/lb	○	○	○	Farmstand, Farmer's Market, or Meat Market at $8.50/lb
Supermarket Ground Steak at $10/lb	○	○	○	Farmstand, Farmer's Market, or Meat Market at $8/lb

Table 13: Supermarket Ground Beef vs. Freezer Beef (Assorted cuts)

	Supermarket Choice (on left)	Neither Choice (middle)	Freezer Beef Choice (on right)	
	1 (1)	2 (2)	3 (3)	
Supermarket Ground Beef at $4/lb	○	○	○	Freezer Beef Assorted Cuts at $8/lb
Supermarket Ground Beef at $4/lb	○	○	○	Freezer Beef Assorted Cuts at $7.50/lb
Supermarket Ground Beef at $4/lb	○	○	○	Freezer Beef Assorted Cuts at $7/lb
Supermarket Ground Beef at $4/lb	○	○	○	Freezer Beef Assorted Cuts at $6.50/lb
Supermarket Ground Beef at $4/lb	○	○	○	Freezer Beef Assorted Cuts at $6/lb
Supermarket Ground Beef at $4/lb	○	○	○	Freezer Beef Assorted Cuts at $5.50/lb
Supermarket Ground Beef at $4/lb	○	○	○	Freezer Beef Assorted Cuts at $5/lb
Supermarket Ground Beef at $4/lb	○	○	○	Freezer Beef Assorted Cuts at $4.50/lb
Supermarket Ground Beef at $4/lb	○	○	○	Freezer Beef Assorted Cuts at $4/lb
Supermarket Ground Beef at $4/lb	○	○	○	Freezer Beef Assorted Cuts at $3.50/lb
Supermarket Ground Beef at $4/lb	○	○	○	Freezer Beef Assorted Cuts at $3/lb
Supermarket Ground Beef at $4/lb	○	○	○	Freezer Beef Assorted Cuts at $2.50/lb
Supermarket Ground Beef at $4/lb	○	○	○	Freezer Beef Assorted Cuts at $2/lb

Table 14: Supermarket Steak vs. Freezer Beef (Assorted cuts)

	Supermarket Choice (on left)	Neither Choice (middle)	Freezer Beef Choice (on right)	
	1 (1)	2 (2)	3 (3)	
Supermarket Steak at $10/lb	○	○	○	Freezer Beef Assorted Cuts at $8/lb
Supermarket Steak at $10/lb	○	○	○	Freezer Beef Assorted Cuts at $7.50/lb
Supermarket Steak at $10/lb	○	○	○	Freezer Beef Assorted Cuts at $7/lb
Supermarket Steak at $10/lb	○	○	○	Freezer Beef Assorted Cuts at $6.50/lb
Supermarket Steak at $10/lb	○	○	○	Freezer Beef Assorted Cuts at $6/lb
Supermarket Steak at $10/lb	○	○	○	Freezer Beef Assorted Cuts at $5.50/lb
Supermarket Steak at $10/lb	○	○	○	Freezer Beef Assorted Cuts at $5/lb
Supermarket Steak at $10/lb	○	○	○	Freezer Beef Assorted Cuts at $4.50/lb
Supermarket Steak at $10/lb	○	○	○	Freezer Beef Assorted Cuts at $4/lb
Supermarket Steak at $10/lb	○	○	○	Freezer Beef Assorted Cuts at $3.50/lb
Supermarket Steak at $10/lb	○	○	○	Freezer Beef Assorted Cuts at $3/lb
Supermarket Steak at $10/lb	○	○	○	Freezer Beef Assorted Cuts at $2.50/lb
Supermarket Steak at $10/lb	○	○	○	Freezer Beef Assorted Cuts at $2/lb

Table 15: Other markets (Ground Beef) vs. Freezer Beef (Assorted cuts)

	Supermarket Choice (on left)	Neither Choice (middle)	Freezer Beef Choice (on right)	
	1 (1)	2 (2)	3 (3)	
Farmstand, Farmer's Market, or Meat Market Ground Beef at $2/lb	○	○	○	Freezer Beef Assorted Cuts at $8/lb
Farmstand, Farmer's Market, or Meat Market Ground Beef at $2.50/lb	○	○	○	Freezer Beef Assorted Cuts at $7.50/lb
Farmstand, Farmer's Market, or Meat Market Ground Beef at $3/lb	○	○	○	Freezer Beef Assorted Cuts at $7/lb
Farmstand, Farmer's Market, or Meat Market Ground Beef at $3.50/lb	○	○	○	Freezer Beef Assorted Cuts at $6.50/lb
Farmstand, Farmer's Market, or Meat Market Ground Beef at $4/lb	○	○	○	Freezer Beef Assorted Cuts at $6/lb
Farmstand, Farmer's Market, or Meat Market Ground Beef at $4.50/lb	○	○	○	Freezer Beef Assorted Cuts at $5.50/lb
Farmstand, Farmer's Market, or Meat Market Ground Beef at $5/lb	○	○	○	Freezer Beef Assorted Cuts at $5/lb
Farmstand, Farmer's Market, or Meat Market Ground Beef at $5.50/lb	○	○	○	Freezer Beef Assorted Cuts at $4.50/lb
Farmstand, Farmer's Market, or Meat Market Ground Beef at $6/lb	○	○	○	Freezer Beef Assorted Cuts at $4/lb
Farmstand, Farmer's Market, or Meat Market Ground Beef at $6.50/lb	○	○	○	Freezer Beef Assorted Cuts at $3.50/lb
Farmstand, Farmer's Market, or Meat Market Ground Beef at $7/lb	○	○	○	Freezer Beef Assorted Cuts at $3/lb
Farmstand, Farmer's Market, or Meat Market Ground Beef at $7.50/lb	○	○	○	Freezer Beef Assorted Cuts at $2.50/lb
Farmstand, Farmer's Market, or Meat Market Ground Beef at $8/lb	○	○	○	Freezer Beef Assorted Cuts at $2/lb

Table 16: Other markets (Steak) vs. Freezer Beef (Assorted cuts)

	Supermarket Choice (on left)	Neither Choice (middle)	Freezer Beef Choice (on right)	
	1 (1)	2 (2)	3 (3)	
Farmstand, Farmer's Market, or Meat Market Steak at $8/lb	○	○	○	Freezer Beef Assorted Cuts at $8/lb
Farmstand, Farmer's Market, or Meat Market Steak at $8.50/lb	○	○	○	Freezer Beef Assorted Cuts at $7.50/lb
Farmstand, Farmer's Market, or Meat Market Steak at $9/lb	○	○	○	Freezer Beef Assorted Cuts at $7/lb
Farmstand, Farmer's Market, or Meat Market Steak at $9.50/lb	○	○	○	Freezer Beef Assorted Cuts at $6.50/lb
Farmstand, Farmer's Market, or Meat Market Steak at $10/lb	○	○	○	Freezer Beef Assorted Cuts at $6/lb
Farmstand, Farmer's Market, or Meat Market Steak at $10.50/lb	○	○	○	Freezer Beef Assorted Cuts at $5.50/lb
Farmstand, Farmer's Market, or Meat Market Steak at $11/lb	○	○	○	Freezer Beef Assorted Cuts at $5/lb
Farmstand, Farmer's Market, or Meat Market Steak at $11.50/lb	○	○	○	Freezer Beef Assorted Cuts at $4.50/lb
Farmstand, Farmer's Market, or Meat Market Steak at $12/lb	○	○	○	Freezer Beef Assorted Cuts at $4/lb
Farmstand, Farmer's Market, or Meat Market Steak at $12.50/lb	○	○	○	Freezer Beef Assorted Cuts at $3.50/lb
Farmstand, Farmer's Market, or Meat Market Steak at $13/lb	○	○	○	Freezer Beef Assorted Cuts at $3/lb
Farmstand, Farmer's Market, or Meat Market Steak at $13.50/lb	○	○	○	Freezer Beef Assorted Cuts at $2.50/lb
Farmstand, Farmer's Market, or Meat Market Steak at $14/lb	○	○	○	Freezer Beef Assorted Cuts at $2/lb

Appendix B: Proportion of consumers across different WTP values

Table 17: WTP Premium on Beef: Supermarket (Ground Beef/Steak) vs. Other markets (GB/Steak)

WTP Premium	**Ground Beef: Other Markets vs Supermarket**			**Steak: Other Markets vs Supermarket**		
WTP Premium	Frequency	%	Cumulative %	Frequency	%	Cumulative %
$0.00	245	27.59	27.59	189	23.65	23.65
$0.50	6	0.68	28.27	19	2.38	26.03
$1.00	10	1.13	29.39	28	3.50	29.54
$1.50	21	2.36	31.76	21	2.63	32.17
$2.00	77	8.67	40.43	81	10.14	42.30
$2.50	93	10.47	50.90	71	8.89	51.19
$3.00	49	5.52	56.42	41	5.13	56.32
$3.50	52	5.86	62.27	31	3.88	60.20
$4.00	34	3.83	66.10	23	2.88	63.08
$4.50	42	4.73	70.83	34	4.26	67.33
$5.00	42	4.73	75.56	27	3.38	70.71
$5.50	45	5.07	80.63	41	5.13	75.84
$6.00	37	4.17	84.80	51	6.38	82.23
$6.50	135	15.20	100.00	142	17.77	100.00
Total	**888**	**100**		**799**	**100**	

Table 18: WTP Premium on Supermarket (Ground Beef/Steak) vs. Freezer Beef

WTP Premium	**Freezer Beef vs Supermarket (Ground Beef)**			**Freezer Beef vs Supermarket (Steak)**		
WTP Premium	Frequency	%	Cumulative %	Frequency	%	Cumulative %
$0.00	283	32.16	32.16	216	25.71	25.71
$0.50	8	0.91	33.07	9	1.07	26.79
$1.00	13	1.48	34.55	12	1.43	28.21
$1.50	23	2.61	37.16	10	1.19	29.40
$2.00	66	7.50	44.66	12	1.43	30.83
$2.50	65	7.39	52.05	24	2.86	33.69
$3.00	40	4.55	56.59	17	2.02	35.71
$3.50	45	5.11	61.70	17	2.02	37.74
$4.00	47	5.34	67.05	28	3.33	41.07
$4.50	39	4.43	71.48	27	3.21	44.29
$5.00	32	3.64	75.11	37	4.40	48.69
$5.50	54	6.14	81.25	52	6.19	54.88
$6.00	47	5.34	86.59	39	4.64	59.52
$6.50	118	13.41	100.00	340	1.07	26.79
Total	**880**	**100**		**840**	**100**	

Table 19: WTP Premium on Other market (Ground Beef/Steak) vs. Freezer Beef

WTP Premium	**Other market (Ground Beef) vs. Freezer Beef**			**Other market (Steak) vs. Freezer Beef**		
WTP Premium	Frequency	%	Cumulative %	Frequency	%	Cumulative %
$0.00	221	32.16	32.16	180	22.39	22.39
$0.50	5	0.91	33.07	10	1.24	23.63
$1.00	15	1.48	34.55	13	1.62	25.25
$1.50	23	2.61	37.16	11	1.37	26.62
$2.00	21	7.50	44.66	18	2.24	28.86
$2.50	27	7.39	52.05	23	2.86	31.72
$3.00	100	4.55	56.59	14	1.74	33.46
$3.50	99	5.11	61.70	26	3.23	36.69
$4.00	38	5.34	67.05	28	3.48	40.17
$4.50	33	4.43	71.48	31	3.86	44.03
$5.00	41	3.64	75.11	44	5.47	49.50
$5.50	44	6.14	81.25	97	12.06	61.57
$6.00	47	5.34	86.59	117	14.55	76.12
$6.50	132	13.41	100.00	192	23.88	100.00
Total	**846**	**100**		**804**	**100**	

Appendix C: Wilcox test on the Mean WTP premiums across Treatments

Table 20: Supermarket (Ground Beef) vs. Other markets (Ground Beef)

Treatments in Group 1	Treatments in Group 2	Sample of Group 1	Sample of Group 2	Statistic	p-value
Information	No Information	170	183	14536	0.281
Information	Information and Organic	170	188	15841	0.886
Information	Information and Hormone-free	170	180	14320	0.294
Information	Information and SGA	170	167	14536	0.281

Note: One (*), two (**), three (***) asterisks represent 0.10, 0.05, and 0.01 levels of statistical significance, respectively

Table 21: Supermarket (Steak) vs. Other markets (Steak)

Treatments in Group 1	Treatments in Group 2	Sample of Group 1	Sample of Group 2	Statistic	p-value
Information	No Information	150	166	11226	0.128
Information	Information and Organic	150	166	12186	0.743
Information	Information and Hormone-free	150	162	11324	0.294
Information	Information and SGA	150	155	11714	0.907

Note: One (*), two (**), three (***) asterisks represent 0.10, 0.05, and 0.01 levels of statistical significance, respectively

Table 22: Supermarket (Ground Beef) vs. Freezer Beef

Treatments in Group 1	Treatments in Group 2	Sample of Group 1	Sample of Group 2	Statistic	p-value
Information	No Information	168	184	15010	0.635
Information	Information and Organic	168	184	15548	0.922
Information	Information and Hormone-free	168	178	13240	0.062
Information	Information and SGA	168	166	13822	0.889

Note: One (*), two (**), three (***) asterisks represent 0.10, 0.05, and 0.01 levels of statistical significance, respectively

Table 23: Supermarket (Steak) vs. Freezer Beef

Treatments in Group 1	Treatments in Group 2	Sample of Group 1	Sample of Group 2	Statistic	p-value
Information	No Information	159	177	14956	0.298
Information	Information and Organic	159	175	15195	0.129
Information	Information and Hormone-free	159	169	14518	0.185
Information	Information and SGA	159	160	13592	0.269

Note: One (*), two (**), three (***) asterisks represent 0.10, 0.05, and 0.01 levels of statistical significance, respectively

Table 24: Other market (Ground Beef) vs. Freezer Beef

Treatments in Group 1	Treatments in Group 2	Sample of Group 1	Sample of Group 2	Statistic	p-value
Information	No Information	167	178	13092	0.053*
Information	Information and Organic	167	172	13586	0.385
Information	Information and Hormone-free	167	164	13325	0.667
Information	Information and SGA	167	165	13393	0.657

Note: One (*), two (**), three (***) asterisks represent 0.10, 0.05, and 0.01 levels of statistical significance, respectively

Table 25: Other market (Steak) vs. Freezer Beef

Treatments in Group 1	Treatments in Group 2	Sample of Group 1	Sample of Group 2	Statistic	p-value
Information	No Information	161	168	13616	0.915
Information	Information and Organic	161	165	14230	0.258
Information	Information and Hormone-free	161	152	12972	0.350
Information	Information and SGA	161	158	13261	0.505

Note: One (*), two (**), three (***) asterisks represent 0.10, 0.05, and 0.01 levels of statistical significance, respectively

Appendix D: Two sample T-test on the Mean WTP premiums across Treatments

Table 26: Supermarket (Ground Beef) vs. Other markets (Ground Beef)

Treatments in Group 1	Treatments in Group 2	Sample of Group 1	Sample of Group 2	t-statistic	p-value
Information	No Information	170	183	1.0249	0.3061
Information	Information and Organic	170	188	-0.0569	0.9546
Information	Information and Hormone-free	170	180	-0.9855	0.3251
Information	Information and SGA	170	167	0.3004	0.7640

Note: One (*), two (**), three (***) asterisks represent 0.10, 0.05, and 0.01 levels of statistical significance, respectively

Table 27: Supermarket (Steak) vs. Other markets (Steak)

Treatments in Group 1	Treatments in Group 2	Sample of Group 1	Sample of Group 2	t-statistic	p-value
Information	No Information	150	166	1.4795	0.1400
Information	Information and Organic	150	166	-0.4117	0.6808
Information	Information and Hormone-free	150	162	-1.0278	0.3048
Information	Information and SGA	150	155	0.0772	0.9386

Note: One (*), two (**), three (***) asterisks represent 0.10, 0.05, and 0.01 levels of statistical significance, respectively

Table 28: Supermarket (Ground Beef) vs. Freezer Beef

Treatments in Group 1	Treatments in Group 2	Sample of Group 1	Sample of Group 2	t-statistic	p-value
Information	No Information	168	184	0.5235	0.6010
Information	Information and Organic	168	184	0.0041	0.9968
Information	Information and Hormone-free	168	178	-1.8255	0.0688
Information	Information and SGA	168	166	-0.2302	0.5910

Note: One (*), two (**), three (***) asterisks represent 0.10, 0.05, and 0.01 levels of statistical significance, respectively

Table 29: Supermarket (Steak) vs. Freezer Beef

Treatments in Group 1	Treatments in Group 2	Sample of Group 1	Sample of Group 2	t-statistic	p-value
Information	No Information	159	177	-0.8683	0.3859
Information	Information and Organic	159	175	1.5194	0.1296
Information	Information and Hormone-free	159	169	1.4100	0.1595
Information	Information and SGA	159	160	1.0581	0.2908

Note: One (*), two (**), three (***) asterisks represent 0.10, 0.05, and 0.01 levels of statistical significance, respectively

Table 30: Other Market (Ground Beef) vs. Freezer Beef

Treatments in Group 1	Treatments in Group 2	Sample of Group 1	Sample of Group 2	t-statistic	p-value
Information	No Information	167	178	1.7396	0.0828*
Information	Information and Organic	167	172	-0.6156	0.5385
Information	Information and Hormone-free	167	164	-0.3051	0.7605
Information	Information and SGA	167	165	-0.3592	0.7197

Note: One (*), two (**), three (***) asterisks represent 0.10, 0.05, and 0.01 levels of statistical significance, respectively

Table 31: Other Market (Steak) vs. Freezer Beef

Treatments in Group 1	Treatments in Group 2	Sample of Group 1	Sample of Group 2	t-statistic	p-value
Information	No Information	161	168	0.2023	0.8398
Information	Information and Organic	161	165	1.7863	0.0750*
Information	Information and Hormone-free	161	152	0.9479	0.3439
Information	Information and SGA	161	158	0.4898	0.6246

Note: One (*), two (**), three (***) asterisks represent 0.10, 0.05, and 0.01 levels of statistical significance, respectively

Appendix E: Maximum Likelihood estimates for Tobit vs Double Hurdle results using selected variables for Truncated Regression

(Tables 32, 33 and 34)

Table 32: Comparison of Tobit to Double Hurdle model (Maximum Likelihood Estimation – MLE): Choice Problems 1 and 2

	Choice Problem 1: WTP Premium on Ground Beef – Supermarket vs. Other markets			**Choice Problem 2: WTP Premium on Steak – Supermarket vs. Other markets**		
Variables	**Tobit[a]**	**Double Hurdle Model**		**Tobit[a]**	**Double Hurdle Model**	
		Hurdle 1: Probit Regression[b]	**Hurdle 2: Truncated Regression[c]**		**Hurdle 1: Probit Regression[b]**	**Hurdle 2: Truncated Regression[c]**
Treatment (Base: Information treatment)						
No information treatment	0.244	-0.146	0.433*	0.500	-0.00709	0.432
	(0.412)	(0.148)	(0.227)	(0.443)	(0.162)	(0.383)
Information and organic treatment	-0.227	-0.160	0.292	-0.0863	-0.171	0.452
	(0.411)	(0.147)	(0.221)	(0.444)	(0.159)	(0.382)
Information and hormone-free treatment	0.187	-0.142	0.554**	0.307	-0.153	0.944**
	(0.413)	(0.148)	(0.226)	(0.447)	(0.161)	(0.398)
Information and SGA treatment	-0.269	-0.126	0.260	-0.123	-0.0364	0.228
	(0.419)	(0.151)	(0.221)	(0.448)	(0.163)	(0.373)
Household level characteristics						
Household size	0.231***	0.0400		0.0417	-0.0193	
	(0.0905)	(0.0316)		(0.0988)	(0.0340)	
Median income	3.97e-06	3.50e-06***	2.15e-06	7.17e-06**	9.51e-07	7.09e-07
	(3.35e-06)	(1.22e-06)	(1.82e-06)	(3.61e-06)	(1.30e-06)	(3.27e-06)
Age (Base: Young)						
Middle	-1.226**	-0.292	-0.244	-1.182*	-0.337*	-0.414
	(0.472)	(0.174)	(0.280)	(0.484)	(0.182)	(0.443)
Old	-2.181***	-0.297	-1.202***	-2.302	-0.337***	-1.943***
	(0.524)	(0.192)	(0.296)	(0.549)	(0.206)	(0.505)
Location (Base: Rural)						
Suburban	-0.0527	0.0724	0.00857	-0.00478	0.0642	0.0804

	(0.305)	(0.109)	(0.161)	(0.329)	(0.119)	(0.277)
Urban	0.437	-0.0116	0.469**	-0.0868	-0.0985	0.302
	(0.366)	(0.128)	(0.212)	(0.388)	(0.136)	(0.346)
Gender (Base: Male)						
Female	-0.681***	-0.191*	0.108	-0.175	-0.247***	0.267
	(0.280)	(0.100)	(0.149)	(0.298)	(0.109)	(0.253)
Educational level (Base: Some/full high school)						
Some/above college education	0.0372	0.137	-0.107	-0.0353	0.0439	0.147
	(0.305)	(0.105)	(0.174)	(0.325)	(0.114)	(0.288)
Primary purchaser of food (Base: No)						
Yes	0.0296	-0.0328		-0.0167	-0.00616	
	(0.277)	(0.0996)		(0.298)	(0.108)	
Ownership of freezer (Base: No)						
Yes	1.0711***	0.377***		0.687***	0.213**	
	(0.276)	(0.0964)		(0.296)	(0.105)	
Definition of freezer beef (Base: Otherwise)						
Correct	0.814***	0.318***		0.905***	0.423***	
	(0.297)	(0.110)		(0.321)	(0.123)	
Race (Base: White)						
Black	0.637	-0.0310	0.937***	0.541	-0.0485	1.402***
	(0.332)	(0.118)	(0.196)	(0.351)	(0.124)	(0.341)
Constant	2.521*	0.501*	3.406***	2.994***	1.008***	3.144***
	(0.733)	(0.263)	(0.375)	(0.763)	(0.276)	(0.596)
Number of observations	888	888	508	799	799	468
Log-likelihood at maximum	88.05	48.50	95.65	52.53	33.77	48.44

Notes: Standard errors are in parenthesis

One (*), two (**), three (***) asterisks represent 0.10, 0.05, and 0.01 levels of statistical significance, respectively

[a] Indicates that the Tobit model was employed

[b] Indicates that the Probit model was employed

[c] Indicates that the Truncated model was employed

Table 33: Comparison of Tobit to Double Hurdle model (MLE): Choice Problems 3 and 4

Variables	Choice Problem 3: WTP Premium on Ground Beef from Supermarket vs. Freezer Beef			Choice Problem 4: WTP Premium on Steak from Supermarket vs. Freezer Beef		
	Tobit[a]	Double Hurdle Model		Tobit[a]	Double Hurdle Model	
		Hurdle 1: Probit Regression[b]	Hurdle 2: Truncated Regression[c]		Hurdle 1: Probit Regression[b]	Hurdle 2: Truncated Regression[c]
Treatment (Base: Information treatment)						
No information treatment	0.121	-0.115	0.473*	-1.168	-0.310*	1.604**
	(0.439)	(0.143)	(0.276)	(0.847)	(0.157)	(0.672)
Information and organic treatment	-0.169	-0.196	0.0885	-1.222	-0.248	-0.0836
	(0.443)	(0.143)	(0.281)	(0.850)	(0.159)	(0.577)
Information and hormone-free treatment	0.650	-0.0217	0.558**	-1.497*	-0.430**	1.212*
	(0.442)	(0.145)	(0.280)	(0.859)	(0.158)	(0.668)
Information and SGA treatment	-0.0597	-0.0812	0.0900	-1.096	-0.222	0.448
	(0.450)	(0.147)	(0.277)	(0.863)	(0.162)	(0.593)
Household level characteristics						
Household size	0.0310	0.00597		-0.0474	-0.00876	
	(0.0978)	(0.0314)		(0.184)	(0.0319)	
Median income	-1.13e-06	1.06e-08	-5.29e-07	-6.68e-06	-7.24e-07	-2.75e-06
	(3.60e-06)	(1.16e-06)	(2.33e-06)	(6.85e-06)	(1.22e-06)	(4.93e-06)
Age (Base: Young)						
Middle	-0.872	-0.241	-0.658*	-0.187	-0.194	-0.497
	(0.495)	(0.169)	(0.341)	(0.918)	(0.172)	(0.673)
Old	-2.390***	-0.472**	-1.733***	-0.860	-0.120	-2.459***
	(0.554)	(0.186)	(0.373)	(1.0354)	(0.193)	(0.808)
Location (Base: Rural)						
Suburban	-0.204	-0.0414	-0.182	0.192	0.0113	0.178
	(0.327)	(0.106)	(0.204)	(0.629)	(0.115)	(0.455)
Urban	0.361	-0.0306	0.109	-1.163	-0.197	0.158
	(0.394)	(0.128)	(0.265)	(0.744)	(0.133)	(0.544)
Gender (Base: Male)						
Female	-0.771***	-0.295***	0.123	-1.947***	-0.351***	-0.768*
	(0.298)	(0.0981)	(0.184)	(0.577)	(0.106)	(0.431)
Educational level (Base: Some/full high school)						
Some/above college education	0.159	0.0890	0.203	-0.334	-0.0608	-0.236
	(0.327)	(0.105)	(0.214)	(0.619)	(0.112)	(0.447)

Primary purchaser of food (Base: No)						
Yes	0.338	-0.0153		-0.0265	-0.0334	
	(0.298)	(0.0970)		(0.570)	(0.103)	
Ownership of freezer (Base: No)						
Yes	1.478***	0.404***		1.214**	0.242***	
	(0.298)	(0.0943)		(0.566)	(0.101)	
Definition of freezer beef (Base: Otherwise)						
Correct	0.880***	0.413***		2.109***	0.415***	
	(0.317)	(0.108)		(0.618)	(0.116)	
Race (Base: White)						
Black	0.794	0.0321	1.128***	-0.112	-0.00403	0.483
	(0.358)	(0.116)	(0.257)	(0.672)	(0.121)	(0.505)
Constant	2.274	0.630	4.098***	7.244***	1.210***	6.038***
	(0.775)	(0.255)	(0.458)	(1.479)	(0.272)	(1.031)
Number of observations	880	880	479	840	840	284
Log-likelihood at maximum	93.83	58.91	70.06	37.72	46.73	20.65

Notes:
Standard errors are in parenthesis
One (*), two (**), three (***) asterisks represent 0.10, 0.05, and 0.01 levels of statistical significance, respectively
[a] Indicates that the Tobit model was employed
[b] Indicates that the Probit model was employed
[c] Indicates that the Truncated model was employed

Table 34: Comparison of Tobit to Double Hurdle model (MLE): Choice Problems 5 and 6

Variables	Choice Problem 5: WTP Premium on Ground Beef from Other Markets vs. Freezer Beef			Choice Problem 6: WTP Premium on Steak from Other Market vs. Freezer Beef		
	Tobit[a]	Double Hurdle Model		Tobit[a]	Double Hurdle Model	
		Hurdle 1: Probit Regression[b]	Hurdle 2: Truncated Regression[c]		Hurdle 1: Probit Regression[b]	Hurdle 2: Truncated Regression[c]
Treatment (Base: Information treatment)						
No information treatment	2.177*	0.100	0.191	0.349	-0.00264	6.134
	(1.278)	(0.151)	(0.820)	(0.973)	(0.162)	(15.09)
Information and organic treatment	1.158	0.104	-1.338*	-1.154	-0.239	-15.73
	(1.273)	(0.153)	(0.780)	(0.982)	(0.158)	(30.66)
Information and hormone-free treatment	0.0494	-0.179	-0.303	-0.899	-0.229	4.139
	(1.285)	(0.149)	(0.863)	(0.996)	(0.161)	(12.78)
Information and SGA treatment	0.304	0.0362	-0.365	-0.463	-0.0306	-0.849
	(1.268)	(0.152)	(0.737)	(0.981)	(0.164)	(9.657)
Household level characteristics						
Household size	0.0709	0.00962		0.0424	-0.00589	
	(0.278)	(0.0342)		(0.213)	(0.0332)	
Median income	-1.59e-05	-1.04e-06	-4.06e-06	-1.43e-05*	-1.74e-06	-8.55e-05
	(1.05e-05)	(1.22e-06)	(6.44e-06)	(8.01e-06)	(1.25e-06)	(0.000178)
Age (Base: Young)						
Middle	-2.425	-0.148	-0.502	1.487	0.00969	-1.324
	(1.509)	(0.173)	(1.183)	(1.070)	(0.172)	(11.13)
Old	-4.252**	-0.198	-0.228	0.508	0.120	-18.91
	(1.679)	(0.192)	(1.223)	(1.204)	(0.196)	(36.81)
Location (Base: Rural)						
Suburban	0.699	0.161	0.745	0.0526	0.0347	3.353
	(0.954)	(0.114)	(0.598)	(0.735)	(0.120)	(9.610)
Urban	-0.0592	-0.0848	0.913	-1.043	-0.206	2.562
	(1.150)	(0.131)	(0.877)	(0.875)	(0.138)	(10.28)
Gender (Base: Male)						
Female	-1.381	-0.191*	-0.838	-1.493**	-0.208*	-19.44
	(0.873)	(0.103)	(0.571)	(0.665)	(0.109)	(36.56)
Educational level (Base: Some/full high school)						
Some/above college education	0.593	0.00890	-0.382	-1.123	-0.145	-1.668
	(0.948)	(0.111)	(0.593)	(0.727)	(0.119)	(7.951)

Primary purchaser of food (Base: No)						
Yes	-0.316	-0.0987		-0.518	-0.123	
	(0.867)	(0.103)		(0.664)	(0.108)	
Ownership of freezer (Base: No)						
Yes	4.560***	0.447***		1.951***	0.263**	
	(0.885)	(0.0992)		(0.663)	(0.106)	
Definition of freezer beef (Base: Otherwise)						
Correct	1.721*	0.243**		0.820	0.134	
	(0.939)	(0.113)		(0.719)	(0.118)	
Race (Base: White)						
Black	1.855*	0.0986	-1.062	1.091	0.120	-5.978
	(1.064)	(0.123)	(0.758)	(0.795)	(0.130)	(13.73)
Constant	6.465***	0.600**	6.884***	8.497***	1.069***	73.19
	(2.278)	(0.265)	(1.727)	(1.698)	(0.277)	(124.7)
Number of observations	846	846	191	804	804	432
Log-likelihood at maximum	57.32	42.24	7.80	33.66	28.42	0.29

Notes:
Standard errors are in parenthesis
One (*), two (**), three (***) asterisks represent 0.10, 0.05, and 0.01 levels of statistical significance, respectively
[a] Indicates that the Tobit model was employed
[b] Indicates that the Probit model was employed
[c] Indicates that the Truncated model was employed

Appendix F: Average Marginal Effect estimates for the Tobit vs Double Hurdle results using selected variables for Truncated Regression

(Tables 35, 36 and 37):

Table 35: Comparison of Tobit to Double Hurdle model (Average Marginal Effects – AME): Choice Problems 1 and 2

	Choice Problem 1: WTP Premium on Ground Beef from Supermarket vs. Other Markets			**Choice Problem 2: WTP Premium on Steak from Supermarket vs. Other Markets**		
Variables	**Tobit[a]**	**Double Hurdle Model**		**Tobit[a]**	**Double Hurdle Model**	
		Hurdle 1: Probit Regression[b]	**Hurdle 2: Truncated Regression[c]**		**Hurdle 1: Probit Regression[b]**	**Hurdle 2: Truncated Regression[c]**
Treatment (Base: Information treatment)						
No information treatment	0.145	-0.0465	0.412*	0.299	-0.00210	0.366
	(0.245)	(0.0469)	(0.216)	(0.265)	(0.0478)	(0.323)
Information and organic treatment	-0.135	-0.0509	0.277	-0.0516	-0.0505	0.382
	(0.244)	(0.0468)	(0.211)	(0.266)	(0.0472)	(0.322)
Information and hormone-free treatment	0.111	-0.0452	0.528***	0.184	-0.0452	0.799**
	(0.246)	(0.0471)	(0.214)	(0.267)	(0.0475)	(0.329)
Information and SGA treatment	-0.160	-0.0402	0.247	-0.0733	-0.0108	0.193
	(0.249)	(0.0479)	(0.211)	(0.268)	(0.0483)	(0.315)
Household level characteristics						
Household size	0.138**	0.0136		0.0249	-0.00570	
	(0.0535)	(0.0109)		(0.0590)	(0.0101)	
Median income	2.36e-06	5.38e-07	2.05e-06	4.29e-06**	2.82e-07	6.00e-07
	(1.99e-06)	(3.87e-07)	(1.73e-06)	(2.15e-06)	(3.84e-07)	(2.77e-06)
Age (Base: Young)						
Middle	-0.729**	-0.0927	-0.233	-0.707***	-0.0998*	-0.350
	(0.278)	(0.0554)	(0.266)	(0.288)	(0.0535)	(0.374)
Old	-1.297***	-0.0944	-1.144***	-1.377***	-0.0998*	-1.645***
	(0.306)	(0.0610)	(0.279)	(0.323)	(0.0606)	(0.400)
Location (Base: Rural)						
Suburban	-0.0313	0.0230	0.00816	-0.00285	0.0190	0.0681

	(0.181)	(0.0347)	(0.154)	(0.196)	(0.0354)	(0.234)
Urban	0.260	-0.00369	0.447**	0.0520	-0.0292	0.256
	(0.217)	(0.0408)	(0.201)	(0.232)	(0.0403)	(0.292)
Gender (Base: Male)						
Female	-0.406**	-0.0609**		-0.105	-0.0732**	0.226
	(0.160)	(0.0316)		(0.178)	(0.0318)	(0.213)
Educational level (Base: Some/full high school)						
Some/above college education	0.0221	0.0435	-0.102	-0.0211	0.0130	0.124
	(0.181)	(0.0335)	(0.166)	(0.194)	(0.0336)	(0.244)
Primary purchaser of food (Base: No)						
Yes	0.0176	-0.0104		-0.0100	-0.00182	
	(0.165)	(0.0316)		(0.178)	(0.0319)	
Ownership of freezer (Base: No)						
Yes	0.637***	0.120***		0.411***	0.0630**	
	(0.161)	(0.0299)		(0.176)	(0.0309)	
Definition of freezer beef (Base: Otherwise)						
Correct	0.484***	0.101***		0.541***	0.125***	
	(0.175)	(0.0346)		(0.190)	(0.0359)	
Race (Base: White)						
Black	0.379	-0.00985	0.893***	0.324	-0.0144	1.187***
	(0.197)	(0.0374)	(0.183)	(0.209)	(0.0368)	(0.268)
Number of observations	888	888	508	799	799	468
Log-likelihood at maximum	88.05	48.50	95.65	52.53	33.77	48.44

Notes: Standard errors are in parenthesis

One (*), two (**), three (***) asterisks represent 0.10, 0.05, and 0.01 levels of statistical significance, respectively

[a] Indicates that the Tobit model was employed

[b] Indicates that the Probit model was employed

[c] Indicates that the Truncated model was employed

Table 36: Comparison of Tobit to Double Hurdle model (AME): Choice Problems 3 and 4

Variables	Choice Problem 3: WTP Premium on Ground Beef from Supermarket vs. Freezer Beef			Choice Problem 4: WTP Premium on Steak from Supermarket vs. Freezer Beef		
	Tobit[a]	Double Hurdle Model		Tobit[a]	Double Hurdle Model	
		Hurdle 1: Probit Regression[b]	Hurdle 2: Truncated Regression[c]		Hurdle 1: Probit Regression[b]	Hurdle 2: Truncated Regression[c]
Treatment (Base: Information treatment)						
No information treatment	0.0677	-0.0388	0.430*	-0.403	-0.0951*	1.113***
	(0.245)	(0.0483)	(0.249)	(0.291)	(0.0480)	(0.426)
Information and organic treatment	-0.0947	-0.0661	0.0804	-0.421	-0.0759	-0.0580
	(0.247)	(0.0485)	(0.255)	(0.292)	(0.0485)	(0.400)
Information and hormone-free treatment	0.363	-0.00733	0.507**	-0.516*	-0.132**	0.841*
	(0.246)	(0.0491)	(0.253)	(0.294)	(0.0477)	(0.441)
Information and SGA treatment	-0.0334	-0.0275	0.0817	0.378	-0.0678	0.311
	(0.252)	(0.0499)	(0.252)	(0.297)	(0.0495)	(0.408)
Household level characteristics						
Household size	0.0173	0.00202		-0.0163	-0.00268	
	(0.0547)	(0.0106)		(0.0635)	(0.00976)	
Median income	-6.32e-07	3.57e-09	-4.81e-07	-2.30e-06	-2.21e-07	-1.91e-06
	(2.01e-06)	(3.93e-07)	(2.11e-06)	(2.36e-06)	(3.73e-07)	(3.41e-06)
Age (Base: Young)						
Middle	-0.487	-0.0814	-0.598*	-0.0646	-0.0594	-0.345
	(0.495)	(0.0569)	(0.307)	(0.316)	(0.0524)	(0.463)
Old	-1.336***	-0.159**	-1.575***	-0.296	-0.0368	-1.706***
	(0.305)	(0.0621)	(0.326)	(0.356)	(0.0592)	(0.480)
Location (Base: Rural)						
Suburban	-0.115	-0.0140	-0.165	0.0662	0.00347	0.123
	(0.183)	(0.0360)	(0.185)	(0.217)	(0.0352)	(0.315)
Urban	0.202	-0.0103	0.0988	-0.401	-0.0604	0.109
	(0.220)	(0.0433)	(0.241)	(0.255)	(0.0405)	(0.377)
Gender (Base: Male)						
Female	-0.431***	-0.0995***	0.112	-0.670	-0.107***	-0.533*
	(0.166)	(0.0327)	(0.167)	(0.194)	(0.0319)	(0.285)
Educational level (Base: Some/full high school)						
Some/above college education	0.0889	0.0300	0.184	-0.115	-0.0186	-0.164
	(0.183)	(0.0353)	(0.194)	(0.213)	(0.0343)	(0.309)

Primary purchaser of food (Base: No)						
Yes	0.189	-0.00518		-0.0265	-0.0102	
	(0.167)	(0.0328)		(0.570)	(0.0324)	
Ownership of freezer (Base: No)						
Yes	0.826***	0.136***		0.418**	0.0743***	
	(0.162)	(0.0309)		(0.194)	(0.0318)	
Definition of freezer beef (Base: Otherwise)						
Correct	0.826***	0.139***		0.726***	0.127***	
	(0.162)	(0.0356)		(0.208)	(0.0351)	
Race (Base: White)						
Black	0.444	0.0109	1.025***	-0.0387	-0.00123	0.335
	(0.200)	(0.0394)	(0.224)	(0.231)	(0.0372)	(0.345)
Number of observations	880	880	479	840	840	284
Log-likelihood at maximum	93.83	58.91	70.06	37.72	46.73	20.65

Notes:
Standard errors are in parenthesis
One (*), two (**), three (***) asterisks represent 0.10, 0.05, and 0.01 levels of statistical significance, respectively
[a] Indicates that the Tobit model was employed
[b] Indicates that the Probit model was employed
[c] Indicates that the was employed

Table 37: Comparison of Tobit to Double Hurdle model (AME): Choice Problems 5 and 6

Variables	Choice Problem 5: WTP Premium on Ground Beef from Other Markets vs. Freezer Beef			Choice Problem 6: WTP Premium on Steak from Other Markets vs. Freezer Beef		
	Tobit[a]	Double Hurdle Model		Tobit[a]	Double Hurdle Model	
		Hurdle 1: Probit Regression[b]	Hurdle 2: Truncated Regression[c]		Hurdle 1: Probit Regression[b]	Hurdle 2: Truncated Regression[c]
Treatment (Base: Information treatment)						
No information treatment	0.497*	-0.0312	0.124	0.185	-0.000764	0. 184
	(0.289)	(0470)	(0. 533)	(0.518)	(0.0469)	(0.427)
Information and organic treatment	0.265	0.0324	-0.871*	-0.614	-0.0690	-0. 473
	(0.290)	(0.0474)	(0.468)	(0.521)	(0.0453)	(0.836)
Information and hormone-free treatment	0.0113**	-0.0556	-0.197	-0.478	-0.0661	0.124
	(0.293)	(0.0462)	(0.561)	(0.529)	(0.0465)	(0.370)
Information and SGA treatment	0.0696	0.0112	-0.237	0.246	-0.00885	-0.0256
	(0.290)	(0.0472)	(0.477)	(0.521)	(0.0473)	(0.290)
Household level characteristics						
Household size	0.0162	0.00299		0.0226	-0.00170	
	(0.0635)	(0.0106)		(0.113)	(0.00959)	
Median income	-3.64e-06	-3.23e-07	-2.65e-06	-7.59e-06*	-5.02e-07	-2.57e-06
	(2.37e-06)	(3.79e-07)	(4.15e-06)	(4.25e-06)	(3.60e-07)	(4.90e-06)
Age (Base: Young)						
Middle	-0.554	-0.0461	-0.327	0.791	0.00280	-0.0399
	(0.342)	(0.0537)	(0.768)	(0.567)	(0.0498)	(0.333)
Old	-0.971***	-0.0614	-1.148	0.270	0.0346	-0.568
	(0.376)	(0.0596)	(0.796)	(0.640)	(0.0567)	(1.000)
Location (Base: Rural)						
Suburban	0.160	0.0499	0.486	0.0280	0.0100	0.101
	(0.218)	(0.0351)	(0.373)	(0.391)	(0.0347)	(0.278)
Urban	-0.0135	-0.0263	0.595	-0.555	-0.0594	0.0771
	(0.263)	(0.0407)	(0.555)	(0.386)	(0.0396)	(0.302)
Gender (Base: Male)						
Female	-0.316	-0.0593*	0.546	-0.794**	-0.0602*	-0.584
	(0.198)	(0.0318)	(0.351)	(0.352)	(0.0313)	(0.984)
Educational level (Base: Some/full high school)						
Some/above college education	0.135	0.00276	0.249	-0.597	-0.0420	-0.0502
	(0.216)	(0.0345)	(0.382)	(0.386)	(0.0344)	(0.236)

Primary purchaser of food (Base: No)						
Yes	-0.0722	-0.0306		-0.276	-0.0356	
	(0.198)	(0.0320)		(0.352)	(0.0313)	
Ownership of freezer (Base: No)						
Yes	1.041***	0.139***		1.038***	0.0759**	
	(0.186)	(0.0298)		(0.348)	(0.0302)	
Definition of freezer beef (Base: Otherwise)						
Correct	0.393*	0.0753**		0.436	0.0385	
	(0.213)	(0.0348)		(0.381)	(0.0341)	
Race (Base: White)						
Black	0.424*	0.0306	-1.691	0.580	0.0347	-0.180
	(0.241)	(0.0382)	(0.468)	(0.421)	(0.0374)	(0.385)
Number of observations	846	846	191	804	804	432
Log-likelihood at maximum	57.32	42.24	7.80	33.66	28.42	0.29

Notes:
Standard errors are in parenthesis
One (*), two (**), three (***) asterisks represent 0.10, 0.05, and 0.01 levels of statistical significance, respectively
[a] Indicates that the Tobit model was employed
[b] Indicates that the Probit model was employed
[c] Indicates that the was employed

Appendix G: Maximum Likelihood estimates of Tobit vs Double Hurdle results using Full Model for the Truncated Regression

(Tables 38, 39 and 40):

Table 38: Comparison of Tobit to Double Hurdle model (MLE): Choice Problems 1 and 2

	Choice Problem 1: WTP Premium on Ground Beef – Supermarket vs. Other Markets			**Choice Problem 2: WTP Premium on Steak – Supermarket vs. Other Markets**		
Variables	**Tobit[a]**	**Double Hurdle Model**		**Tobit[a]**	**Double Hurdle Model**	
		Hurdle 1: Probit Regression[b]	**Hurdle 2: Truncated Regression[c]**		**Hurdle 1: Probit Regression[b]**	**Hurdle 2: Truncated Regression[c]**
Treatment (Base: Information treatment)						
No information treatment	0.244	-0.146	0.481**	0.500	-0.00709	0.429
	(0.412)	(0.148)	(0.226)	(0.443)	(0.162)	(0.380)
Information and organic treatment	-0.227	-0.160	0.330	-0.0863	-0.171	0.479
	(0.411)	(0.147)	(0.221)	(0.444)	(0.159)	(0.381)
Information and hormone-free treatment	0.187	-0.142	0.575**	0.307	-0.153	1.031***
	(0.413)	(0.148)	(0.225)	(0.447)	(0.161)	(0.398)
Information and SGA treatment	-0.269	-0.126	0.278	-0.123	-0.0364	0.321
	(0.419)	(0.151)	(0.220)	(0.448)	(0.163)	(0.373)
Household level characteristics						
Household size	0.231***	0.0400	-0.0134	0.0417	-0.0193	0.0751
	(0.0905)	(0.0316)	(0.0498)	(0.0988)	(0.0340)	(0.0949)
Median income	3.97e-06	3.50e-06***	1.76e-06	7.17e-06**	9.51e-07	2.98e-08
	(3.35e-06)	(1.22e-06)	(1.83e-06)	(3.61e-06)	(1.30e-06)	(3.25e-06)
Age (Base: Young)						
Middle	-1.226**	-0.292	-0.247	-1.182*	-0.337*	-0.282
	(0.472)	(0.174)	(0.279)	(0.484)	(0.182)	(0.443)
Old	-2.181***	-0.297	-1.204***	-2.302	-0.337***	-1.746***
	(0.524)	(0.192)	(0.302)	(0.549)	(0.206)	(0.508)
Location (Base: Rural)						

Suburban	-0.0527	0.0724	0.0352	-0.00478	0.0642	0.114
	(0.305)	(0.109)	(0.161)	(0.329)	(0.119)	(0.277)
Urban	0.437	-0.0116	0.455**	-0.0868	-0.0985	0.375
	(0.366)	(0.128)	(0.211)	(0.388)	(0.136)	(0.347)
Gender (Base: Male)						
Female	-0.681***	-0.191*	0.121	-0.175	-0.247***	0.353
	(0.280)	(0.100)	(0.152)	(0.298)	(0.109)	(0.261)
Educational level (Base: Some/full high school)						
Some/above college education	0.0372	0.137	-0.0674	-0.0353	0.0439	0.157
	(0.305)	(0.105)	(0.174)	(0.325)	(0.114)	(0.289)
Primary purchaser of food (Base: No)			0.0116			
Yes	0.0296	-0.0328	(0.149)	-0.0167	-0.00616	-0.434*
	(0.277)	(0.0996)		(0.298)	(0.108)	(0.262)
Ownership of freezer (Base: No)						
Yes	1.0711***	0.377***	0.357**	0.687***	0.213**	0.156
	(0.276)	(0.0964)	(0.150)	(0.296)	(0.105)	(0.252)
Definition of freezer beef (Base: Otherwise)						
Correct	0.814***	0.318***	-0.0592	0.905***	0.423***	0.00640
	(0.297)	(0.110)	(0.158)	(0.321)	(0.123)	(0.274)
Race (Base: White)						
Black	0.637	-0.0310	0.879***	0.541	-0.0485	1.362***
	(0.332)	(0.118)	(0.195)	(0.351)	(0.124)	(0.338)
Constant	2.521*	0.501*	3.189***	2.994***	1.008***	2.897***
	(0.733)	(0.263)	(0.426)	(0.763)	(0.276)	(0.676)
Number of observations	888	888	508	799	799	468
Log-likelihood at maximum	88.05	48.50	100.75	52.53	33.77	50.60

Notes: Standard errors are in parenthesis

One (*), two (**), three (***) asterisks represent 0.10, 0.05, and 0.01 levels of statistical significance, respectively

[a] Indicates that the Tobit model was employed

[b] Indicates that the Probit model was employed

[c] Indicates that the Truncated model was employed

Table 39: Comparison of Tobit to Double Hurdle model (MLE): Choice Problems 3 and 4

	Choice Problem 3: WTP Premium on Ground Beef from Supermarket vs. Freezer Beef			Choice Problem 4: WTP Premium on Steak from Supermarket vs. Freezer Beef		
Variables	**Tobit[a]**	**Double Hurdle Model**		**Tobit[a]**	**Double Hurdle Model**	
		Hurdle 1: Probit Regression[b]	**Hurdle 2: Truncated Regression[c]**		**Hurdle 1: Probit Regression[b]**	**Hurdle 2: Truncated Regression[c]**
Treatment (Base: Information treatment)						
No information treatment	0.121	-0.115	0.517*	-1.168	-0.310*	1.667**
	(0.439)	(0.143)	(0.271)	(0.847)	(0.157)	(0.655)
Information and organic treatment	-0.169	-0.196	0.109	-1.222	-0.248	0.0393
	(0.443)	(0.143)	(0.277)	(0.850)	(0.159)	(0.567)
Information and hormone-free treatment	0.650	-0.0217	0.577**	-1.497*	-0.430**	1.206*
	(0.442)	(0.145)	(0.276)	(0.859)	(0.158)	(0.653)
Information and SGA treatment	-0.0597	-0.0812	0.0596	-1.096	-0.222	0.394
	(0.450)	(0.147)	(0.273)	(0.863)	(0.162)	(0.579)
Household level characteristics						
Household size	0.0310	0.00597	0.000718	-0.0474	-0.00876	-0.0222
	(0.0978)	(0.0314)	(0.0665)	(0.184)	(0.0319)	(0.147)
Median income	-1.13e-06	1.06e-08	-1.18e-06	-6.68e-06	-7.24e-07	-3.07e-06
	(3.60e-06)	(1.16e-06)	(2.34e-06)	(6.85e-06)	(1.22e-06)	(4.96e-06)
Age (Base: Young)						
Middle	-0.872	-0.241	-0.681**	-0.187	-0.194	-0.608
	(0.495)	(0.169)	(0.337)	(0.918)	(0.172)	(0.659)
Old	-2.390***	-0.472**	-1.764***	-0.860	-0.120	-2.605***
	(0.554)	(0.186)	(0.376)	(1.0354)	(0.193)	(0.824)
Location (Base: Rural)						
Suburban	-0.204	-0.0414	-0.123	0.192	0.0113	0.379
	(0.327)	(0.106)	(0.204)	(0.629)	(0.115)	(0.456)
Urban	0.361	-0.0306	0.0856	-1.163	-0.197	0.174
	(0.394)	(0.128)	(0.263)	(0.744)	(0.133)	(0.529)
Gender (Base: Male)						
Female	-0.771***	-0.295***	0.116	-1.947***	-0.351***	-0.763*
	(0.298)	(0.0981)	(0.188)	(0.577)	(0.106)	(0.427)
Educational level (Base: Some/full high school)						
Some/above college education	0.159	0.0890	0.233	-0.334	-0.0608	-0.286
	(0.327)	(0.105)	(0.213)	(0.619)	(0.112)	(0.442)

Primary purchaser of food (Base: No)						
Yes	0.338	-0.0153	0.143	-0.0265	-0.0334	0.423
	(0.298)	(0.0970)	(0.190)	(0.570)	(0.103)	(0.415)
Ownership of freezer (Base: No)						
Yes	1.478***	0.404***	0.552***	1.214**	0.242***	0.730*
	(0.298)	(0.0943)	(0.193)	(0.566)	(0.101)	(0.422)
Definition of freezer beef (Base: Otherwise)						
Correct	0.880***	0.413***	-0.0245	2.109***	0.415***	0.484
	(0.317)	(0.108)	(0.193)	(0.618)	(0.116)	(0.439)
Race (Base: White)						
Black	0.794	0.0321	0.985***	-0.112	-0.00403	0.428
	(0.358)	(0.116)	(0.254)	(0.672)	(0.121)	(0.494)
Constant	2.274	0.630	3.699***	7.244***	1.210***	5.257***
	(0.775)	(0.255)	(0.508)	(1.479)	(0.272)	(1.118)
Number of observations	880	880	479	840	840	284
Log-likelihood at maximum	93.83	58.91	76.71	37.72	46.73	22.60

Notes:
Standard errors are in parenthesis
One (*), two (**), three (***) asterisks represent 0.10, 0.05, and 0.01 levels of statistical significance, respectively
[a] Indicates that the Tobit model was employed
[b] Indicates that the Probit model was employed
[c] Indicates that the Truncated model was employed

Table 40: Comparison of Tobit to Double Hurdle model (MLE): Choice Problems 5 and 6

	Choice Problem 3: WTP Premium on Ground Beef from Other Markets vs. Freezer Beef			Choice Problem 4: WTP Premium on Steak from Other markets vs. Freezer Beef		
Variables	**Tobit[a]**	**Double Hurdle Model**		**Tobit[a]**	**Double Hurdle Model**	
		Hurdle 1: Probit Regression[b]	**Hurdle 2: Truncated Regression[c]**		**Hurdle 1: Probit Regression[b]**	**Hurdle 2: Truncated Regression[c]**
Treatment (Base: Information treatment)						
No information treatment	2.177*	0.100	0.228	0.349	-0.00264	5.288
	(1.278)	(0.151)	(0.740)	(0.973)	(0.162)	(12.11)
Information and organic treatment	1.158	0.104	-1.418**	-1.154	-0.239	-14.10
	(1.273)	(0.153)	(0.720)	(0.982)	(0.158)	(24.12)
Information and hormone-free treatment	0.0494	-0.179	-0.363	-0.899	-0.229	3.385
	(1.285)	(0.149)	(0.777)	(0.996)	(0.161)	(10.40)
Information and SGA treatment	0.304	0.0362	-0.202	-0.463	-0.0306	-0.884
	(1.268)	(0.152)	(0.659)	(0.981)	(0.164)	(8.384)
Household level characteristics						
Household size	0.0709	0.00962	-0.252	0.0424	-0.00589	1.582
	(0.278)	(0.0342)	(0.175)	(0.213)	(0.0332)	(3.278)
Median income	-1.59e-05	-1.04e-06	-5.15e-06	-1.43e-05*	-1.74e-06	-8.11e-05
	(1.05e-05)	(1.22e-06)	(6.10e-06)	(8.01e-06)	(1.25e-06)	(0.000149)
Age (Base: Young)						
Middle	-2.425	-0.148	-0.579	1.487	0.00969	-0.514
	(1.509)	(0.173)	(1.179)	(1.070)	(0.172)	(9.540)
Old	-4.252**	-0.198	-0.604	0.508	0.120	-15.61
	(1.679)	(0.192)	(1.255)	(1.204)	(0.196)	(27.05)
Location (Base: Rural)						
Suburban	0.699	0.161	0.701	0.0526	0.0347	3.993
	(0.954)	(0.114)	(0.539)	(0.735)	(0.120)	(9.086)
Urban	-0.0592	-0.0848	0.749	-1.043	-0.206	3.286
	(1.150)	(0.131)	(0.781)	(0.875)	(0.138)	(9.518)
Gender (Base: Male)						
Female	-1.381	-0.191*	-0.480	-1.493**	-0.208*	-17.06
	(0.873)	(0.103)	(0.516)	(0.665)	(0.109)	(27.97)
Educational level (Base: Some/full high school)						
Some/above college education	0.593	0.00890	-0.372	-1.123	-0.145	-3.281
	(0.948)	(0.111)	(0.548)	(0.727)	(0.119)	(8.314)

Primary purchaser of food (Base: No)						
Yes	-0.316	-0.0987	-1.090**	-0.518	-0.123	1.208
	(0.867)	(0.103)	(0.546)	(0.664)	(0.108)	(6.226)
Ownership of freezer (Base: No)						
Yes	4.560***	0.447***	-0.861*	1.951***	0.263**	-4.255
	(0.885)	(0.0992)	(0.504)	(0.663)	(0.106)	(8.948)
Definition of freezer beef (Base: Otherwise)						
Correct	1.721*	0.243**	0.401	0.820	0.134	9.911
	(0.939)	(0.113)	(0.525)	(0.719)	(0.118)	(17.12)
Race (Base: White)						
Black	1.855*	0.0986	-0.846	1.091	0.120	-3.288
	(1.064)	(0.123)	(0.687)	(0.795)	(0.130)	(8.897)
Constant	6.465***	0.600**	8.396***	8.497***	1.069***	59.48
	(2.278)	(0.265)	(1.864)	(1.698)	(0.277)	(86.63)
Number of observations	846	846	191	804	804	432
Log-likelihood at maximum	57.32	42.24	12.47	33.66	28.42	0.38

Notes:
Standard errors are in parenthesis
One (*), two (**), three (***) asterisks represent 0.10, 0.05, and 0.01 levels of statistical significance, respectively
[a] Indicates that the Tobit model was employed
[b] Indicates that the Probit model was employed
[c] Indicates that the Truncated model was employed

Appendix H: Average Marginal Effect estimates of Tobit vs Double Hurdle results using Full Model for the Truncated Regression

(Tables 41, 42 and 43)

Table 41: Comparison of Tobit to Double Hurdle model (AME): Choice Problems 1 and 2

	Choice Problem 1: WTP Premium on Ground Beef – Supermarket vs. Other Markets			**Choice Problem 2: WTP Premium on Steak – Supermarket vs. Other Markets**		
Variables	**Tobit[a]**	**Double Hurdle Model**		**Tobit[a]**	**Double Hurdle Model**	
		Hurdle 1: Probit Regression[b]	**Hurdle 2: Truncated Regression[c]**		**Hurdle 1: Probit Regression[b]**	**Hurdle 2: Truncated Regression[c]**
Treatment (Base: Information treatment)						
No information treatment	0.145	-0.0465	0.458**	0.299	-0.00210	0.364
	(0.245)	(0.0469)	(0.215)	(0.265)	(0.0478)	(0.320)
Information and organic treatment	-0.135	-0.0509	0.315	-0.0516	-0.0505	0.406
	(0.244)	(0.0468)	(0.210)	(0.266)	(0.0472)	(0.320)
Information and hormone-free treatment	0.111	-0.0452	0.548***	0.184	-0.0452	0.873***
	(0.246)	(0.0471)	(0.213)	(0.267)	(0.0475)	(0.328)
Information and SGA treatment	-0.160	-0.0402	0.265	-0.0733	-0.0108	0.272
	(0.249)	(0.0479)	(0.209)	(0.268)	(0.0483)	(0.315)
Household level characteristics						
Household size	0.138**	0.0136	-0.0128	0.0249	-0.00570	0.0636
	(0.0535)	(0.0109)	(0.0474)	(0.0590)	(0.0101)	(0.0802)
Median income	2.36e-06	5.38e-07	1.67e-06	4.29e-06**	2.82e-07	2.53e-08
	(1.99e-06)	(3.87e-07)	(1.74e-06)	(2.15e-06)	(3.84e-07)	(2.75e-06)
Age (Base: Young)						
Middle	-0.729**	-0.0927	-0.235	-0.707***	-0.0998*	-0.239
	(0.278)	(0.0554)	(0.266)	(0.288)	(0.0535)	(0.375)
Old	-1.297***	-0.0944	-1.147***	-1.377***	-0.0998*	-1.479***
	(0.306)	(0.0610)	(0.285)	(0.323)	(0.0606)	(0.409)
Location (Base: Rural)						
Suburban	-0.0313	0.0230	0.0335	-0.00285	0.0190	0.0969

	(0.181)	(0.0347)	0 .153	(0.196)	(0.0354)	(0.235)
Urban	0.260	-0.00369	0.433**	0.0520	-0.0292	0.317
	(0.217)	(0.0408)	(0.200)	(0.232)	(0.0403)	(0.293)
Gender (Base: Male)						
Female	-0.406**	-0.0609**	0.116	-0.105	-0.0732**	0.299
	(0.160)	(0.0316)	(0.145)	(0.178)	(0.0318)	(0.220)
Educational level (Base: Some/full high school)						
Some/above college education	0.0221	0.0435	-0. 642	-0.0211	0.0130	0.133
	(0.181)	(0.0335)	(0.165)	(0.194)	(0.0336)	(0.245)
Primary purchaser of food (Base: No)						
Yes	0.0176	-0.0104	0. 0110	-0.0100	-0.00182	-0.368**
	(0.165)	(0.0316)	(0.142)	(0.178)	(0.0319)	(0.220)
Ownership of freezer (Base: No)						
Yes	0.637***	0.120***	0.340**	0.411***	0.0630**	0.132
	(0.161)	(0.0299)	(0.142)	(0.176)	(0.0309)	(0.213)
Definition of freezer beef (Base: Otherwise)						
Correct	0.484***	0.101***	-0.0564	0.541***	0.125***	0.00542
	(0.175)	(0.0346)	(0.151)	(0.190)	(0.0359)	(0.232)
Race (Base: White)						
Black	0.379	-0.00985	0.837***	0.324	-0.0144	1.154***
	(0.197)	(0.0374)	(0.182)	(0.209)	(0.0368)	(0.267)
Number of observations	888	888	508	799	799	468
Log-likelihood at maximum	88.05	48.50	100.75	52.53	33.77	50.60

Notes: Standard errors are in parenthesis

One (*), two (**), three (***) asterisks represent 0.10, 0.05, and 0.01 levels of statistical significance, respectively

[a] Indicates that the Tobit model was employed

[b] Indicates that the Probit model was employed

[c] Indicates that the Truncated model was employed

Table 42: Comparison of Tobit to Double Hurdle model (AME): Choice Problems 3 and 4

Variables	Choice Problem 3: WTP Premium on Ground Beef from Supermarket vs. Freezer Beef			Choice Problem 4: WTP Premium on Steak from Supermarket vs. Freezer Beef		
	Tobit[a]	Double Hurdle Model		Tobit[a]	Double Hurdle Model	
		Hurdle 1: Probit Regression[b]	Hurdle 2: Truncated Regression[c]		Hurdle 1: Probit Regression[b]	Hurdle 2: Truncated Regression[c]
Treatment (Base: Information treatment)						
No information treatment	0.0677	-0.0388	0.470*	-0.403	-0.0951*	1.166***
	(0.245)	(0.0483)	(0.245)	(0.291)	(0.0480)	(0.417)
Information and organic treatment	-0.0947	-0.0661	0.0989	-0.421	-0.0759	0.0275
	(0.247)	(0.0485)	(0.252)	(0.292)	(0.0485)	(0.397)
Information and hormone-free treatment	0.363	-0.00733	0.525**	-0.516*	-0.132**	0.843**
	(0.246)	(0.0491)	(0.249)	(0.294)	(0.0477)	(0.435)
Information and SGA treatment	-0.0334	-0.0275	0.0542	0.378	-0.0678	0.276
	(0.252)	(0.0499)	(0.248)	(0.297)	(0.0495)	(0.403)
Household level characteristics						
Household size	0.0173	0.00202	0.000653	-0.0163	-0.00268	-0.016
	(0.0547)	(0.0106)	(0.0605)	(0.0635)	(0.00976)	(0.103)
Median income	-6.32e-07	3.57e-09	-1.07e-06	-2.30e-06	-2.21e-07	-2.15e-06
	(2.01e-06)	(3.93e-07)	(2.13e-06)	(2.36e-06)	(3.73e-07)	(3.45e-06)
Age (Base: Young)						
Middle	-0.487	-0.0814	-0.619**	-0.0646	-0.0594	-0.425
	(0.495)	(0.0569)	(0.304)	(0.316)	(0.0524)	(0.456)
Old	-1.336***	-0.159**	-1.604***	-0.296	-0.0368	-1.823***
	(0.305)	(0.0621)	(0.329)	(0.356)	(0.0592)	(0.494)
Location (Base: Rural)						
Suburban	-0.115	-0.0140	-0.111	0.0662	0.00347	0.265
	(0.183)	(0.0360)	(0.185)	(0.217)	(0.0352)	(.316)
Urban	0.202	-0.0103	0.0778	-0.401	-0.0604	0.122
	(0.220)	(0.0433)	(0.239)	(0.255)	(0.0405)	(0.370)
Gender (Base: Male)						
Female	-0.431***	-0.0995***	0.106	-0.670	-0.107***	-0.534*
	(0.166)	(0.0327)	(0.171)	(0.194)	(0.0319)	(0 .286)
Educational level (Base: Some/full high school)						
Some/above college education	0.0889	0.0300	0.212	-0.115	-0.0186	-0.200
	(0.183)	(0.0353)	(0.193)	(0.213)	(0.0343)	(0.308)

Primary purchaser of food (Base: No)						
Yes	0.189	-0.00518	0.130	-0.0265	-0.0102	0.296
	(0.167)	(0.0328)	(0.172)	(0.570)	(0.0324)	(0.287)
Ownership of freezer (Base: No)						
Yes	0.826***	0.136***	0.502***	0.418**	0.0743***	0.511*
	(0.162)	(0.0309)	(0.173)	(0.194)	(0.0318)	(0.283)
Definition of freezer beef (Base: Otherwise)						
Correct	0.826***	0.139***	-0.0223	0.726***	0.127***	0.339
	(0.162)	(0.0356)	(0.176)	(0.208)	(0.0351)	(0.302)
Race (Base: White)						
Black	0.444	0.0109	0.896***	-0.0387	-0.00123	0.300
	(0.200)	(0.0394)	(0.224)	(0.231)	(0.0372)	(0.342)
Number of observations	880	880	479	840	840	284
Log-likelihood at maximum	93.83	58.91	76.71	37.72	46.73	22.60

Notes:
Standard errors are in parenthesis
One (*), two (**), three (***) asterisks represent 0.10, 0.05, and 0.01 levels of statistical significance, respectively
[a] Indicates that the Tobit model was employed
[b] Indicates that the Probit model was employed
[c] Indicates that the Truncated model was employed

Table 43: Comparison of Tobit to Double Hurdle model (AME): Choice Problems 5 and 6

Variables	Choice Problem 3: WTP Premium on Ground Beef from Other Markets vs. Freezer Beef			Choice Problem 4: WTP Premium on Steak from Other markets vs. Freezer Beef		
	Tobit[a]	Double Hurdle Model		Tobit[a]	Double Hurdle Model	
		Hurdle 1: Probit Regression[b]	Hurdle 2: Truncated Regression[c]		Hurdle 1: Probit Regression[b]	Hurdle 2: Truncated Regression[c]
Treatment (Base: Information treatment)						
No information treatment	0.497*	-0.0312	0.154	0.185	-0.000764	1.226
	(0.289)	(0470)	(0.500)	(0.518)	(0.0469)	(0.455)
Information and organic treatment	0.265	0.0324	-0.959**	-0.614	-0.0690	-0.602
	(0.290)	(0.0474)	(0.448)	(0.521)	(0.0453)	(0.790)
Information and hormone-free treatment	0.0113**	-0.0556	-0.245	-0.478	-0.0661	0.144
	(0.293)	(0.0462)	(0.523)	(0.529)	(0.0465)	(0.414)
Information and SGA treatment	0.0696	0.0112	-0.136	0.246	-0.00885	-0.0378
	(0.290)	(0.0472)	(0.445)	(0.521)	(0.0473)	(0.356)
Household level characteristics						
Household size	0.0162	0.00299	-0.170	0.0226	-0.00170	0.0676
	(0.0635)	(0.0106)	(0.113)	(0.113)	(0.00959)	(0.118)
Median income	-3.64e-06	-3.23e-07	-3.48e-06	-7.59e-06*	-5.02e-07	-3.47e-06
	(2.37e-06)	(3.79e-07)	(4.07e-06)	(4.25e-06)	(3.60e-07)	(5.11e-06)
Age (Base: Young)						
Middle	-0.554	-0.0461	-0.391	0.791	0.00280	-0.0220
	(0.342)	(0.0537)	(0.794)	(0.567)	(0.0498)	(0.407)
Old	-0.971***	-0.0614	-1.408	0.270	0.0346	-1.667
	(0.376)	(0.0596)	(0.845)	(0.640)	(0.0567)	(0.892)
Location (Base: Rural)						
Suburban	0.160	0.0499	0.474	0.0280	0.0100	0.171
	(0.218)	(0.0351)	(0.352)	(0.391)	(0.0347)	(0.342)
Urban	-0.0135	-0.0263	0.507	-0.555	-0.0594	0.140
	(0.263)	(0.0407)	(0.518)	(0.386)	(0.0396)	(0.377)
Gender (Base: Male)						
Female	-0.316	-0.0593*	-0.324	-0.794**	-0.0602*	0.140
	(0.198)	(0.0318)	(0.343)	(0.352)	(0.0313)	(0.885)
Educational level (Base: Some/full high school)						
Some/above college education	0.135	0.00276	-0.252	-0.597	-0.0420	-0.140
	(0.216)	(0.0345)	(0.367)	(0.386)	(0.0344)	(0.320)

Primary purchaser of food (Base: No)						
Yes	-0.0722	-0.0306	-0.737	-0.276	-0.0356	0.0517
	(0.198)	(0.0320)	(0.339)	(0.352)	(0.0313)	(0.259)
Ownership of freezer (Base: No)						
Yes	1.041***	0.139***	-0.582	1.038***	0.0759**	-0.181
	(0.186)	(0.0298)	(0.321)	(0.348)	(0.0302)	(0.328)
Definition of freezer beef (Base: Otherwise)						
Correct	0.393*	0.0753**	0.271	0.436	0.0385	0.423
	(0.213)	(0.0348)	(0.351)	(0.381)	(0.0341)	(0.564)
Race (Base: White)						
Black	0.424*	0.0306	0.572	0.580	0.0347	-0.141
	(0.241)	(0.0382)	(0.450)	(0.421)	(0.0374)	(0.348)
Number of observations	846	846	479	804	804	432
Log-likelihood at maximum	57.32	42.24	76.71	33.66	28.42	0.38

Notes:
Standard errors are in parenthesis
One (*), two (**), three (***) asterisks represent 0.10, 0.05, and 0.01 levels of statistical significance, respectively
[a] Indicates that the Tobit model was employed
[b] Indicates that the Probit model was employed
[c] Indicates that the Truncated model was employed

Appendix I: Questionnaire

AL Beef Consumer

Start of Block: IRB

Q1
Alabama Resident Food Purchasing

In effort to better understand the food purchasing behaviors of Alabama residents, the Alabama Cooperative Extension System and Auburn University asks you to please complete the following short survey concerning your food purchasing and consumption. The title of this study is, "Consumer Survey to Evaluate New Beef Processing in Alabama."

You are invited to participate in a research study to assess consumer demand, perceptions, and attitudes towards beef products grown and processed in Alabama. The study is being conducted by Adam Rabinowitz and Wendiam Sawadgo in the Auburn University Department of Agricultural Economics and Rural Sociology and Alabama Cooperative Extension System, with partial funding from the Alabama Cattlemen's Association. You are invited to participate because of your participation in a Qualtrics panel, you have been identified as an Alabama resident, and are at least 18 years of age or older.

What will be involved if you participate? Your participation is completely voluntary. If you decide to participate in this research study, you will be asked to complete a survey to assess your food purchasing behaviors. In the survey, you will be asked to answer a series of questions about your food purchasing and consumption. Your total time commitment will be approximately 15 minutes.

Are there any risks or discomforts? The risks associated with participating in this study are from the regular use of the Internet on a computer, smartphone, or tablet. There is also a minimal risk that your information could be accessed by others, however our survey host (Qualtrics) uses encryption and other methods to protect your data.

Are there any benefits to yourself or others? If you participate in this study, you can expect that your responses will be combined with others to inform the beef cattle industry about purchasing behaviors of Alabama residents. Participants will not personally benefit from participating in the study.

Will you receive compensation for participating? You will not receive any compensation from Auburn University or the Alabama Cooperative Extension System for participating, but you will be compensated (e.g., points for participation or some other incentive) by Qualtrics, LLC. according to the terms you agreed with them.

If you change your mind about participating, you can withdraw at any time by closing your browser window. Once you've submitted anonymous data, it cannot be withdrawn since it will be unidentifiable. Your decision about whether or not to participate or to stop participating will not jeopardize your future relations with Auburn University, the Department of Agricultural Economics and Rural Sociology or the Alabama Cooperative Extension System.

Any data obtained in connection with this study will remain anonymous. We will protect your privacy and the data you provide by not sharing individual responses. Information collected through your participation may be combined with other answers in summary form and used in media releases, published in a professional journal, and/or presented at professional and industry meetings.

The Auburn University Institutional Review Board has approved this document for use from May 18, 2021 to --------- Protocol #21-244 EX 2105, Rabinowitz.

If you have any questions about this study, please contact the principal investigator:

Adam Rabinowitz
adam.rabinowitz@auburn.edu
334-844-5620

Wendiam Sawadgo
wendiam@auburn.edu
334-844-4800

If you have any questions about your rights as a study participant, you may contact the Auburn University Office of Research Compliance or the Institutional Review Board by phone (334) 844-5966 or e-mail at IRBadmin@auburn.edu or IRBChair@auburn.edu.

HAVING READ THE INFORMATION ABOVE, YOU MUST DECIDE IF YOU WANT TO PARTICIPATE IN THIS RESEARCH PROJECT. IF YOU DECIDE TO PARTICIPATE, PLEASE CLICK AGREE TO PARTICIPATE BELOW. YOU MAY PRINT A COPY OF THIS LETTER TO KEEP.

- ○ Agree to participate (continue) (1)
- ○ Do not agree to participate (leave) (2)

Skip To: End of Block If Q1 = 2

End of Block: IRB

Start of Block: Quota

Q2 What is your age?

- ○ <18 years of age (1)
- ○ 18-24 years of age (2)
- ○ 25-54 years of age (3)
- ○ 55 years or older (4)

Skip To: End of Block If Q2 = 1

Page Break

Q3 In what US state do you live?

▼ Alabama (1) ... Wyoming (51)

Skip To: End of Block If Q3 != 1

Page Break

Q4 Which best describes the area in which you live?

- ○ Rural (1)
- ○ Suburban (2)
- ○ Urban (3)
- ○ Prefer not to answer (4)

Skip To: End of Block If Q4 = 4

Page Break

Q5 What is your gender?

- ○ Male (1)
- ○ Female (2)
- ○ Non-binary / third gender / other (3)

Page Break

Q6 What is the highest level of education you have completed?

- ○ Less than High School (1)
- ○ High School/GED (2)
- ○ Some College (3)
- ○ 2-Year College Degree (Associates) (4)
- ○ 4-Year College Degree (BA, BS) (5)
- ○ Master's Degree (6)
- ○ Professional Degree (Ph.D., J.D., M.D., etc.) (7)

Page Break

Q7 What is your annual household income?

▼ --- (0) ... $250,000 or more (26)

Page Break

Q8 Who is the primary purchaser of food in your household?

- ○ You (1)
- ○ Another adult in the household (2)
- ○ You and another adult in the household, split evenly (3)
- ○ An adult outside of the household (4)

End of Block: Quota

Start of Block: Segmentation

Q9 What is the first word or phrase that comes to mind when you hear the term **"freezer beef"**?

_____

Page Break

Q10 Have you purchased meat in the last 12 months?

- ○ Yes (1)
- ○ No (2)

Page Break

Q11 Do you own a dedicated deep freezer? This can be either a chest freezer or upright freezer, but does not have an attached refrigerator.

- ○ Yes (1)
- ○ No (2)

Page Break

Q12 Which of the following options do you think best defines the term "freezer beef"?

- ○ Purchasing beef from the freezer section of the supermarket. (1)
- ○ Purchasing beef in bulk quantity directly from a cattle producer, usually as a whole, half, or quarter of the animal. (2)
- ○ Purchasing frozen beef from a mail order beef company. (3)
- ○ Some other definition not listed above. (4) _____

Page Break

Display This Question:

If Q10 = 1

Q13 What type of meat have you purchased in the last 12 months? (select all that apply)

- ☐ Beef (1)
- ☐ Chicken (2)
- ☐ Pork (3)
- ☐ Turkey (4)
- ☐ Goat (5)
- ☐ Sheep or Lamb (6)
- ☐ Game (including Venison) (8)
- ☐ Seafood (9)
- ☐ Other (10) _____

Page Break

Display This Question:

If Q13 = 1

Q14 Which of the following cuts of beef have you purchased in the last 12 months? (select all that apply)

- [ ] Ground beef (1)
- [ ] Steak (2)
- [ ] Roasts (3)
- [ ] Stew (4)
- [ ] Ribs (5)
- [ ] Others (6) _____
- [ ] I don't know (7)

Page Break

Display This Question:

If Q13 = 1

Q15 Have you purchased any of the following beef grades in the last 12 months? (select all that apply)

- ☐ USDA Prime (1)
- ☐ USDA Choice (2)
- ☐ USDA Select (3)
- ☐ non-USDA grade (4)
- ☐ I do not know the grade (5)

Page Break

Q16 Have you seen any of the following labels on any products that you purchased within the last 12 months?

	Not aware (Never heard of) (1)	Aware of but have not seen on any product (2)	Seen on a product (3)
Image:Logo (Q492_6)	○	○	○
Image:Website logo1 (Q492_8)	○	○	○
Image:Freshfromflorida (Q492_12)	○	○	○
Image:Ptp logo2 (Q492_16)	○	○	○
Image:Sweet Grown Alabama (Q65_17)	○	○	○

End of Block: Segmentation

Start of Block: Freezer Beef Experiment Control Ground

Q17 In the following scenarios you will be presented with options to purchase different beef products. All beef is USDA Choice beef. These options include: Beef from a supermarket in individual packages that range in sizes from 1-3 pounds (lbs) per package. You may purchase a single package or multiple packages on each shopping trip.

Beef from a farmstand, farmers market, or meat market in individual packages that range in sizes from 1-3 pounds (lbs) per package. You may purchase a single package or multiple packages on each shopping trip.

Freezer beef directly from the producer - 1/4 of the animal processed in assorted cuts.

Page Break

Q18 For each row click the button next to the option you prefer on the left (**supermarket ground beef**) or the right (**farmstand, farmer's market, or meat market ground beef**). If you do not want to choose either option, you may choose the middle option. All ground beef is 85% lean/15% fat.

Remember: Supermarket beef comes in 1-3 lb packages. Farmstand, Farmer's Market, and Meat Market beef comes in 1-3lb packages. You may purchase any number of packages at the stated price.

	Supermarket Choice (on left)	Neither Choice (middle)	Farmstand, Farmer's Market, or Meat Market Choice (on right)	

	1 (1)	2 (2)	3 (3)	
Supermarket Ground Beef at $4/lb	○	○	○	Farmstand, Farmer's Market, or Meat Market Ground Beef at $8/lb
Supermarket Ground Beef at $4/lb	○	○	○	Farmstand, Farmer's Market, or Meat Market Ground Beef at $7.50/lb
Supermarket Ground Beef at $4/lb	○	○	○	Farmstand, Farmer's Market, or Meat Market Ground Beef at $7/lb
Supermarket Ground Beef at $4/lb	○	○	○	Farmstand, Farmer's Market, or Meat Market Ground Beef at $6.50/lb
Supermarket Ground Beef at $4/lb	○	○	○	Farmstand, Farmer's Market, or Meat Market Ground Beef at $6/lb
Supermarket Ground Beef at $4/lb	○	○	○	Farmstand, Farmer's Market, or Meat Market Ground Beef at $5.50/lb
Supermarket Ground Beef at $4/lb	○	○	○	Farmstand, Farmer's Market, or Meat Market Ground Beef at $5/lb
Supermarket Ground Beef at $4/lb	○	○	○	Farmstand, Farmer's Market, or Meat Market Ground Beef at $4.50/lb
Supermarket Ground Beef at $4/lb	○	○	○	Farmstand, Farmer's Market, or Meat Market Ground Beef at $4/lb

Supermarket Ground Beef at $4/lb	○	○	○	Farmstand, Farmer's Market, or Meat Market Ground Beef at $3.50/lb
Supermarket Ground Beef at $4/lb	○	○	○	Farmstand, Farmer's Market, or Meat Market Ground Beef at $3/lb
Supermarket Ground Beef at $4/lb	○	○	○	Farmstand, Farmer's Market, or Meat Market Ground Beef at $2.50/lb
Supermarket Ground Beef at $4/lb	○	○	○	Farmstand, Farmer's Market, or Meat Market Ground Beef at $2/lb

Page Break

Q19 For each row click the button next to the option you prefer on the left (**farmstand, farmer's market, or meat market ground beef**) or the right (**freezer beef assorted cuts**). If you do not want to choose either option, you may choose the middle option. All ground beef is 85% lean/15% fat.

Remember: Farmstand, Farmer's Market, and Meat Market beef comes in 1-3lb packages. You may purchase any number of packages at the stated price. Freezer beef directly from the producer - 1/4 of the animal processed in assorted cuts. Prices are per lb of processed beef.

	Farmstand, Farmer's Market, or Meat Market Choice (on left)	Neither Choice (middle)	Freezer Beef Choice (on right)	

	1 (1)	2 (2)	3 (3)	
Farmstand, Farmer's Market, or Meat Market Ground Beef at $2/lb	○	○	○	Freezer Beef Assorted Cuts at $8/lb
Farmstand, Farmer's Market, or Meat Market Ground Beef at $2.50/lb	○	○	○	Freezer Beef Assorted Cuts at $7.50/lb
Farmstand, Farmer's Market, or Meat Market Ground Beef at $3/lb	○	○	○	Freezer Beef Assorted Cuts at $7/lb
Farmstand, Farmer's Market, or Meat Market Ground Beef at $3.50/lb	○	○	○	Freezer Beef Assorted Cuts at $6.50/lb
Farmstand, Farmer's Market, or Meat Market Ground Beef at $4/lb	○	○	○	Freezer Beef Assorted Cuts at $6/lb
Farmstand, Farmer's Market, or Meat Market Ground Beef at $4.50/lb	○	○	○	Freezer Beef Assorted Cuts at $5.50/lb
Farmstand, Farmer's Market, or Meat Market Ground Beef at $5/lb	○	○	○	Freezer Beef Assorted Cuts at $5/lb
Farmstand, Farmer's Market, or Meat Market Ground Beef at $5.50/lb	○	○	○	Freezer Beef Assorted Cuts at $4.50/lb
Farmstand, Farmer's Market, or Meat Market Ground Beef at $6/lb	○	○	○	Freezer Beef Assorted Cuts at $4/lb

Farmstand, Farmer's Market, or Meat Market Ground Beef at $6.50/lb	○	○	○	Freezer Beef Assorted Cuts at $3.50/lb
Farmstand, Farmer's Market, or Meat Market Ground Beef at $7/lb	○	○	○	Freezer Beef Assorted Cuts at $3/lb
Farmstand, Farmer's Market, or Meat Market Ground Beef at $7.50/lb	○	○	○	Freezer Beef Assorted Cuts at $2.50/lb
Farmstand, Farmer's Market, or Meat Market Ground Beef at $8/lb	○	○	○	Freezer Beef Assorted Cuts at $2/lb

Page Break

Q20 For each row click the button next to the option you prefer on the left (**supermarket ground beef**) or the right (**freezer beef assorted cuts**). If you do not want to choose either option, you may choose the middle option. All ground beef is 85% lean/15% fat.

Remember: Supermarket beef comes in 1-3lb packages. You may purchase any number of packages at the stated price. Freezer beef directly from the producer - 1/4 of the animal processed in assorted cuts. Prices are per lb of processed beef.

	Supermarket Choice (on left)	Neither Choice (middle)	Freezer Beef Choice (on right)	

	1 (1)	2 (2)	3 (3)	
Supermarket Ground Beef at $4/lb	○	○	○	Freezer Beef Assorted Cuts at $8/lb
Supermarket Ground Beef at $4/lb	○	○	○	Freezer Beef Assorted Cuts at $7.50/lb
Supermarket Ground Beef at $4/lb	○	○	○	Freezer Beef Assorted Cuts at $7/lb
Supermarket Ground Beef at $4/lb	○	○	○	Freezer Beef Assorted Cuts at $6.50/lb
Supermarket Ground Beef at $4/lb	○	○	○	Freezer Beef Assorted Cuts at $6/lb
Supermarket Ground Beef at $4/lb	○	○	○	Freezer Beef Assorted Cuts at $5.50/lb
Supermarket Ground Beef at $4/lb	○	○	○	Freezer Beef Assorted Cuts at $5/lb
Supermarket Ground Beef at $4/lb	○	○	○	Freezer Beef Assorted Cuts at $4.50/lb
Supermarket Ground Beef at $4/lb	○	○	○	Freezer Beef Assorted Cuts at $4/lb
Supermarket Ground Beef at $4/lb	○	○	○	Freezer Beef Assorted Cuts at $3.50/lb
Supermarket Ground Beef at $4/lb	○	○	○	Freezer Beef Assorted Cuts at $3/lb
Supermarket Ground Beef at $4/lb	○	○	○	Freezer Beef Assorted Cuts at $2.50/lb
Supermarket Ground Beef at $4/lb	○	○	○	Freezer Beef Assorted Cuts at $2/lb

Page Break

End of Block: Freezer Beef Experiment Control Ground

Start of Block: Freezer Beef Experiment Control Steak

Q21 For each row click the button next to the option you prefer on the left (**supermarket boneless sirloin steak**) or the right (**farmstand, farmer's market, or meat market boneless sirloin steak**). If you do not want to choose either option, you may choose the middle option.

Remember: Supermarket beef comes in 1-3 lb packages. Farmstand, Farmer's Market, and Meat Market beef comes in 1-3lb packages. You may purchase any number of packages at the stated price.

	Supermarket Choice (on left)	Neither Choice (middle)	Farmstand, Farmer's Market, or Meat Market Choice (on right)	

	1 (1)	2 (2)	3 (3)	
Supermarket Steak at $10/lb	○	○	○	Farmstand, Farmer's Market, or Meat Market Steak at $14/lb
Supermarket Steak at $10/lb	○	○	○	Farmstand, Farmer's Market, or Meat Market Steak at $13.50/lb
Supermarket Steak at $10/lb	○	○	○	Farmstand, Farmer's Market, or Meat Market Steak at $13/lb
Supermarket Steak at $10/lb	○	○	○	Farmstand, Farmer's Market, or Meat Market Steak at $12.50/lb
Supermarket Steak at $10/lb	○	○	○	Farmstand, Farmer's Market, or Meat Market Steak at $12/lb
Supermarket Steak at $10/lb	○	○	○	Farmstand, Farmer's Market, or Meat Market Steak at $11.50/lb
Supermarket Steak at $10/lb	○	○	○	Farmstand, Farmer's Market, or Meat Market Steak at $11/lb
Supermarket Steak at $10/lb	○	○	○	Farmstand, Farmer's Market, or Meat Market Steak at $10.50/lb
Supermarket Steak at $10/lb	○	○	○	Farmstand, Farmer's Market, or Meat Market Steak at $10/lb
Supermarket Steak at $10/lb	○	○	○	Farmstand, Farmer's Market, or Meat Market Steak at $9.50/lb
Supermarket Steak at $10/lb	○	○	○	Farmstand, Farmer's Market, or Meat Market Steak at $9/lb

Supermarket Steak at $10/lb	○	○	○	Farmstand, Farmer's Market, or Meat Market Steak at $8.50/lb
Supermarket Steak at $10/lb	○	○	○	Farmstand, Farmer's Market, or Meat Market Steak at $8/lb

Q22 For each row click the button next to the option you prefer on the left (**farmstand, farmer's market, or meat market boneless sirloin steak**) or the right (**freezer beef assorted cuts**). If you do not want to choose either option, you may choose the middle option.

Remember: Farmstand, Farmer's Market, and Meat Market beef comes in 1-3lb packages. You may purchase any number of packages at the stated price. Freezer beef directly from the producer - 1/4 of the animal processed in assorted cuts. Prices are per lb of processed beef.

	Farmstand, Farmer's Market, or Meat Market Choice (on left)	Neither Choice (middle)	Freezer Beef Choice (on right)	

	1 (1)	2 (2)	3 (3)	
Farmstand, Farmer's Market, or Meat Market Steak at $8/lb	○	○	○	Freezer Beef Assorted Cuts at $8/lb
Farmstand, Farmer's Market, or Meat Market Steak at $8.50/lb	○	○	○	Freezer Beef Assorted Cuts at $7.50/lb
Farmstand, Farmer's Market, or Meat Market Steak at $9/lb	○	○	○	Freezer Beef Assorted Cuts at $7/lb
Farmstand, Farmer's Market, or Meat Market Steak at $9.50/lb	○	○	○	Freezer Beef Assorted Cuts at $6.50/lb
Farmstand, Farmer's Market, or Meat Market Steak at $10/lb	○	○	○	Freezer Beef Assorted Cuts at $6/lb
Farmstand, Farmer's Market, or Meat Market Steak at $10.50/lb	○	○	○	Freezer Beef Assorted Cuts at $5.50/lb
Farmstand, Farmer's Market, or Meat Market Steak at $11/lb	○	○	○	Freezer Beef Assorted Cuts at $5/lb
Farmstand, Farmer's Market, or Meat Market Steak at $11.50/lb	○	○	○	Freezer Beef Assorted Cuts at $4.50/lb
Farmstand, Farmer's Market, or Meat Market Steak at $12/lb	○	○	○	Freezer Beef Assorted Cuts at $4/lb
Farmstand, Farmer's Market, or Meat Market Steak at $12.50/lb	○	○	○	Freezer Beef Assorted Cuts at $3.50/lb
Farmstand, Farmer's Market, or Meat Market Steak at $13/lb	○	○	○	Freezer Beef Assorted Cuts at $3/lb

Farmstand, Farmer's Market, or Meat Market Steak at $13.50/lb	○	○	○	Freezer Beef Assorted Cuts at $2.50/lb
Farmstand, Farmer's Market, or Meat Market Steak at $14/lb	○	○	○	Freezer Beef Assorted Cuts at $2/lb

Q23 For each row click the button next to the option you prefer on the left (**supermarket boneless sirloin steak**) or the right (**freezer beef assorted cuts**). If you do not want to choose either option, you may choose the middle option.

Remember: Supermarket beef comes in 1-3lb packages. You may purchase any number of packages at the stated price. Freezer beef directly from the producer - 1/4 of the animal processed in assorted cuts. Prices are per lb of processed beef.

	Supermarket Choice (on left)	Neither Choice (middle)	Freezer Beef Choice (on right)	

	1 (1)	2 (2)	3 (3)	
Supermarket Steak at $10/lb	○	○	○	Freezer Beef Assorted Cuts at $8/lb
Supermarket Steak at $10/lb	○	○	○	Freezer Beef Assorted Cuts at $7.50/lb
Supermarket Steak at $10/lb	○	○	○	Freezer Beef Assorted Cuts at $7/lb
Supermarket Steak at $10/lb	○	○	○	Freezer Beef Assorted Cuts at $6.50/lb
Supermarket Steak at $10/lb	○	○	○	Freezer Beef Assorted Cuts at $6/lb
Supermarket Steak at $10/lb	○	○	○	Freezer Beef Assorted Cuts at $5.50/lb
Supermarket Steak at $10/lb	○	○	○	Freezer Beef Assorted Cuts at $5/lb
Supermarket Steak at $10/lb	○	○	○	Freezer Beef Assorted Cuts at $4.50/lb
Supermarket Steak at $10/lb	○	○	○	Freezer Beef Assorted Cuts at $4/lb
Supermarket Steak at $10/lb	○	○	○	Freezer Beef Assorted Cuts at $3.50/lb
Supermarket Steak at $10/lb	○	○	○	Freezer Beef Assorted Cuts at $3/lb
Supermarket Steak at $10/lb	○	○	○	Freezer Beef Assorted Cuts at $2.50/lb
Supermarket Steak at $10/lb	○	○	○	Freezer Beef Assorted Cuts at $2/lb

End of Block: Freezer Beef Experiment Control Steak

Start of Block: Freezer Beef Experiment Control End

Display This Question:

If Q18 [3] (Count) = 0

And Q19 [1] (Count) = 0

And Q21 [3] (Count) = 0

And Q22 [1] (Count) = 0

Q24 From the choices you made in the previous questions you never selected the **Farmstand, Farmer's Market, or Meat Market** option. What are the reasons why you did not select that option? (select all that apply)

- ☐ The price was was too high (1)
- ☐ Previous bad experience with purchasing from a farmstand, farmer's market, or meat market (2)
- ☐ I am not familiar with these outlets (3)
- ☐ I do not trust the purchasing option (4)
- ☐ I am concerned about the quality (5)
- ☐ I have no interest in purchasing from that a farmstand, farmer's market, or meat market (6)
- ☐ I prefer a different cut of beef (8)
- ☐ Other (7) _____

Display This Question:

If Q19 [3] (Count) = 0

And Q20 [3] (Count) = 0

And Q22 [3] (Count) = 0

And Q23 [3] (Count) = 0

Q25 From the choices you made in the previous questions you never selected the **Freezer Beef** option. What are the reasons why you did not select that option? (select all that apply)

- ☐ The quantity of beef is too much (1)
- ☐ The price was was too high (2)
- ☐ Previous bad experience with freezer beef (3)
- ☐ I am not familiar with freezer beef (4)
- ☐ I do not trust the purchasing option (5)
- ☐ I am concerned about the quality (6)
- ☐ I have no interest in purchasing freezer beef (7)
- ☐ I do not want the assorted cuts (9)
- ☐ I do not want to pay the amount of money necessary to purchase that amount of beef (10)
- ☐ Other (8) _____

End of Block: Freezer Beef Experiment Control End

Start of Block: Freezer Beef Experiment Information Ground

Q26 In the following scenarios you will be presented with options to purchase different beef products. All beef is USDA Choice beef. These options include: Beef from a supermarket in individual packages that range in sizes from 1-3 pounds (lbs) per package. You may purchase a single package or multiple packages on each shopping trip.

Beef from a farmstand, farmers market, or meat market in individual packages that range in sizes from 1-3 pounds (lbs) per package. You may purchase a single package or multiple packages on each shopping trip.

Beef from a beef cattle producer as a portion of the entire animal. We call this "Freezer Beef". Each portion consists of a quarter (1/4) of the animal that yields approximately 120-150 pounds (lbs) of processed beef. The beef will be individually packaged in a variety of cuts of various sizes depending on the cut of the meat. Cuts of meat may include steaks, ground beef, and roasts. You must purchase the full portion to be delivered or picked up at one time. This will require approximately 4.5 cu. ft. of a chest freezer space or 5.5 cu. ft. of an upright freezer space.

Page Break

Q27 For each row click the button next to the option you prefer on the left (**supermarket ground beef**) or the right (**farmstand, farmer's market, or meat market ground beef**). If you do not want to choose either option, you may choose the middle option. All ground beef is 85% lean/15% fat.

Remember: Supermarket beef comes in 1-3 lb packages. Farmstand, Farmer's Market, and Meat Market beef comes in 1-3lb packages. You may purchase any number of packages at the stated price.

	Supermarket Choice (on left)	Neither Choice (middle)	Farmstand, Farmer's Market, or Meat Market Choice (on right)	

	1 (1)	2 (2)	3 (3)	
Supermarket Ground Beef at $4/lb	○	○	○	Farmstand, Farmer's Market, or Meat Market Ground Beef at $8/lb
Supermarket Ground Beef at $4/lb	○	○	○	Farmstand, Farmer's Market, or Meat Market Ground Beef at $7.50/lb
Supermarket Ground Beef at $4/lb	○	○	○	Farmstand, Farmer's Market, or Meat Market Ground Beef at $7/lb
Supermarket Ground Beef at $4/lb	○	○	○	Farmstand, Farmer's Market, or Meat Market Ground Beef at $6.50/lb
Supermarket Ground Beef at $4/lb	○	○	○	Farmstand, Farmer's Market, or Meat Market Ground Beef at $6/lb
Supermarket Ground Beef at $4/lb	○	○	○	Farmstand, Farmer's Market, or Meat Market Ground Beef at $5.50/lb
Supermarket Ground Beef at $4/lb	○	○	○	Farmstand, Farmer's Market, or Meat Market Ground Beef at $5/lb
Supermarket Ground Beef at $4/lb	○	○	○	Farmstand, Farmer's Market, or Meat Market Ground Beef at $4.50/lb
Supermarket Ground Beef at $4/lb	○	○	○	Farmstand, Farmer's Market, or Meat Market Ground Beef at $4/lb

Supermarket Ground Beef at $4/lb	○	○	○	Farmstand, Farmer's Market, or Meat Market Ground Beef at $3.50/lb
Supermarket Ground Beef at $4/lb	○	○	○	Farmstand, Farmer's Market, or Meat Market Ground Beef at $3/lb
Supermarket Ground Beef at $4/lb	○	○	○	Farmstand, Farmer's Market, or Meat Market Ground Beef at $2.50/lb
Supermarket Ground Beef at $4/lb	○	○	○	Farmstand, Farmer's Market, or Meat Market Ground Beef at $2/lb

Page Break

Q28 For each row click the button next to the option you prefer on the left (**farmstand, farmer's market, or meat market ground beef**) or the right (**freezer beef assorted cuts**). If you do not want to choose either option, you may choose the middle option. All ground beef is 85% lean/15% fat.

Remember: Farmstand, Farmer's Market, and Meat Market beef comes in 1-3lb packages. You may purchase any number of packages at the stated price. Freezer Beef is a 1/4 of the animal and must be purchased as 120-150lbs of individually packaged assorted cuts, including steaks, ground beef, and roasts. Prices are per lb of processed beef.

	Farmstand, Farmer's Market, or Meat Market Choice (on left)	Neither Choice (middle)	Freezer Beef Choice (on right)	

	1 (1)	2 (2)	3 (3)	
Farmstand, Farmer's Market, or Meat Market Ground Beef at $2/lb	○	○	○	Freezer Beef Assorted Cuts at $8/lb
Farmstand, Farmer's Market, or Meat Market Ground Beef at $2.50/lb	○	○	○	Freezer Beef Assorted Cuts at $7.50/lb
Farmstand, Farmer's Market, or Meat Market Ground Beef at $3/lb	○	○	○	Freezer Beef Assorted Cuts at $7/lb
Farmstand, Farmer's Market, or Meat Market Ground Beef at $3.50/lb	○	○	○	Freezer Beef Assorted Cuts at $6.50/lb
Farmstand, Farmer's Market, or Meat Market Ground Beef at $4/lb	○	○	○	Freezer Beef Assorted Cuts at $6/lb
Farmstand, Farmer's Market, or Meat Market Ground Beef at $4.50/lb	○	○	○	Freezer Beef Assorted Cuts at $5.50/lb
Farmstand, Farmer's Market, or Meat Market Ground Beef at $5/lb	○	○	○	Freezer Beef Assorted Cuts at $5/lb
Farmstand, Farmer's Market, or Meat Market Ground Beef at $5.50/lb	○	○	○	Freezer Beef Assorted Cuts at $4.50/lb
Farmstand, Farmer's Market, or Meat Market Ground Beef at $6/lb	○	○	○	Freezer Beef Assorted Cuts at $4/lb

Farmstand, Farmer's Market, or Meat Market Ground Beef at $6.50/lb	○	○	○	Freezer Beef Assorted Cuts at $3.50/lb
Farmstand, Farmer's Market, or Meat Market Ground Beef at $7/lb	○	○	○	Freezer Beef Assorted Cuts at $3/lb
Farmstand, Farmer's Market, or Meat Market Ground Beef at $7.50/lb	○	○	○	Freezer Beef Assorted Cuts at $2.50/lb
Farmstand, Farmer's Market, or Meat Market Ground Beef at $8/lb	○	○	○	Freezer Beef Assorted Cuts at $2/lb

Page Break

Q29 For each row click the button next to the option you prefer on the left (**supermarket ground beef**) or the right (**freezer beef assorted cuts**). If you do not want to choose either option, you may choose the middle option. All ground beef is 85% lean/15% fat.

Remember: Supermarket beef comes in 1-3lb packages. You may purchase any number of packages at the stated price. Freezer Beef is a 1/4 of the animal and must be purchased as 120-150lbs of individually packaged assorted cuts, including steaks, ground beef, and roasts. Prices are per lb of processed beef.

	Supermarket Choice (on left)	Neither Choice (middle)	Freezer Beef Choice (on right)	

	1 (1)	2 (2)	3 (3)	
Supermarket Ground Beef at $4/lb	○	○	○	Freezer Beef Assorted Cuts at $8/lb
Supermarket Ground Beef at $4/lb	○	○	○	Freezer Beef Assorted Cuts at $7.50/lb
Supermarket Ground Beef at $4/lb	○	○	○	Freezer Beef Assorted Cuts at $7/lb
Supermarket Ground Beef at $4/lb	○	○	○	Freezer Beef Assorted Cuts at $6.50/lb
Supermarket Ground Beef at $4/lb	○	○	○	Freezer Beef Assorted Cuts at $6/lb
Supermarket Ground Beef at $4/lb	○	○	○	Freezer Beef Assorted Cuts at $5.50/lb
Supermarket Ground Beef at $4/lb	○	○	○	Freezer Beef Assorted Cuts at $5/lb
Supermarket Ground Beef at $4/lb	○	○	○	Freezer Beef Assorted Cuts at $4.50/lb
Supermarket Ground Beef at $4/lb	○	○	○	Freezer Beef Assorted Cuts at $4/lb
Supermarket Ground Beef at $4/lb	○	○	○	Freezer Beef Assorted Cuts at $3.50/lb
Supermarket Ground Beef at $4/lb	○	○	○	Freezer Beef Assorted Cuts at $3/lb
Supermarket Ground Beef at $4/lb	○	○	○	Freezer Beef Assorted Cuts at $2.50/lb
Supermarket Ground Beef at $4/lb	○	○	○	Freezer Beef Assorted Cuts at $2/lb

End of Block: Freezer Beef Experiment Information Ground

Start of Block: Freezer Beef Experiment Information Steak

Q30 For each row click the button next to the option you prefer on the left (**supermarket boneless sirloin steak**) or the right (**farmstand, farmer's market, or meat market boneless sirloin steak**). If you do not want to choose either option, you may choose the middle option.

Remember: Supermarket beef comes in 1-3 lb packages. Farmstand, Farmer's Market, and Meat Market beef comes in 1-3lb packages. You may purchase any number of packages at the stated price.

	Supermarket Choice (on left)	Neither Choice (middle)	Farmstand, Farmer's Market, or Meat Market Choice (on right)	

	1 (1)	2 (2)	3 (3)	
Supermarket Steak at $10/lb	○	○	○	Farmstand, Farmer's Market, or Meat Market Steak at $14/lb
Supermarket Steak at $10/lb	○	○	○	Farmstand, Farmer's Market, or Meat Market Steak at $13.50/lb
Supermarket Steak at $10/lb	○	○	○	Farmstand, Farmer's Market, or Meat Market Steak at $13/lb
Supermarket Steak at $10/lb	○	○	○	Farmstand, Farmer's Market, or Meat Market Steak at $12.50/lb
Supermarket Steak at $10/lb	○	○	○	Farmstand, Farmer's Market, or Meat Market Steak at $12/lb
Supermarket Steak at $10/lb	○	○	○	Farmstand, Farmer's Market, or Meat Market Steak at $11.50/lb
Supermarket Steak at $10/lb	○	○	○	Farmstand, Farmer's Market, or Meat Market Steak at $11/lb
Supermarket Steak at $10/lb	○	○	○	Farmstand, Farmer's Market, or Meat Market Steak at $10.50/lb
Supermarket Steak at $10/lb	○	○	○	Farmstand, Farmer's Market, or Meat Market Steak at $10/lb
Supermarket Steak at $10/lb	○	○	○	Farmstand, Farmer's Market, or Meat Market Steak at $9.50/lb
Supermarket Steak at $10/lb	○	○	○	Farmstand, Farmer's Market, or Meat Market Steak at $9/lb

Supermarket Steak at $10/lb	○	○	○	Farmstand, Farmer's Market, or Meat Market Steak at $8.50/lb
Supermarket Steak at $10/lb	○	○	○	Farmstand, Farmer's Market, or Meat Market Steak at $8/lb

Q31 For each row click the button next to the option you prefer on the left (**farmstand, farmer's market, or meat market boneless sirloin steak**) or the right (**freezer beef assorted cuts**). If you do not want to choose either option, you may choose the middle option.

Remember: Farmstand, Farmer's Market, and Meat Market beef comes in 1-3lb packages. You may purchase any number of packages at the stated price. Freezer Beef is a 1/4 of the animal and must be purchased as 120-150lbs of individually packaged assorted cuts, including steaks, ground beef, and roasts. Prices are per lb of processed beef.

	Farmstand, Farmer's Market, or Meat Market Choice (on left)	Neither Choice (middle)	Freezer Beef Choice (on right)	

	1 (1)	2 (2)	3 (3)	
Farmstand, Farmer's Market, or Meat Market Steak at $8/lb	○	○	○	Freezer Beef Assorted Cuts at $8/lb
Farmstand, Farmer's Market, or Meat Market Steak at $8.50/lb	○	○	○	Freezer Beef Assorted Cuts at $7.50/lb
Farmstand, Farmer's Market, or Meat Market Steak at $9/lb	○	○	○	Freezer Beef Assorted Cuts at $7/lb
Farmstand, Farmer's Market, or Meat Market Steak at $9.50/lb	○	○	○	Freezer Beef Assorted Cuts at $6.50/lb
Farmstand, Farmer's Market, or Meat Market Steak at $10/lb	○	○	○	Freezer Beef Assorted Cuts at $6/lb
Farmstand, Farmer's Market, or Meat Market Steak at $10.50/lb	○	○	○	Freezer Beef Assorted Cuts at $5.50/lb
Farmstand, Farmer's Market, or Meat Market Steak at $11/lb	○	○	○	Freezer Beef Assorted Cuts at $5/lb
Farmstand, Farmer's Market, or Meat Market Steak at $11.50/lb	○	○	○	Freezer Beef Assorted Cuts at $4.50/lb
Farmstand, Farmer's Market, or Meat Market Steak at $12/lb	○	○	○	Freezer Beef Assorted Cuts at $4/lb
Farmstand, Farmer's Market, or Meat Market Steak at $12.50/lb	○	○	○	Freezer Beef Assorted Cuts at $3.50/lb
Farmstand, Farmer's Market, or Meat Market Steak at $13/lb	○	○	○	Freezer Beef Assorted Cuts at $3/lb

Farmstand, Farmer's Market, or Meat Market Steak at $13.50/lb	○	○	○	Freezer Beef Assorted Cuts at $2.50/lb
Farmstand, Farmer's Market, or Meat Market Steak at $14/lb	○	○	○	Freezer Beef Assorted Cuts at $2/lb

Q32 For each row click the button next to the option you prefer on the left (**supermarket boneless sirloin steak**) or the right (**freezer beef assorted cuts**). If you do not want to choose either option, you may choose the middle option.

Remember: Supermarket beef comes in 1-3lb packages. You may purchase any number of packages at the stated price. Freezer Beef is a 1/4 of the animal and must be purchased as 120-150lbs of individually packaged assorted cuts, including steaks, ground beef, and roasts. Prices are per lb of processed beef.

	Supermarket Choice (on left)	Neither Choice (middle)	Freezer Beef Choice (on right)	

	1 (1)	2 (2)	3 (3)	
Supermarket Steak at $10/lb	○	○	○	Freezer Beef Assorted Cuts at $8/lb
Supermarket Steak at $10/lb	○	○	○	Freezer Beef Assorted Cuts at $7.50/lb
Supermarket Steak at $10/lb	○	○	○	Freezer Beef Assorted Cuts at $7/lb
Supermarket Steak at $10/lb	○	○	○	Freezer Beef Assorted Cuts at $6.50/lb
Supermarket Steak at $10/lb	○	○	○	Freezer Beef Assorted Cuts at $6/lb
Supermarket Steak at $10/lb	○	○	○	Freezer Beef Assorted Cuts at $5.50/lb
Supermarket Steak at $10/lb	○	○	○	Freezer Beef Assorted Cuts at $5/lb
Supermarket Steak at $10/lb	○	○	○	Freezer Beef Assorted Cuts at $4.50/lb
Supermarket Steak at $10/lb	○	○	○	Freezer Beef Assorted Cuts at $4/lb
Supermarket Steak at $10/lb	○	○	○	Freezer Beef Assorted Cuts at $3.50/lb
Supermarket Steak at $10/lb	○	○	○	Freezer Beef Assorted Cuts at $3/lb
Supermarket Steak at $10/lb	○	○	○	Freezer Beef Assorted Cuts at $2.50/lb
Supermarket Steak at $10/lb	○	○	○	Freezer Beef Assorted Cuts at $2/lb

End of Block: Freezer Beef Experiment Information Steak

Start of Block: Freezer Beef Experiment Information End

Display This Question:

If Q27 [3] (Count) = 0

And Q28 [1] (Count) = 0

And Q30 [3] (Count) = 0

And Q31 [1] (Count) = 0

Q33 From the choices you made in the previous questions you never selected the **Farmstand, Farmer's Market, or Meat Market** option. What are the reasons why you did not select that option? (select all that apply)

- ☐ The price was was too high (1)
- ☐ Previous bad experience with purchasing from a farmstand, farmer's market, or meat market (2)
- ☐ I am not familiar with these outlets (3)
- ☐ I do not trust the purchasing option (4)
- ☐ I am concerned about the quality (5)
- ☐ I have no interest in purchasing from that a farmstand, farmer's market, or meat market (6)
- ☐ I prefer a different cut of beef (8)
- ☐ Other (7) _____

Display This Question:

If Q28 [3] (Count) = 0

And Q29 [3] (Count) = 0

And Q31 [3] (Count) = 0

And Q32 [3] (Count) = 0

Q34 From the choices you made in the previous questions you never selected the **Freezer Beef** option. What are the reasons why you did not select that option? (select all that apply)

- ☐ The quantity of beef is too much (1)
- ☐ The price was was too high (2)
- ☐ Previous bad experience with freezer beef (3)
- ☐ I am not familiar with freezer beef (4)
- ☐ I do not trust the purchasing option (5)
- ☐ I am concerned about the quality (6)
- ☐ I have no interest in purchasing freezer beef (7)
- ☐ I do not want the assorted cuts (9)
- ☐ I do not want to pay the amount of money necessary to purchase that amount of beef (10)
- ☐ Other (8) _____

End of Block: Freezer Beef Experiment Information End

Start of Block: Freezer Beef Experiment Information with Organic Ground

Q35 In the following scenarios you will be presented with options to purchase different beef products. All beef is USDA Choice beef. These options include: Beef from a supermarket in individual packages that range in sizes from 1-3 pounds (lbs) per package. You may purchase a single package or multiple packages on each shopping trip.

Organic beef from a farmstand, farmers market, or meat market in individual packages that range in sizes from 1-3 pounds (lbs) per package. You may purchase a single package or multiple packages on each shopping trip.

Organic beef from a beef cattle producer as a portion of the entire animal. We call this "Freezer Beef". Each portion consists of a quarter (1/4) of the animal that yields approximately 120-150 pounds (lbs) of processed beef. The beef will be individually packaged in a variety of cuts of various sizes depending on the cut of the meat. Cuts of meat may include steaks, ground beef, and roasts. You must purchase the full portion to be delivered or picked up at one time. This will require approximately 4.5 cu. ft. of a chest freezer space or 5.5 cu. ft. of an upright freezer space.

Page Break

Q36 For each row click the button next to the option you prefer on the left (**supermarket ground beef**) or the right (**farmstand, farmer's market, or meat market organic ground beef**). If you do not want to choose either option, you may choose the middle option. All ground beef is 85% lean/15% fat.

Remember: Supermarket beef comes in 1-3 lb packages. Farmstand, Farmer's Market, and Meat Market organic beef comes in 1-3lb packages. You may purchase any number of packages at the stated price.

	Supermarket Choice (on left)	Neither Choice (middle)	Farmstand, Farmer's Market, or Meat Market Choice (on right)	

	1 (1)	2 (2)	3 (3)	
Supermarket Ground Beef at $4/lb	○	○	○	Farmstand, Farmer's Market, or Meat Market Organic Ground Beef at $8/lb
Supermarket Ground Beef at $4/lb	○	○	○	Farmstand, Farmer's Market, or Meat Market Organic Ground Beef at $7.50/lb
Supermarket Ground Beef at $4/lb	○	○	○	Farmstand, Farmer's Market, or Meat Market Organic Ground Beef at $7/lb
Supermarket Ground Beef at $4/lb	○	○	○	Farmstand, Farmer's Market, or Meat Market Organic Ground Beef at $6.50/lb
Supermarket Ground Beef at $4/lb	○	○	○	Farmstand, Farmer's Market, or Meat Market Organic Ground Beef at $6/lb
Supermarket Ground Beef at $4/lb	○	○	○	Farmstand, Farmer's Market, or Meat Market Organic Ground Beef at $5.50/lb
Supermarket Ground Beef at $4/lb	○	○	○	Farmstand, Farmer's Market, or Meat Market Organic Ground Beef at $5/lb
Supermarket Ground Beef at $4/lb	○	○	○	Farmstand, Farmer's Market, or Meat Market Organic Ground Beef at $4.50/lb
Supermarket Ground Beef at $4/lb	○	○	○	Farmstand, Farmer's Market, or Meat Market Organic Ground Beef at $4/lb

Supermarket Ground Beef at $4/lb	○	○	○	Farmstand, Farmer's Market, or Meat Market Organic Ground Beef at $3.50/lb
Supermarket Ground Beef at $4/lb	○	○	○	Farmstand, Farmer's Market, or Meat Market Organic Ground Beef at $3/lb
Supermarket Ground Beef at $4/lb	○	○	○	Farmstand, Farmer's Market, or Meat Market Organic Ground Beef at $2.50/lb
Supermarket Ground Beef at $4/lb	○	○	○	Farmstand, Farmer's Market, or Meat Market Organic Ground Beef at $2/lb

Page Break

Q37 For each row click the button next to the option you prefer on the left (**farmstand, farmer's market, or meat market organic ground beef**) or the right (**organic freezer beef assorted cuts**). If you do not want to choose either option, you may choose the middle option. All ground beef is 85% lean/15% fat.

Remember: Farmstand, Farmer's Market, and Meat Market organic beef comes in 1-3lb packages. You may purchase any number of packages at the stated price. Organic Freezer Beef is a 1/4 of the animal and must be purchased as 120-150lbs of individually packaged assorted cuts, including steaks, ground beef, and roasts. Prices are per lb of processed beef.

	Farmstand, Farmer's Market, or Meat Market Choice (on left)	Neither Choice (middle)	Freezer Beef Choice (on right)	

	1 (1)	2 (2)	3 (3)	
Farmstand, Farmer's Market, or Meat Market Organic Ground Beef at $2/lb	○	○	○	Organic Freezer Beef Assorted Cuts at $8/lb
Farmstand, Farmer's Market, or Meat Market Organic Ground Beef at $2.50/lb	○	○	○	Organic Freezer Beef Assorted Cuts at $7.50/lb
Farmstand, Farmer's Market, or Meat Market Organic Ground Beef at $3/lb	○	○	○	Organic Freezer Beef Assorted Cuts at $7/lb
Farmstand, Farmer's Market, or Meat Market Organic Ground Beef at $3.50/lb	○	○	○	Organic Freezer Beef Assorted Cuts at $6.50/lb
Farmstand, Farmer's Market, or Meat Market Organic Ground Beef at $4/lb	○	○	○	Organic Freezer Beef Assorted Cuts at $6/lb
Farmstand, Farmer's Market, or Meat Market Organic Ground Beef at $4.50/lb	○	○	○	Organic Freezer Beef Assorted Cuts at $5.50/lb
Farmstand, Farmer's Market, or Meat Market Organic Ground Beef at $5/lb	○	○	○	Organic Freezer Beef Assorted Cuts at $5/lb
Farmstand, Farmer's Market, or Meat Market Organic Ground Beef at $5.50/lb	○	○	○	Organic Freezer Beef Assorted Cuts at $4.50/lb
Farmstand, Farmer's Market, or Meat Market Organic Ground Beef at $6/lb	○	○	○	Organic Freezer Beef Assorted Cuts at $4/lb

Farmstand, Farmer's Market, or Meat Market Organic Ground Beef at $6.50/lb	○	○	○	Organic Freezer Beef Assorted Cuts at $3.50/lb
Farmstand, Farmer's Market, or Meat Market Organic Ground Beef at $7/lb	○	○	○	Organic Freezer Beef Assorted Cuts at $3/lb
Farmstand, Farmer's Market, or Meat Market Organic Ground Beef at $7.50/lb	○	○	○	Organic Freezer Beef Assorted Cuts at $2.50/lb
Farmstand, Farmer's Market, or Meat Market Organic Ground Beef at $8/lb	○	○	○	Organic Freezer Beef Assorted Cuts at $2/lb

Page Break

Q38 For each row click the button next to the option you prefer on the left (**supermarket ground beef**) or the right (**organic freezer beef assorted cuts**). If you do not want to choose either option, you may choose the middle option. All ground beef is 85% lean/15% fat.

Remember: Supermarket beef comes in 1-3lb packages. You may purchase any number of packages at the stated price. Organic Freezer Beef is a 1/4 of the animal and must be purchased as 120-150lbs of individually packaged assorted cuts, including steaks, ground beef, and roasts. Prices are per lb of processed beef.

	Supermarket Choice (on left)	Neither Choice (middle)	Freezer Beef Choice (on right)	

	1 (1)	2 (2)	3 (3)	
Supermarket Ground Beef at $4/lb	○	○	○	Organic Freezer Beef Assorted Cuts at $8/lb
Supermarket Ground Beef at $4/lb	○	○	○	Organic Freezer Beef Assorted Cuts at $7.50/lb
Supermarket Ground Beef at $4/lb	○	○	○	Organic Freezer Beef Assorted Cuts at $7/lb
Supermarket Ground Beef at $4/lb	○	○	○	Organic Freezer Beef Assorted Cuts at $6.50/lb
Supermarket Ground Beef at $4/lb	○	○	○	Organic Freezer Beef Assorted Cuts at $6/lb
Supermarket Ground Beef at $4/lb	○	○	○	Organic Freezer Beef Assorted Cuts at $5.50/lb
Supermarket Ground Beef at $4/lb	○	○	○	Organic Freezer Beef Assorted Cuts at $5/lb
Supermarket Ground Beef at $4/lb	○	○	○	Organic Freezer Beef Assorted Cuts at $4.50/lb
Supermarket Ground Beef at $4/lb	○	○	○	Organic Freezer Beef Assorted Cuts at $4/lb
Supermarket Ground Beef at $4/lb	○	○	○	Organic Freezer Beef Assorted Cuts at $3.50/lb
Supermarket Ground Beef at $4/lb	○	○	○	Organic Freezer Beef Assorted Cuts at $3/lb
Supermarket Ground Beef at $4/lb	○	○	○	Organic Freezer Beef Assorted Cuts at $2.50/lb
Supermarket Ground Beef at $4/lb	○	○	○	Organic Freezer Beef Assorted Cuts at $2/lb

End of Block: Freezer Beef Experiment Information with Organic Ground

Start of Block: Freezer Beef Experiment Information with Organic Steak

Q39 For each row click the button next to the option you prefer on the left (**supermarket boneless sirloin steak**) or the right (**farmstand, farmer's market, or meat market organic boneless sirloin steak**). If you do not want to choose either option, you may choose the middle option.

Remember: Supermarket beef comes in 1-3 lb packages. Organic Farmstand, Farmer's Market, and Meat Market beef comes in 1-3lb packages. You may purchase any number of packages at the stated price.

	Supermarket Choice (on left)	Neither Choice (middle)	Farmstand, Farmer's Market, or Meat Market Choice (on right)	

	1 (1)	2 (2)	3 (3)	
Supermarket Steak at $10/lb	○	○	○	Farmstand, Farmer's Market, or Meat Market Organic Steak at $14/lb
Supermarket Steak at $10/lb	○	○	○	Farmstand, Farmer's Market, or Meat Market Organic Steak at $13.50/lb
Supermarket Steak at $10/lb	○	○	○	Farmstand, Farmer's Market, or Meat Market Organic Steak at $13/lb
Supermarket Steak at $10/lb	○	○	○	Farmstand, Farmer's Market, or Meat Market Organic Steak at $12.50/lb
Supermarket Steak at $10/lb	○	○	○	Farmstand, Farmer's Market, or Meat Market Organic Steak at $12/lb
Supermarket Steak at $10/lb	○	○	○	Farmstand, Farmer's Market, or Meat Market Organic Steak at $11.50/lb
Supermarket Steak at $10/lb	○	○	○	Farmstand, Farmer's Market, or Meat Market Organic Steak at $11/lb
Supermarket Steak at $10/lb	○	○	○	Farmstand, Farmer's Market, or Meat Market Organic Steak at $10.50/lb
Supermarket Steak at $10/lb	○	○	○	Farmstand, Farmer's Market, or Meat Market Organic Steak at $10/lb

Supermarket Steak at $10/lb	○	○	○	Farmstand, Farmer's Market, or Meat Market Organic Steak at $9.50/lb
Supermarket Steak at $10/lb	○	○	○	Farmstand, Farmer's Market, or Meat Market Organic Steak at $9/lb
Supermarket Steak at $10/lb	○	○	○	Farmstand, Farmer's Market, or Meat Market Organic Steak at $8.50/lb
Supermarket Steak at $10/lb	○	○	○	Farmstand, Farmer's Market, or Meat Market Organic Steak at $8/lb

Q40 For each row click the button next to the option you prefer on the left (**farmstand, farmer's market, or meat market organic boneless sirloin steak**) or the right (**organic freezer beef assorted cuts**). If you do not want to choose either option, you may choose the middle option.

Remember: Farmstand, Farmer's Market, and Meat Market organic beef comes in 1-3lb packages. You may purchase any number of packages at the stated price. Organic Freezer Beef is a 1/4 of the animal and must be purchased as 120-150lbs of individually packaged assorted cuts, including steaks, ground beef, and roasts. Prices are per lb of processed beef.

	Farmstand, Farmer's Market, or Meat Market Choice (on left)	Neither Choice (middle)	Freezer Beef Choice (on right)	

	1 (1)	2 (2)	3 (3)	
Farmstand, Farmer's Market, or Meat Market Organic Steak at $8/lb	○	○	○	Organic Freezer Beef Assorted Cuts at $8/lb
Farmstand, Farmer's Market, or Meat Market Organic Steak at $8.50/lb	○	○	○	Organic Freezer Beef Assorted Cuts at $7.50/lb
Farmstand, Farmer's Market, or Meat Market Organic Steak at $9/lb	○	○	○	Organic Freezer Beef Assorted Cuts at $7/lb
Farmstand, Farmer's Market, or Meat Market Organic Steak at $9.50/lb	○	○	○	Organic Freezer Beef Assorted Cuts at $6.50/lb
Farmstand, Farmer's Market, or Meat Market Organic Steak at $10/lb	○	○	○	Organic Freezer Beef Assorted Cuts at $6/lb
Farmstand, Farmer's Market, or Meat Market Organic Steak at $10.50/lb	○	○	○	Organic Freezer Beef Assorted Cuts at $5.50/lb
Farmstand, Farmer's Market, or Meat Market Organic Steak at $11/lb	○	○	○	Organic Freezer Beef Assorted Cuts at $5/lb
Farmstand, Farmer's Market, or Meat Market Organic Steak at $11.50/lb	○	○	○	Organic Freezer Beef Assorted Cuts at $4.50/lb
Farmstand, Farmer's Market, or Meat Market Organic Steak at $12/lb	○	○	○	Organic Freezer Beef Assorted Cuts at $4/lb

Farmstand, Farmer's Market, or Meat Market Organic Steak at $12.50/lb	○	○	○	Organic Freezer Beef Assorted Cuts at $3.50/lb
Farmstand, Farmer's Market, or Meat Market Organic Steak at $13/lb	○	○	○	Organic Freezer Beef Assorted Cuts at $3/lb
Farmstand, Farmer's Market, or Meat Market Organic Steak at $13.50/lb	○	○	○	Organic Freezer Beef Assorted Cuts at $2.50/lb
Farmstand, Farmer's Market, or Meat Market Organic Steak at $14/lb	○	○	○	Organic Freezer Beef Assorted Cuts at $2/lb

Q41 For each row click the button next to the option you prefer on the left (**supermarket boneless sirloin steak**) or the right (**organic freezer beef assorted cuts**). If you do not want to choose either option, you may choose the middle option.

Remember: Supermarket beef comes in 1-3lb packages. You may purchase any number of packages at the stated price. Organic Freezer Beef is a 1/4 of the animal and must be purchased as 120-150lbs of individually packaged assorted cuts, including steaks, ground beef, and roasts. Prices are per lb of processed beef.

	Supermarket Choice (on left)	Neither Choice (middle)	Freezer Beef Choice (on right)	

	1 (1)	2 (2)	3 (3)	
Supermarket Steak at $10/lb	○	○	○	Organic Freezer Beef Assorted Cuts at $8/lb
Supermarket Steak at $10/lb	○	○	○	Organic Freezer Beef Assorted Cuts at $7.50/lb
Supermarket Steak at $10/lb	○	○	○	Organic Freezer Beef Assorted Cuts at $7/lb
Supermarket Steak at $10/lb	○	○	○	Organic Freezer Beef Assorted Cuts at $6.50/lb
Supermarket Steak at $10/lb	○	○	○	Organic Freezer Beef Assorted Cuts at $6/lb
Supermarket Steak at $10/lb	○	○	○	Organic Freezer Beef Assorted Cuts at $5.50/lb
Supermarket Steak at $10/lb	○	○	○	Organic Freezer Beef Assorted Cuts at $5/lb
Supermarket Steak at $10/lb	○	○	○	Organic Freezer Beef Assorted Cuts at $4.50/lb
Supermarket Steak at $10/lb	○	○	○	Organic Freezer Beef Assorted Cuts at $4/lb
Supermarket Steak at $10/lb	○	○	○	Organic Freezer Beef Assorted Cuts at $3.50/lb
Supermarket Steak at $10/lb	○	○	○	Organic Freezer Beef Assorted Cuts at $3/lb
Supermarket Steak at $10/lb	○	○	○	Organic Freezer Beef Assorted Cuts at $2.50/lb
Supermarket Steak at $10/lb	○	○	○	Organic Freezer Beef Assorted Cuts at $2/lb

End of Block: Freezer Beef Experiment Information with Organic Steak

Start of Block: Freezer Beef Experiment Information with Organic End

Display This Question:

If Q36 [3] (Count) = 0

And Q37 [1] (Count) = 0

And Q39 [3] (Count) = 0

And Q40 [1] (Count) = 0

Q42 From the choices you made in the previous questions you never selected the **Farmstand, Farmer's Market, or Meat Market** option. What are the reasons why you did not select that option? (select all that apply)

- ☐ The price was was too high (1)
- ☐ Previous bad experience with purchasing from a farmstand, farmer's market, or meat market (2)
- ☐ I am not familiar with these outlets (3)
- ☐ I do not trust the purchasing option (4)
- ☐ I am concerned about the quality (5)
- ☐ I have no interest in purchasing from that a farmstand, farmer's market, or meat market (6)
- ☐ I prefer a different cut of beef (8)
- ☐ Other (7) _____

Display This Question:

If Q37 [3] (Count) = 0

And Q38 [3] (Count) = 0

And Q40 [3] (Count) = 0

And Q41 [3] (Count) = 0

Q43 From the choices you made in the previous questions you never selected the **Freezer Beef** option. What are the reasons why you did not select that option? (select all that apply)

- ☐ The quantity of beef is too much (1)
- ☐ The price was was too high (2)
- ☐ Previous bad experience with freezer beef (3)
- ☐ I am not familiar with freezer beef (4)
- ☐ I do not trust the purchasing option (5)
- ☐ I am concerned about the quality (6)
- ☐ I have no interest in purchasing freezer beef (7)
- ☐ I do not want the assorted cuts (9)
- ☐ I do not want to pay the amount of money necessary to purchase that amount of beef (10)
- ☐ Other (8) _____

End of Block: Freezer Beef Experiment Information with Organic End

Start of Block: Freezer Beef Experiment Information with Hormone Free Ground

Q44 In the following scenarios you will be presented with options to purchase different beef products. All beef is USDA Choice beef. These options include: Beef from a supermarket in individual packages that range in sizes from 1-3 pounds (lbs) per package. You may purchase a single package or multiple packages on each shopping trip.

Hormone free beef from a farmstand, farmers market, or meat market in individual packages that range in sizes from 1-3 pounds (lbs) per package. You may purchase a single package or multiple packages on each shopping trip.

Hormone free beef from a beef cattle producer as a portion of the entire animal. We call this "Freezer Beef". Each portion consists of a quarter (1/4) of the animal that yields approximately 120-150 pounds (lbs) of processed beef. The beef will be individually packaged in a variety of cuts of various sizes depending on the cut of the meat. Cuts of meat may include steaks, ground beef, and roasts. You must purchase the full portion to be delivered or picked up at one time. This will require approximately 4.5 cu. ft. of a chest freezer space or 5.5 cu. ft. of an upright freezer space.

Page Break

Q45 For each row click the button next to the option you prefer on the left (**supermarket ground beef**) or the right (**farmstand, farmer's market, or meat market hormone free ground beef**). If you do not want to choose either option, you may choose the middle option. All ground beef is 85% lean/15% fat.

Remember: Supermarket beef comes in 1-3 lb packages. Farmstand, Farmer's Market, and Meat Market hormone free beef comes in 1-3lb packages. You may purchase any number of packages at the stated price.

	Supermarket Choice (on left)	Neither Choice (middle)	Farmstand, Farmer's Market, or Meat Market Choice (on right)	

	1 (1)	2 (2)	3 (3)	
Supermarket Ground Beef at $4/lb	○	○	○	Farmstand, Farmer's Market, or Meat Market Hormone Free Ground Beef at $8/lb
Supermarket Ground Beef at $4/lb	○	○	○	Farmstand, Farmer's Market, or Meat Market Hormone Free Ground Beef at $7.50/lb
Supermarket Ground Beef at $4/lb	○	○	○	Farmstand, Farmer's Market, or Meat Market Hormone Free Ground Beef at $7/lb
Supermarket Ground Beef at $4/lb	○	○	○	Farmstand, Farmer's Market, or Meat Market Hormone Free Ground Beef at $6.50/lb
Supermarket Ground Beef at $4/lb	○	○	○	Farmstand, Farmer's Market, or Meat Market Hormone Free Ground Beef at $6/lb
Supermarket Ground Beef at $4/lb	○	○	○	Farmstand, Farmer's Market, or Meat Market Hormone Free Ground Beef at $5.50/lb
Supermarket Ground Beef at $4/lb	○	○	○	Farmstand, Farmer's Market, or Meat Market Hormone Free Ground Beef at $5/lb

Supermarket Ground Beef at $4/lb	○	○	○	Farmstand, Farmer's Market, or Meat Market Hormone Free Ground Beef at $4.50/lb
Supermarket Ground Beef at $4/lb	○	○	○	Farmstand, Farmer's Market, or Meat Market Hormone Free Ground Beef at $4/lb
Supermarket Ground Beef at $4/lb	○	○	○	Farmstand, Farmer's Market, or Meat Market Hormone Free Ground Beef at $3.50/lb
Supermarket Ground Beef at $4/lb	○	○	○	Farmstand, Farmer's Market, or Meat Market Hormone Free Ground Beef at $3/lb
Supermarket Ground Beef at $4/lb	○	○	○	Farmstand, Farmer's Market, or Meat Market Hormone Free Ground Beef at $2.50/lb
Supermarket Ground Beef at $4/lb	○	○	○	Farmstand, Farmer's Market, or Meat Market Hormone Free Ground Beef at $2/lb

Page Break

Q46 For each row click the button next to the option you prefer on the left (**farmstand, farmer's market, or meat market hormone free ground beef**) or the right (**hormone free freezer beef assorted cuts**). If you do not want to choose either option, you may choose the middle option. All ground beef is 85% lean/15% fat.

Remember: Farmstand, Farmer's Market, and Meat Market hormone free beef comes in 1-3lb packages. You may purchase any number of packages at the stated price. Hormone Free Freezer Beef is a 1/4 of the animal and must be purchased as 120-150lbs of individually packaged assorted cuts, including steaks, ground beef, and roasts. Prices are per lb of processed beef.

	Farmstand, Farmer's Market, or Meat Market Choice (on left)	Neither Choice (middle)	Freezer Beef Choice (on right)	

	1 (1)	2 (2)	3 (3)	
Farmstand, Farmer's Market, or Meat Market Hormone Free Ground Beef at $2/lb	○	○	○	Hormone Free Freezer Beef Assorted Cuts at $8/lb
Farmstand, Farmer's Market, or Meat Market Hormone Free Ground Beef at $2.50/lb	○	○	○	Hormone Free Freezer Beef Assorted Cuts at $7.50/lb
Farmstand, Farmer's Market, or Meat Market Hormone Free Ground Beef at $3/lb	○	○	○	Hormone Free Freezer Beef Assorted Cuts at $7/lb
Farmstand, Farmer's Market, or Meat Market Hormone Free Ground Beef at $3.50/lb	○	○	○	Hormone Free Freezer Beef Assorted Cuts at $6.50/lb
Farmstand, Farmer's Market, or Meat Market Hormone Free Ground Beef at $4/lb	○	○	○	Hormone Free Freezer Beef Assorted Cuts at $6/lb
Farmstand, Farmer's Market, or Meat Market Hormone Free Ground Beef at $4.50/lb	○	○	○	Hormone Free Freezer Beef Assorted Cuts at $5.50/lb
Farmstand, Farmer's Market, or Meat Market Hormone Free Ground Beef at $5/lb	○	○	○	Hormone Free Freezer Beef Assorted Cuts at $5/lb

Farmstand, Farmer's Market, or Meat Market Hormone Free Ground Beef at $5.50/lb	○	○	○	Hormone Free Freezer Beef Assorted Cuts at $4.50/lb
Farmstand, Farmer's Market, or Meat Market Hormone Free Ground Beef at $6/lb	○	○	○	Hormone Free Freezer Beef Assorted Cuts at $4/lb
Farmstand, Farmer's Market, or Meat Market Hormone Free Ground Beef at $6.50/lb	○	○	○	Hormone Free Freezer Beef Assorted Cuts at $3.50/lb
Farmstand, Farmer's Market, or Meat Market Hormone Free Ground Beef at $7/lb	○	○	○	Hormone Free Freezer Beef Assorted Cuts at $3/lb
Farmstand, Farmer's Market, or Meat Market Hormone Free Ground Beef at $7.50/lb	○	○	○	Hormone Free Freezer Beef Assorted Cuts at $2.50/lb
Farmstand, Farmer's Market, or Meat Market Hormone Free Ground Beef at $8/lb	○	○	○	Hormone Free Freezer Beef Assorted Cuts at $2/lb

Page Break

Q47 For each row click the button next to the option you prefer on the left (**supermarket ground beef**) or the right (**hormone free freezer beef assorted cuts**). If you do not want to choose either option, you may choose the middle option. All ground beef is 85% lean/15% fat.

Remember: Supermarket beef comes in 1-3lb packages. You may purchase any number of packages at the stated price. Hormone Free Freezer Beef is a 1/4 of the animal and must be purchased as 120-150lbs of individually packaged assorted cuts, including steaks, ground beef, and roasts. Prices are per lb of processed beef.

	Supermarket Choice (on left)	Neither Choice (middle)	Freezer Beef Choice (on right)	

	1 (1)	2 (2)	3 (3)	
Supermarket Ground Beef at $4/lb	○	○	○	Hormone Free Freezer Beef Assorted Cuts at $8/lb
Supermarket Ground Beef at $4/lb	○	○	○	Hormone Free Freezer Beef Assorted Cuts at $7.50/lb
Supermarket Ground Beef at $4/lb	○	○	○	Hormone Free Freezer Beef Assorted Cuts at $7/lb
Supermarket Ground Beef at $4/lb	○	○	○	Hormone Free Freezer Beef Assorted Cuts at $6.50/lb
Supermarket Ground Beef at $4/lb	○	○	○	Hormone Free Freezer Beef Assorted Cuts at $6/lb
Supermarket Ground Beef at $4/lb	○	○	○	Hormone Free Freezer Beef Assorted Cuts at $5.50/lb
Supermarket Ground Beef at $4/lb	○	○	○	Hormone Free Freezer Beef Assorted Cuts at $5/lb
Supermarket Ground Beef at $4/lb	○	○	○	Hormone Free Freezer Beef Assorted Cuts at $4.50/lb
Supermarket Ground Beef at $4/lb	○	○	○	Hormone Free Freezer Beef Assorted Cuts at $4/lb
Supermarket Ground Beef at $4/lb	○	○	○	Hormone Free Freezer Beef Assorted Cuts at $3.50/lb
Supermarket Ground Beef at $4/lb	○	○	○	Hormone Free Freezer Beef Assorted Cuts at $3/lb

Supermarket Ground Beef at $4/lb	○	○	○	Hormone Free Freezer Beef Assorted Cuts at $2.50/lb
Supermarket Ground Beef at $4/lb	○	○	○	Hormone Free Freezer Beef Assorted Cuts at $2/lb

End of Block: Freezer Beef Experiment Information with Hormone Free Ground

Start of Block: Freezer Beef Experiment Information with Hormone Free Steak

Q48 For each row click the button next to the option you prefer on the left (**supermarket boneless sirloin steak**) or the right (**farmstand, farmer's market, or meat market hormone free boneless sirloin steak**). If you do not want to choose either option, you may choose the middle option.

Remember: Supermarket beef comes in 1-3 lb packages. Hormone Free Farmstand, Farmer's Market, and Meat Market beef comes in 1-3lb packages. You may purchase any number of packages at the stated price.

	Supermarket Choice (on left)	Neither Choice (middle)	Farmstand, Farmer's Market, or Meat Market Choice (on right)	

	1 (1)	2 (2)	3 (3)	
Supermarket Steak at $10/lb	○	○	○	Farmstand, Farmer's Market, or Meat Market Hormone Free Steak at $14/lb
Supermarket Steak at $10/lb	○	○	○	Farmstand, Farmer's Market, or Meat Market Hormone Free Steak at $13.50/lb
Supermarket Steak at $10/lb	○	○	○	Farmstand, Farmer's Market, or Meat Market Hormone Free Steak at $13/lb
Supermarket Steak at $10/lb	○	○	○	Farmstand, Farmer's Market, or Meat Market Hormone Free Steak at $12.50/lb
Supermarket Steak at $10/lb	○	○	○	Farmstand, Farmer's Market, or Meat Market Hormone Free Steak at $12/lb
Supermarket Steak at $10/lb	○	○	○	Farmstand, Farmer's Market, or Meat Market Hormone Free Steak at $11.50/lb
Supermarket Steak at $10/lb	○	○	○	Farmstand, Farmer's Market, or Meat Market Hormone Free Steak at $11/lb
Supermarket Steak at $10/lb	○	○	○	Farmstand, Farmer's Market, or Meat Market Hormone Free Steak at $10.50/lb
Supermarket Steak at $10/lb	○	○	○	Farmstand, Farmer's Market, or Meat Market Hormone Free Steak at $10/lb

Supermarket Steak at $10/lb	○	○	○	Farmstand, Farmer's Market, or Meat Market Hormone Free Steak at $9.50/lb
Supermarket Steak at $10/lb	○	○	○	Farmstand, Farmer's Market, or Meat Market Hormone Free Steak at $9/lb
Supermarket Steak at $10/lb	○	○	○	Farmstand, Farmer's Market, or Meat Market Hormone Free Steak at $8.50/lb
Supermarket Steak at $10/lb	○	○	○	Farmstand, Farmer's Market, or Meat Market Hormone Free Steak at $8/lb

Q49 For each row click the button next to the option you prefer on the left (**farmstand, farmer's market, or meat market hormone free boneless sirloin steak**) or the right (**hormone free freezer beef assorted cuts**). If you do not want to choose either option, you may choose the middle option.

Remember: Farmstand, Farmer's Market, and Meat Market hormone free beef comes in 1-3lb packages. You may purchase any number of packages at the stated price. Hormone Free Freezer Beef is a 1/4 of the animal and must be purchased as 120-150lbs of individually packaged assorted cuts, including steaks, ground beef, and roasts. Prices are per lb of processed beef.

	Farmstand, Farmer's Market, or Meat Market Choice (on left)	Neither Choice (middle)	Freezer Beef Choice (on right)	

	1 (1)	2 (2)	3 (3)	
Farmstand, Farmer's Market, or Meat Market Hormone Free Steak at $8/lb	○	○	○	Hormone Free Freezer Beef Assorted Cuts at $8/lb
Farmstand, Farmer's Market, or Meat Market Hormone Free Steak at $8.50/lb	○	○	○	Hormone Free Freezer Beef Assorted Cuts at $7.50/lb
Farmstand, Farmer's Market, or Meat Market Hormone Free Steak at $9/lb	○	○	○	Hormone Free Freezer Beef Assorted Cuts at $7/lb
Farmstand, Farmer's Market, or Meat Market Hormone Free Steak at $9.50/lb	○	○	○	Hormone Free Freezer Beef Assorted Cuts at $6.50/lb
Farmstand, Farmer's Market, or Meat Market Hormone Free Steak at $10/lb	○	○	○	Hormone Free Freezer Beef Assorted Cuts at $6/lb
Farmstand, Farmer's Market, or Meat Market Hormone Free Steak at $10.50/lb	○	○	○	Hormone Free Freezer Beef Assorted Cuts at $5.50/lb
Farmstand, Farmer's Market, or Meat Market Hormone Free Steak at $11/lb	○	○	○	Hormone Free Freezer Beef Assorted Cuts at $5/lb
Farmstand, Farmer's Market, or Meat Market Hormone Free Steak at $11.50/lb	○	○	○	Hormone Free Freezer Beef Assorted Cuts at $4.50/lb
Farmstand, Farmer's Market, or Meat Market Hormone Free Steak at $12/lb	○	○	○	Hormone Free Freezer Beef Assorted Cuts at $4/lb

Farmstand, Farmer's Market, or Meat Market Hormone Free Steak at $12.50/lb	○	○	○	Hormone Free Freezer Beef Assorted Cuts at $3.50/lb
Farmstand, Farmer's Market, or Meat Market Hormone Free Steak at $13/lb	○	○	○	Hormone Free Freezer Beef Assorted Cuts at $3/lb
Farmstand, Farmer's Market, or Meat Market Hormone Free Steak at $13.50/lb	○	○	○	Hormone Free Freezer Beef Assorted Cuts at $2.50/lb
Farmstand, Farmer's Market, or Meat Market Hormone Free Steak at $14/lb	○	○	○	Hormone Free Freezer Beef Assorted Cuts at $2/lb

Q50 For each row click the button next to the option you prefer on the left (**supermarket boneless sirloin steak**) or the right (**hormone free freezer beef assorted cuts**). If you do not want to choose either option, you may choose the middle option.

Remember: Supermarket beef comes in 1-3lb packages. You may purchase any number of packages at the stated price. Hormone Free Freezer Beef is a 1/4 of the animal and must be purchased as 120-150lbs of individually packaged assorted cuts, including steaks, ground beef, and roasts. Prices are per lb of processed beef.

	Supermarket Choice (on left)	Neither Choice (middle)	Freezer Beef Choice (on right)	

	1 (1)	2 (2)	3 (3)	
Supermarket Steak at $10/lb	○	○	○	Hormone Free Freezer Beef Assorted Cuts at $8/lb
Supermarket Steak at $10/lb	○	○	○	Hormone Free Freezer Beef Assorted Cuts at $7.50/lb
Supermarket Steak at $10/lb	○	○	○	Hormone Free Freezer Beef Assorted Cuts at $7/lb
Supermarket Steak at $10/lb	○	○	○	Hormone Free Freezer Beef Assorted Cuts at $6.50/lb
Supermarket Steak at $10/lb	○	○	○	Hormone Free Freezer Beef Assorted Cuts at $6/lb
Supermarket Steak at $10/lb	○	○	○	Hormone Free Freezer Beef Assorted Cuts at $5.50/lb
Supermarket Steak at $10/lb	○	○	○	Hormone Free Freezer Beef Assorted Cuts at $5/lb
Supermarket Steak at $10/lb	○	○	○	Hormone Free Freezer Beef Assorted Cuts at $4.50/lb
Supermarket Steak at $10/lb	○	○	○	Hormone Free Freezer Beef Assorted Cuts at $4/lb
Supermarket Steak at $10/lb	○	○	○	Hormone Free Freezer Beef Assorted Cuts at $3.50/lb
Supermarket Steak at $10/lb	○	○	○	Hormone Free Freezer Beef Assorted Cuts at $3/lb

Supermarket Steak at $10/lb	○	○	○	Hormone Free Freezer Beef Assorted Cuts at $2.50/lb
Supermarket Steak at $10/lb	○	○	○	Hormone Free Freezer Beef Assorted Cuts at $2/lb

End of Block: Freezer Beef Experiment Information with Hormone Free Steak

Start of Block: Freezer Beef Experiment Information with Hormone Free End

Display This Question:

If Q45 [3] (Count) = 0

And Q46 [1] (Count) = 0

And Q48 [3] (Count) = 0

And Q49 [1] (Count) = 0

Q51 From the choices you made in the previous questions you never selected the **Farmstand, Farmer's Market, or Meat Market** option. What are the reasons why you did not select that option? (select all that apply)

- ☐ The price was was too high (1)
- ☐ Previous bad experience with purchasing from a farmstand, farmer's market, or meat market (2)
- ☐ I am not familiar with these outlets (3)
- ☐ I do not trust the purchasing option (4)
- ☐ I am concerned about the quality (5)
- ☐ I have no interest in purchasing from that a farmstand, farmer's market, or meat market (6)
- ☐ I prefer a different cut of beef (8)
- ☐ Other (7) _____

Display This Question:

If Q46 [3] (Count) = 0

And Q47 [3] (Count) = 0

And Q48 [3] (Count) = 0

And Q49 [3] (Count) = 0

Q52 From the choices you made in the previous questions you never selected the **Freezer Beef** option. What are the reasons why you did not select that option? (select all that apply)

- ☐ The quantity of beef is too much (1)
- ☐ The price was was too high (2)
- ☐ Previous bad experience with freezer beef (3)
- ☐ I am not familiar with freezer beef (4)
- ☐ I do not trust the purchasing option (5)
- ☐ I am concerned about the quality (6)
- ☐ I have no interest in purchasing freezer beef (7)
- ☐ I do not want the assorted cuts (9)
- ☐ I do not want to pay the amount of money necessary to purchase that amount of beef (10)
- ☐ Other (8) _____

End of Block: Freezer Beef Experiment Information with Hormone Free End

Start of Block: Freezer Beef Experiment Information with SGA Ground

Q53 In the following scenarios you will be presented with options to purchase different beef products. All beef is USDA Choice beef. These options include: Beef from a supermarket in individual packages that range in sizes from 1-3 pounds (lbs) per package. You may purchase a single package or multiple packages on each shopping trip.

Beef from a farmstand, farmers market, or meat market in individual packages that range in sizes from 1-3 pounds (lbs) per package. You may purchase a single package or multiple packages on each shopping trip. The package contains the Sweet Grown Alabama logo.

Beef from a beef cattle producer as a portion of the entire animal. We call this "Freezer Beef". Each portion consists of a quarter (1/4) of the animal that yields approximately 120-150 pounds (lbs) of processed beef. The beef will be individually packaged in a variety of cuts of various sizes depending on the cut of the meat. Cuts of meat may include steaks, ground beef, and roasts. You must purchase the full portion to be delivered or picked up at one time. This will require approximately 4.5 cu. ft. of a chest freezer space or 5.5 cu. ft. of an upright freezer space. The producer is a member of Sweet Grown Alabama.

Page Break

Q54 For each row click the button next to the option you prefer on the left (**supermarket ground beef**) or the right (**farmstand, farmer's market, or meat market ground beef**). If you do not want to choose either option, you may choose the middle option. All ground beef is 85% lean/15% fat.

Remember: Supermarket beef comes in 1-3 lb packages. Farmstand, Farmer's Market, and Meat Market beef comes in 1-3lb packages with the Sweet Grown Alabama logo.

You may purchase any number of packages at the stated price.

	Supermarket Choice (on left)	Neither Choice (middle)	Farmstand, Farmer's Market, or Meat Market Choice (on right)	

	1 (1)	2 (2)	3 (3)	
Supermarket Ground Beef at $4/lb	○	○	○	Farmstand, Farmer's Market, or Meat Market Ground Beef at $8/lb
Supermarket Ground Beef at $4/lb	○	○	○	Farmstand, Farmer's Market, or Meat Market Ground Beef at $7.50/lb
Supermarket Ground Beef at $4/lb	○	○	○	Farmstand, Farmer's Market, or Meat Market Ground Beef at $7/lb
Supermarket Ground Beef at $4/lb	○	○	○	Farmstand, Farmer's Market, or Meat Market Ground Beef at $6.50/lb
Supermarket Ground Beef at $4/lb	○	○	○	Farmstand, Farmer's Market, or Meat Market Ground Beef at $6/lb
Supermarket Ground Beef at $4/lb	○	○	○	Farmstand, Farmer's Market, or Meat Market Ground Beef at $5.50/lb
Supermarket Ground Beef at $4/lb	○	○	○	Farmstand, Farmer's Market, or Meat Market Ground Beef at $5/lb
Supermarket Ground Beef at $4/lb	○	○	○	Farmstand, Farmer's Market, or Meat Market Ground Beef at $4.50/lb
Supermarket Ground Beef at $4/lb	○	○	○	Farmstand, Farmer's Market, or Meat Market Ground Beef at $4/lb

Supermarket Ground Beef at $4/lb	○	○	○	Farmstand, Farmer's Market, or Meat Market Ground Beef at $3.50/lb
Supermarket Ground Beef at $4/lb	○	○	○	Farmstand, Farmer's Market, or Meat Market Ground Beef at $3/lb
Supermarket Ground Beef at $4/lb	○	○	○	Farmstand, Farmer's Market, or Meat Market Ground Beef at $2.50/lb
Supermarket Ground Beef at $4/lb	○	○	○	Farmstand, Farmer's Market, or Meat Market Ground Beef at $2/lb

Page Break

Q55 For each row click the button next to the option you prefer on the left (**farmstand, farmer's market, or meat market ground beef**) or the right (**freezer beef assorted cuts**). If you do not want to choose either option, you may choose the middle option. All ground beef is 85% lean/15% fat.

Remember: Farmstand, Farmer's Market, and Meat Market beef comes in 1-3lb packages with the Sweet Grown Alabama logo. You may purchase any number of packages at the stated price.

Freezer Beef is a 1/4 of the animal and must be purchased as 120-150lbs of individually packaged assorted cuts, including steaks, ground beef, and roasts. The producer is a member of Sweet Grown Alabama. Prices are per lb of processed beef.

	Farmstand, Farmer's Market, or Meat Market Choice (on left)	Neither Choice (middle)	Freezer Beef Choice (on right)	

	1 (1)	2 (2)	3 (3)	
Farmstand, Farmer's Market, or Meat Market Ground Beef at $2/lb	○	○	○	Freezer Beef Assorted Cuts at $8/lb
Farmstand, Farmer's Market, or Meat Market Ground Beef at $2.50/lb	○	○	○	Freezer Beef Assorted Cuts at $7.50/lb
Farmstand, Farmer's Market, or Meat Market Ground Beef at $3/lb	○	○	○	Freezer Beef Assorted Cuts at $7/lb
Farmstand, Farmer's Market, or Meat Market Ground Beef at $3.50/lb	○	○	○	Freezer Beef Assorted Cuts at $6.50/lb
Farmstand, Farmer's Market, or Meat Market Ground Beef at $4/lb	○	○	○	Freezer Beef Assorted Cuts at $6/lb
Farmstand, Farmer's Market, or Meat Market Ground Beef at $4.50/lb	○	○	○	Freezer Beef Assorted Cuts at $5.50/lb
Farmstand, Farmer's Market, or Meat Market Ground Beef at $5/lb	○	○	○	Freezer Beef Assorted Cuts at $5/lb
Farmstand, Farmer's Market, or Meat Market Ground Beef at $5.50/lb	○	○	○	Freezer Beef Assorted Cuts at $4.50/lb
Farmstand, Farmer's Market, or Meat Market Ground Beef at $6/lb	○	○	○	Freezer Beef Assorted Cuts at $4/lb

Farmstand, Farmer's Market, or Meat Market Ground Beef at $6.50/lb	○	○	○	Freezer Beef Assorted Cuts at $3.50/lb
Farmstand, Farmer's Market, or Meat Market Ground Beef at $7/lb	○	○	○	Freezer Beef Assorted Cuts at $3/lb
Farmstand, Farmer's Market, or Meat Market Ground Beef at $7.50/lb	○	○	○	Freezer Beef Assorted Cuts at $2.50/lb
Farmstand, Farmer's Market, or Meat Market Ground Beef at $8/lb	○	○	○	Freezer Beef Assorted Cuts at $2/lb

Page Break

Q56 For each row click the button next to the option you prefer on the left (**supermarket ground beef**) or the right (**freezer beef assorted cuts**). If you do not want to choose either option, you may choose the middle option. All ground beef is 85% lean/15% fat.

Remember: Supermarket beef comes in 1-3lb packages. You may purchase any number of packages at the stated price. Freezer Beef is a 1/4 of the animal and must be purchased as 120-150lbs of individually packaged assorted cuts, including steaks, ground beef, and roasts. The producer is a member of Sweet Grown Alabama. Prices are per lb of processed beef.

	Supermarket Choice (on left)	Neither Choice (middle)	Freezer Beef Choice (on right)	

	1 (1)	2 (2)	3 (3)	
Supermarket Ground Beef at $4/lb	○	○	○	Freezer Beef Assorted Cuts at $8/lb
Supermarket Ground Beef at $4/lb	○	○	○	Freezer Beef Assorted Cuts at $7.50/lb
Supermarket Ground Beef at $4/lb	○	○	○	Freezer Beef Assorted Cuts at $7/lb
Supermarket Ground Beef at $4/lb	○	○	○	Freezer Beef Assorted Cuts at $6.50/lb
Supermarket Ground Beef at $4/lb	○	○	○	Freezer Beef Assorted Cuts at $6/lb
Supermarket Ground Beef at $4/lb	○	○	○	Freezer Beef Assorted Cuts at $5.50/lb
Supermarket Ground Beef at $4/lb	○	○	○	Freezer Beef Assorted Cuts at $5/lb
Supermarket Ground Beef at $4/lb	○	○	○	Freezer Beef Assorted Cuts at $4.50/lb
Supermarket Ground Beef at $4/lb	○	○	○	Freezer Beef Assorted Cuts at $4/lb
Supermarket Ground Beef at $4/lb	○	○	○	Freezer Beef Assorted Cuts at $3.50/lb
Supermarket Ground Beef at $4/lb	○	○	○	Freezer Beef Assorted Cuts at $3/lb
Supermarket Ground Beef at $4/lb	○	○	○	Freezer Beef Assorted Cuts at $2.50/lb
Supermarket Ground Beef at $4/lb	○	○	○	Freezer Beef Assorted Cuts at $2/lb

End of Block: Freezer Beef Experiment Information with SGA Ground

Start of Block: Freezer Beef Experiment Information with SGA Steak

Q57 For each row click the button next to the option you prefer on the left (**supermarket boneless sirloin steak**) or the right (**farmstand, farmer's market, or meat market boneless sirloin steak**). If you do not want to choose either option, you may choose the middle option.

Remember: Supermarket beef comes in 1-3 lb packages. Farmstand, Farmer's Market, and Meat Market beef comes in 1-3lb packages with the Sweet Grown Alabama logo.

You may purchase any number of packages at the stated price.

	Supermarket Choice (on left)	Neither Choice (middle)	Farmstand, Farmer's Market, or Meat Market Choice (on right)	

	1 (1)	2 (2)	3 (3)	
Supermarket Steak at $10/lb	○	○	○	Farmstand, Farmer's Market, or Meat Market Steak at $14/lb
Supermarket Steak at $10/lb	○	○	○	Farmstand, Farmer's Market, or Meat Market Steak at $13.50/lb
Supermarket Steak at $10/lb	○	○	○	Farmstand, Farmer's Market, or Meat Market Steak at $13/lb
Supermarket Steak at $10/lb	○	○	○	Farmstand, Farmer's Market, or Meat Market Steak at $12.50/lb
Supermarket Steak at $10/lb	○	○	○	Farmstand, Farmer's Market, or Meat Market Steak at $12/lb
Supermarket Steak at $10/lb	○	○	○	Farmstand, Farmer's Market, or Meat Market Steak at $11.50/lb
Supermarket Steak at $10/lb	○	○	○	Farmstand, Farmer's Market, or Meat Market Steak at $11/lb
Supermarket Steak at $10/lb	○	○	○	Farmstand, Farmer's Market, or Meat Market Steak at $10.50/lb
Supermarket Steak at $10/lb	○	○	○	Farmstand, Farmer's Market, or Meat Market Steak at $10/lb
Supermarket Steak at $10/lb	○	○	○	Farmstand, Farmer's Market, or Meat Market Steak at $9.50/lb
Supermarket Steak at $10/lb	○	○	○	Farmstand, Farmer's Market, or Meat Market Steak at $9/lb

Supermarket Steak at $10/lb	○	○	○	Farmstand, Farmer's Market, or Meat Market Steak at $8.50/lb
Supermarket Steak at $10/lb	○	○	○	Farmstand, Farmer's Market, or Meat Market Steak at $8/lb

Q58 For each row click the button next to the option you prefer on the left (**farmstand, farmer's market, or meat market boneless sirloin steak**) or the right (**freezer beef assorted cuts**). If you do not want to choose either option, you may choose the middle option.

Remember: Farmstand, Farmer's Market, and Meat Market beef comes in 1-3lb packages with the Sweet Grown Alabama logo. You may purchase any number of packages at the stated price.

Freezer Beef is a 1/4 of the animal and must be purchased as 120-150lbs of individually packaged assorted cuts, including steaks, ground beef, and roasts. The producer is a member of Sweet Grown Alabama. Prices are per lb of processed beef.

	Farmstand, Farmer's Market, or Meat Market Choice (on left)	Neither Choice (middle)	Freezer Beef Choice (on right)	

	1 (1)	2 (2)	3 (3)	
Farmstand, Farmer's Market, or Meat Market Steak at $8/lb	○	○	○	Freezer Beef Assorted Cuts at $8/lb
Farmstand, Farmer's Market, or Meat Market Steak at $8.50/lb	○	○	○	Freezer Beef Assorted Cuts at $7.50/lb
Farmstand, Farmer's Market, or Meat Market Steak at $9/lb	○	○	○	Freezer Beef Assorted Cuts at $7/lb
Farmstand, Farmer's Market, or Meat Market Steak at $9.50/lb	○	○	○	Freezer Beef Assorted Cuts at $6.50/lb
Farmstand, Farmer's Market, or Meat Market Steak at $10/lb	○	○	○	Freezer Beef Assorted Cuts at $6/lb
Farmstand, Farmer's Market, or Meat Market Steak at $10.50/lb	○	○	○	Freezer Beef Assorted Cuts at $5.50/lb
Farmstand, Farmer's Market, or Meat Market Steak at $11/lb	○	○	○	Freezer Beef Assorted Cuts at $5/lb
Farmstand, Farmer's Market, or Meat Market Steak at $11.50/lb	○	○	○	Freezer Beef Assorted Cuts at $4.50/lb
Farmstand, Farmer's Market, or Meat Market Steak at $12/lb	○	○	○	Freezer Beef Assorted Cuts at $4/lb
Farmstand, Farmer's Market, or Meat Market Steak at $12.50/lb	○	○	○	Freezer Beef Assorted Cuts at $3.50/lb
Farmstand, Farmer's Market, or Meat Market Steak at $13/lb	○	○	○	Freezer Beef Assorted Cuts at $3/lb

Farmstand, Farmer's Market, or Meat Market Steak at $13.50/lb	○	○	○	Freezer Beef Assorted Cuts at $2.50/lb
Farmstand, Farmer's Market, or Meat Market Steak at $14/lb	○	○	○	Freezer Beef Assorted Cuts at $2/lb

Q59 For each row click the button next to the option you prefer on the left (**supermarket boneless sirloin steak**) or the right (**freezer beef assorted cuts**). If you do not want to choose either option, you may choose the middle option.

Remember: Supermarket beef comes in 1-3lb packages. You may purchase any number of packages at the stated price. Freezer Beef is a 1/4 of the animal and must be purchased as 120-150lbs of individually packaged assorted cuts, including steaks, ground beef, and roasts. The producer is a member of Sweet Grown Alabama. Prices are per lb of processed beef.

	Supermarket Choice (on left)	Neither Choice (middle)	Freezer Beef Choice (on right)	

	1 (1)	2 (2)	3 (3)	
Supermarket Steak at $10/lb	○	○	○	Freezer Beef Assorted Cuts at $8/lb
Supermarket Steak at $10/lb	○	○	○	Freezer Beef Assorted Cuts at $7.50/lb
Supermarket Steak at $10/lb	○	○	○	Freezer Beef Assorted Cuts at $7/lb
Supermarket Steak at $10/lb	○	○	○	Freezer Beef Assorted Cuts at $6.50/lb
Supermarket Steak at $10/lb	○	○	○	Freezer Beef Assorted Cuts at $6/lb
Supermarket Steak at $10/lb	○	○	○	Freezer Beef Assorted Cuts at $5.50/lb
Supermarket Steak at $10/lb	○	○	○	Freezer Beef Assorted Cuts at $5/lb
Supermarket Steak at $10/lb	○	○	○	Freezer Beef Assorted Cuts at $4.50/lb
Supermarket Steak at $10/lb	○	○	○	Freezer Beef Assorted Cuts at $4/lb
Supermarket Steak at $10/lb	○	○	○	Freezer Beef Assorted Cuts at $3.50/lb
Supermarket Steak at $10/lb	○	○	○	Freezer Beef Assorted Cuts at $3/lb
Supermarket Steak at $10/lb	○	○	○	Freezer Beef Assorted Cuts at $2.50/lb
Supermarket Steak at $10/lb	○	○	○	Freezer Beef Assorted Cuts at $2/lb

End of Block: Freezer Beef Experiment Information with SGA Steak

Start of Block: Freezer Beef Experiment Information with SGA End

Display This Question:

If Q54 [3] (Count) = 0

And Q55 [1] (Count) = 0

And Q57 [3] (Count) = 0

And Q58 [1] (Count) = 0

Q60 From the choices you made in the previous questions you never selected the **Farmstand, Farmer's Market, or Meat Market** option. What are the reasons why you did not select that option? (select all that apply)

- ☐ The price was was too high (1)
- ☐ Previous bad experience with purchasing from a farmstand, farmer's market, or meat market (2)
- ☐ I am not familiar with these outlets (3)
- ☐ I do not trust the purchasing option (4)
- ☐ I am concerned about the quality (5)
- ☐ I have no interest in purchasing from that a farmstand, farmer's market, or meat market (6)
- ☐ I prefer a different cut of beef (8)
- ☐ Other (7) _____

Display This Question:

If Q55 [3] (Count) = 0

And Q56 [3] (Count) = 0

And Q58 [3] (Count) = 0

And Q59 [3] (Count) = 0

Q61 From the choices you made in the previous questions you never selected the **Freezer Beef** option. What are the reasons why you did not select that option? (select all that apply)

- ☐ The quantity of beef is too much (1)
- ☐ The price was was too high (2)
- ☐ Previous bad experience with freezer beef (3)
- ☐ I am not familiar with freezer beef (4)
- ☐ I do not trust the purchasing option (5)
- ☐ I am concerned about the quality (6)
- ☐ I have no interest in purchasing freezer beef (7)
- ☐ I do not want the assorted cuts (9)
- ☐ I do not want to pay the amount of money necessary to purchase that amount of beef (10)
- ☐ Other (8) _____

End of Block: Freezer Beef Experiment Information with SGA End

Start of Block: Meat buyers

Display This Question:

If Q71 = 1

Or Q71 = 2

Q72 Why did you purchase freezer beef? (select all that apply)

- ☐ Prefer to buy from a local producer (1)
- ☐ Better value (2)
- ☐ Better taste (3)
- ☐ Better quality (4)
- ☐ Fresher product (5)
- ☐ Lower price (6)
- ☐ Preferred cuts (7)
- ☐ Availability (8)
- ☐ Other (9) _____

Display This Question:

If Q71 = 3

Or Q71 = 4

Q105 How many children (younger than 18 yrs) live in your household?

▼ 0 (0) ... 10 or more (10)

Page Break

Q106 How many adults (18 yrs or older) live in your household, including yourself?

▼ 1 (1) ... 10 or more (10)

Page Break

Q107 Are you of Hispanic, Latino, or Spanish origin?

- ○ No, not of Hispanic, Latino, or Spanish origin (0)
- ○ Yes, Mexican, Mexican Am., Chicano (1)
- ○ Yes, Puerto Rican (2)
- ○ Yes, Cuban (3)
- ○ Yes, another Hispanic, Latino, or Spanish origin (4)

Page Break

Q108 What is your race?

- [ ] White (1)
- [ ] Black or African American (2)
- [ ] American Indian or Alaskan Native (3)
- [ ] Asian Indian (4)
- [ ] Chinese (5)
- [ ] Filipino (6)
- [ ] Japanese (7)
- [ ] Korean (8)
- [ ] Vietnamese (9)
- [ ] Native Hawaiian (10)
- [ ] Guamanian or Chamorro (11)
- [ ] Samoan (12)
- [ ] Other Pacific Islander (13)
- [ ] Other (14)

Page Break

Q112 Thank you for participating the survey...please click the box below to end the survey

- ○ End Survey (1)

End of Block: Demographics

Chapter 3 Estimating the demand for Carbonated Sweetened Beverage in the U.S.: A Finite Mixture Approach

1.0 Introduction

In the past decade, several cities in the United States (U.S.) have enacted public policies aimed at discouraging the consumption of carbonated sweetened beverages (CSBs). These policies stem from the association between high CSB consumption and health issues like obesity, diabetes, hypertension, gout, and various cardiovascular diseases. The imposition of taxes seeks to increase consumer prices, ultimately leading to reduced CSB consumption (Groger, 2017). The motivation to enact public policy regarding soda taxes is not only due to its adverse effects on public health, but also because of the huge burden it imposes on health care costs. Private individuals share these costs with others through public and private insurance. For example, healthcare costs related to CSB consumption are estimated to surpass $200 billion, equating to an excess of $600 to $1,800 in annual medical expenses per overweight or obese adult (Ward *et al.*, 2021; Kiesel, Lang & Sexton, 2023). The failure to fully incorporate the harmful effect of the private costs of consuming CSBs constitutes both moral hazard and adverse selection problems for the within-person internalities and externalities. These reasons further bolster the arguments for CSB taxes and underscore the need for such CSB taxes. Consequently, various studies focused on the estimations of the relationship between CSB taxes and the resultant savings in healthcare costs. Notably, Wang *et al.* (2012) determined that a one cent per ounce tax over ten years would yield a significant cost reduction, amounting to $17.1 billion. An alternative model, as demonstrated by Long *et al.* (2015), projected even more substantial savings, totaling $23.6 billion over a ten-year period. We revisit this issue by using an innovative econometric approach to analyze big data on the household consumption of CSBs. Therefore, the objective of this study is to estimate the demand for CSBs in the U.S. so as to assess the potential impact of CSB taxes on this demand.

The U.S. ranks among the highest consumers of CSBs on a per capita basis, with the average American consuming nearly 200 CSB calories per day (World Bank, 2020). Berkeley was the pioneer U.S. city to implement a CSB excise tax in 2014 through a referendum, setting an example that prompted swift adoption by other states and cities, including Philadelphia, Pennsylvania, Oakland, California, Boulder, Colorado, Seattle, Washington, San Francisco, and California (Kiesel, Lang & Sexton, 2023). Although CSB taxes have seen successful adoption in some regions, they remain a subject of controversy within the American public. Notably, it has failed to pass in several locations in the U.S. including New York State in 2010 and Santa Fe, New Mexico in 2017. The American Beverage Association asserts that they have thwarted up to 40 proposals for CSB taxation across various local, state, and federal jurisdictions. (Cawley & Frisvold, 2023). One of the primary arguments posed by opponents of such taxes is that they may be regressive, disproportionately impacting low-income populations. If low-income households consume more CSBs compared to their higher-income counterparts, these taxes will be regressive. Another concern raised by opponents of soda taxes is that it incentivizes consumer substitution into other unhealthy food items, undermining the public health objectives of soda taxes, especially if the degree of substitution is significant (Gospodinov & Irvine, 2009; Zhen *et al.*, 2011). To address this problem, specific healthy alternatives to CSBs have been exempted from CSB taxes. For instance, in Philadelphia, CSB taxes do not apply to diet or zero-calorie beverages, 100% fruit juices, and flavored milk, given their essential nutrients and to prevent opposition from agricultural lobbies. (Cawley & Frisvold, 2023). While CSB taxes continue to come under criticism, there are traditional economic frameworks that provide support for their role in correcting externalities.

The economic rationale behind the tax on CSBs (also known as “sin” taxes) stems from the externality-correction taxes approach prescribed by Pigou (1920). The core idea is that when the consumption of a particular good results in harm to others, individuals tend to overconsume if the market remains unregulated. Consequently, imposing a tax on goods associated with negative externalities can enhance overall welfare by curbing consumption to a level where marginal costs equals marginal social benefits.

Furthermore, individuals may sometimes overlook the detrimental or beneficial effects of consumption, often referred to as "internalities," due to factors such as imperfect information or the problem of self-control (Alcott, Lockwood & Taubinsky, 2019). While externalities and internalities differ from direct "health harms," a consumer might consciously choose to consume CSBs despite health risks because, at a personal level, the pleasure derived outweighs the associated health concerns. In the context of sin taxes, what matters is whether consumer decisions lead to harm inflicted on others (externalities) or on themselves due to inadequately internalizing the consequences (internalities). Therefore, the most widely recognized externalized costs linked to CSB consumption are the financial healthcare costs, which are shared with others through both public and private insurance systems. These costs essentially arise from moral hazard in a second-best world characterized by imperfect information (Allcott, Lockwood & Taubinsky, 2019b; Kiesel, Lang & Sexton, 2023). While CSB taxes aim to address these moral hazard costs, two key public finance question emerges: to what extent are these taxes passed on to consumers in the form of higher retail prices (referred to as "pass-through" taxes), and how much of these taxes are retained as profits by firms (producer surplus)? In a perfectly competitive market, the tax incidence depends on the relative price elasticities of supply and demand. For instance, if CSBs have no substitutes, demand becomes perfectly inelastic, and consumers bear the entire burden of CSB taxes. Conversely, in a scenario where perfect substitutes exist for CSBs, the tax is predominantly borne by the producers. In instances of markets characterized by imperfect competition, prices can rise by a magnitude exceeding that of the imposed tax, a phenomenon commonly referred to as "over-shifting" (Cawley & Frisvold, 2023). Furthermore, demand elasticities may vary based on geographical location, due to factors like local climate, the level of competition within the local beverage market, and other location-specific determinants. Consequently, the disparities in demand elasticities across different locations can lead to different levels of “pass-through” taxes across cities and states in the U.S. As a result, there is need for further studies to better understand the effectiveness of CSB taxes across jurisdictions.

A large literature debates the effectiveness of taxes on CSBs as different studies have found that CSB purchases may increase, decrease, or remain the same in response to soda tax (Debnam, 2015; Colantuoni & Rojas, 2015; Jithitikulchai & Andreyeva, 2018; Allcott, Lockwood & Taubinsky, 2019a; Dubois, Griffith & O'Connell, 2020; Ahn & Lusk, 2020; Cawley, Frisvold & Jones, 2019). Most of these studies obtain price elasticity estimates from traditional homogeneous models. These traditional homogeneous models face two key shortcomings. First, they assume that all consumers react equally to changes and as such models might yield biased estimates of aggregate responses if heterogeneous responses are not symmetrically distributed. Second, they ignore the fact consumers tend to have strong preferences over product choices for reasons not entirely observable, suggesting unobservable persistent heterogeneous tastes. These two factors imply that existing studies yield biased estimates of price elasticity leading to inaccurate consumption responses from a given tax. This paper provides estimates of price elasticities based on a finite mixture demand model that better addresses the potential for heterogeneity thereby classifying consumers into different segments.

The finite mixture model (FMM) is a state-of-the-art segmentation technique which optimally classifies consumers into sub-groups so that each group may have its own set of preferences, tastes, or decision-making processes. (Laird, 1978; Heckman & Singer, 1984; Deb & Holmes, 2000). The model has several desirable features over standard specifications, offering more precise predictions of household demand within each sub-group. We discuss some of these feature as follows. First, the model allows data to endogenously identify the optimal number of demand sub-groups, enabling the marginal effects of prices and other control variables on the demand of CSBs to vary across the identified sub-groups. Second, for each sub-group identified, we are able to compute the posterior probabilities of belonging to the sub-group using the Bayes rule based on the estimated parameters in our model. This probability indicates the likelihood that a sample unit belongs to a cluster within the mixture model. Our motivation for identifying these sub-groups within the CSB consumer population is based on previous studies, which highlighted CSBs as the main cause of obesity within certain segments of the U.S. population, particularly among

African-American, Hispanic, and low-income households (Rosinger *et al.*, 2017; Hales *et al.*, 2017; Cawley *et al.*, 2019). Consequently, identifying these subgroups provide valuable insights for policymaking in a heterogeneous population, as opposed to formulating policies that overlook this heterogeneity. We are able to implement the FMM through the construction of a county level panel data of consumers using the Nielsen Homescan dataset from the Chicago Booth Kilts Centre for Marketing. The CSB data collected consists of a three-years county-level data on the prices and quantities of CSBs purchased by households between 2017 – 2019. The dataset samples all states and major markets (excluding Alaska and Hawaii), which means that panelists are geographically and widely distributed. In addition to CSB prices and quantities, we also collect data on the prices of substitute goods such as low-calories CSBs, fruit and vegetable beverages, alcoholic drinks, bottled water, coffee/tea/cocoa, diary, and other drinks. The justification for collecting data on these goods is to account for their substitution effects, which previous studies have found to vary between low-income and high-income households (Zhen *et al.*, 2011).

Our results suggest the existence of two latent sub-groups of consumers. One of the sub-group exhibits a relatively low sensitivity to price changes, whereas the other sub-group displays a relatively high sensitivity to price changes. For the sub-groups of consumers with relatively low sensitivity to price changes, we find that a percentage increase in the own price of CSBs results in a 0.03% decrease in the demand of CSBs. For the sub-groups of consumers with relatively high sensitivity to price changes, a percentage increase in the own price of CSBs leads to a 0.54% decrease in the demand for CSBs. In both the sub-groups, we find an "inelastic" demand for own price of CSBs, which implies that changes in the price have a limited impact on the quantity of the CSBs that consumers are willing to purchase. As regards income elasticity of the demand of CSBs, we find an "elastic" income demand. With respect to demographic characteristics of consumers, we find that larger households and married couples tend to consume fewer soft drinks. Similarly, employed household heads consume less soft drinks than the unemployed, and individuals with above high school education consume fewer soft drinks than

individuals with below high school education. The impact of race differs among sub-groups. However, most of the non-Caucasian households consume more CSB across all the sub-groups except for Asian households in the in the sub-group of consumers with relatively high sensitivity to price changes.

This paper offers several significant contributions to the existing literature. First, this provides the first estimates of how households belonging to various U.S. consumer sub-groups respond to the price and income changes of CSBs. By utilizing the Finite Mixture Model (FMM), this research unveils latent sub-groups, thereby facilitating the examination of heterogeneity among these sub-groups. Second, this paper presents a comparative analysis of the consumption and fiscal impacts stemming from one percent increase in price on the demand for CSBs in the one-class model compared to the two-class model. This comparison enhances our understanding of how policy measures affect distinct consumer sub-groups, ultimately leading to more precise and detailed insights into their responses.

The rest of this paper is organized as follows. Section 2.0 focuses on the data and variables. Section 3.0 focuses on the empirical strategy of the paper. Section 4.0 discusses the results while section 5.0 draws conclusions based on the outcomes of the study.

2.0 Data and Variables

In this study, we use the Nielsen Homescan household panel dataset of 28,861 U.S. consumers between January 2017 and December 2019 to estimate the demand of CSBs. The source of the dataset is the Kilts Center for Marketing at the University of Chicago. Purchases made by households in the dataset are from drug, grocery, mass merchandise and other stores across all states and major markets (excluding Alaska and Hawaii), which means that consumers are geographically and widely distributed (Nielsen Consumer Panel Dataset Manual, 2021). The smallest unit of observation is at the household level. The Kilts Nielsen Homescan consumer panel dataset has been used in previous research and the data is accessible through a partnership between the Nielsen and USDA-Economic Research Service (Li & Dorfman, 2019).

We obtain the variables on CSB products from various aspects of the Kilts Nielsen Homescan consumer panel dataset, such as the panelist, product, purchases, and trip sub-data. The panelist sub-data contains demographic and geographic information of consumers including their unique household codes. The product sub-data provide elaborate product information for each product, using their respective universal product code (UPC). The trips sub-data contains information on consumer shopping trips, which are differentiated using unique trip and household codes. The purchases sub-data entails information about specific products procured by consumers such as quantity, price paid as well as any perceived deals. Consumers and their respective trips are uniquely identified in the purchases sub-data with trip codes and the UPC of products purchased (Nielsen Consumer Panel Dataset Manual, 2021).

Using the unique household and trip codes from the panelist and trips sub-data respectively, we identify and collect information on the households shopping trips made to purchase carbonated soft drinks. We further use the UPCs from the purchases and products sub-data to select the units and weights of carbonated drinks respectively. We also collect data for the unit prices of close substitutes such as low-calorie soft drinks, fruit and vegetable beverages, alcoholic drinks, bottled water, coffee, dairy, and other drinks. We construct an elaborate panel data by matching all the sub-data using trip codes from the trip and purchases datasets. Table 1 provides the summary statistics of the variables used in the analysis sections.

2.1 The Demand for CSBs

In constructing the demand for CSBs, we focus on the weight rather than the units of CSBs purchased. This is because the units of CSBs reported in the data are not homogenous. For example, a can and pack of soda purchased on different trips were reported as one unit even though a pack of Soda constitutes different cans of Soda. We, however, adjust for the units by multiplying the weights by total units purchased per trip to derive the total weight of CSBs purchased. The unit of analysis is at monthly level because we take simple averages of the weights of carbonated drinks purchased for every trip in a month to obtain total weight per month. Therefore, the unit of measurement for the weight of CSBs purchased is

in oz per month. Table 1 shows that the mean weights of CSBs purchased per month by all the consumer in the panel data is 94 oz/month (that's the equivalent of about 12 U.S. cups of soda or 6 red American party cups). In analyzing the demand model, we use the logarithmic transformation of the weights of CSBs. Due to instances where the demand of CSBs is zero, we add a positive constant to all values (including zeros) to ensures that there are no zeros in the dataset, thus making the log transformation feasible. By adding the same constant to all observations, the relative variability and ranking of the data are preserved thereby maintaining the integrity of the relationships within the data. We model the demand for CSBs as a function of its own price, and the prices of other close substitutes. We discuss how we construct these prices in the following sections.

2.2 Unit Price of CSBs

In deriving the unit price of CSBs purchased, we focus on the total price paid for carbonated soft drinks, which is contained in the purchase sub-data. We account for discounts on purchases by subtracting the coupon received for purchasing carbonated soft drinks from the total price paid, thereby deriving the net price paid for carbonated drinks. We further divide the net price paid by total weight of CSBs purchased in section II.A to obtain the unit price per weight of CSBs per trip. We further take a simple average of the unit prices for every trip in a month to derive the unit price of CSB purchased on a monthly basis. Therefore, the unit of measurement for the unit price per weight of CSB purchased per month is in dollars ($) per oz per month. We generate the price index of the unit price of CSB purchased therefore, table 1 shows that the average unit price of CSBs purchased per month by all the consumer in the panel data is $0.10 per ox per month.

2.3 Unit Prices of Close Substitutes

We collect data on the unit prices of the close substitutes of CSBs which include low-calorie soft drinks, fruit and vegetable beverages, alcoholic drinks, bottled water, coffee, dairy, and other drinks. We focus on the prices of these products in each county in the month that the CSBs in section 2.1 were purchased. We further derive the prices per ounce of these products before merging them with the data frame that

contains the demand and unit price of CSBs using household codes. The unit of measurement for the close substitutes is $ per ounce per month. We use their price indices rather than their nominal prices as shown in table 1. The justification for using their prices indices rather than their nominal prices is explained in section 2.2.

2.4 Other Demographic Variables

We control for household demographic factors, which are obtained from the panelist sub-data. These demographic variables serve as demand shifters and include total household expenditure, race, marital status, education level of household etc. Several studies have demonstrated that demand shifters have a significant impact on the demand for CSBs. For example, Ahn & Lusk (2021) and Li & Dorfman (2019) suggest that household consumption is influenced by certain attitudes and habits of households such as non-pecuniary factors, gender, race, and household size. One of the key demand shifters, which constitute a major variable in this study is total expenditure by households. We use this in place of household income because it is continuous as household income variable is categorical and captures the median income of households that consume CSBs. An additional rationale for employing household total expenditure, rather than household income is based on the fact that we do not observe the price data for related products (e.g., complementary goods like cookies and peanuts) that could influence CSB prices. These associated product prices often fluctuate in conjunction with CSB prices and should be considered in any unconditional demand model that is based on income (Deaton, 1988; Etile & Sharma, 2015). We, therefore, calculate the income elasticity of demand using this variable to assess changes in demand relative to household income.

3.0 Empirical Strategy

3.1 Baseline Model

Our baseline parametric model for estimating the price elasticity of the demand for CSBs is expressed as follows:

$$lnw_{ijt} = \beta_0 + \beta_1 lnP_{ijt} + \beta_2 lnE_{it} + \delta_j lnS'_{ijt} + \tau D'_{it} + \varepsilon_{ijt} \quad (1)$$

Where ln represents natural logarithm; w_{ijt} represent the total weight of CSB product, j demanded by household i in month t; P_{ijt} denotes the unit price of CSB demanded by household i in a month, t; E_{it} represents the income of household i in month, t; S'_{ijt} represents the vector of the close substitutes of CSBs, which include low-calorie soft drinks, fruit and vegetable beverages, alcoholic drinks, bottled water, coffee, dairy, and other drinks; D'_{it} represents the vector of demographic variables, such as household size, race, marital status, and education level of household; β_1 represents the own price elasticity of CSBs, β_2 represents the income elasticity of CSBs while δ_j represents the cross elasticity for the various product categories that constitute close substitutes; τ represents the coefficients of the respective demographic variables such as gender, race, and household size etc. Additionally, ε_{ijt} is the error term.

3.2 Normalization of Prices and addressing Endogeneity Bias

The unit prices of CSBs and their close alternatives may exhibit endogeneity due to an underlying unobservable preference for quality (Cox & Wohlgenant, 1986; Deaton, 1988). A household that prioritizes quality over quantity is inclined to consume higher-quality products, which tend to have higher unit prices. Failing to account for these individual preferences when examining price-quantity dynamics among households can lead to a bias in own-price elasticity estimates. Therefore, we acknowledge that unit prices may be subject to measurement errors, and these errors can be linked to household preferences for quality. To address this measurement error bias, we adopt the approach by Zhen *et al.* (2011) and Jithitikulchai & Andreyeva (2018) to address the measurement error bias by implementing the Fisher

price indices based on unit prices. We create a monthly superlative Fisher price index for product j within each county, k. In implementing this approach, we consider unit prices as a function of both location and time. Consequently, the base period (t_0) and the period for which the index is computed (t_n) vary within the index formula for each location. The fishers price index is defined as a geometric average of the Laspreyres price index, and the Paasche price index as follows (Afriat & Milana, 2009):

(2) $$Fishers\ price\ index = \sqrt{Laspeyres\ price\ index\ \cdot Paasche\ price\ index}$$

The Laspeyres and Paasche price index are further defined as follows:

(3) $$Laspeyres\ price\ index = \frac{\sum(p_k,t_n \cdot w_k,t_0)}{\sum(p_k,t_0 \cdot w_k,t_0)}$$

(4) $$Paasche\ price\ index = \frac{\sum(p_k,t_n \cdot w_k,t_n)}{\sum(p_k,t_0 \cdot w_k,t_n)}$$

where t_0 is the base period (that is, the first month of the year in 2017) while t_n is the period for which the index is calculated. p is the relative the price levels in the two periods, t_0 and t_n at county, k.

Another key problem in the estimation of demand models is the endogeneity bias caused by simultaneous causality (Wooldridge, 2016). This problem is due to omitted variable bias, which results in the correlation between prices and unobserved demand shifters. To address this problem, we employ the control function using the Hausmann-type price instrument through the two-stage residual exclusion (Heckman & Robb, 1985). In the first stage of the control function, we use the price index generated in (2) to construct the instrument. To do this, we define P_{jkt} as the prices charged by stores in county k for CSB products j in month t. Recall that from (1), P_{ijt} represents the unit price of CSB demanded by household i in month, t. Therefore, the instrumental variable is represented by the "leave-out" price index, $P_{ijt,-k}$ calculated as the unweighted average of $P_{ijt} - P_{jkt}$ (that is, $P_{ijt,-k} = P_{ijt} - P_{jkt}$) at all the stores outside of county k during the month t. The "leave-out" price index ensures that the instrument is not contaminated by county-specific responses to local demand shocks (Allcott, Lockwood & Taubinsky, 2019a).

In the first stage of the control function, we fit the "leave-out" price index to the households' price index generated as follows:

(5) $$P_{ijt} = \rho_0 + \rho_1 P_{ijt,-k} + v_{ijt}$$

Where v_{ijt} is the error term. In the second stage of the control function, we include the error v_{ijt} in (1) to address the endogeneity issue caused by the simultaneous causality as follows:

(6) $$lnw_{ijt} = \beta_0 + \beta_1 lnP_{ijt} + \beta_2 lnE_{it} + \delta_j lnS'_{ijt} + \tau D'_{it} + \varphi v_{ijt} + \mu_{ijt}$$

We assume that the error term μ_{ijt} are identically and independently distributed (IID) and follow a normal distribution with mean zero and variance, σ.

3.3 The Finite Mixture-of-Regression Method

The finite mixture-of-regression method has been extensively employed in economic and marketing research to optimally classify consumers into subclasses, allowing for unspecified heterogeneity in a dataset. It is a semi-parametric probabilistic model that combines two or more density functions and is closely related to latent class analysis (Laird, 1978; Aitkin & Rubin, 1985; Wedel *et al.*, 1993). The main assumption in this model is that the observed response w is determined by distinct classes, $f_1, f_2, \dots, f_g$ in proportions $\pi_1, \pi_2, \dots, \pi_g$, so that g-component mixture model is given as follows (Deb and Trivedi, 1997):

(7) $$f\left(w_{ijt}|P_{ijt},\ E_{it},\ S_{ijt}, D_{it}; \beta_g, \sigma_g\right) = \sum_{g=1}^{G} \pi_g f_g\left(w_{ijt}|P_{ijt},\ E_{it},\ S_{ijt}, D_{it}; \beta_g, \sigma_g\right)$$

where π_g represents the proportion of households that belong to a specific gth class given $0 \leq \pi_g \geq 1$; The parameters in the latent gth class are β_g and σ_g. Both β_g and σ_g are unknown and were estimated in this study. $f_g(\cdot)$ is the conditional density function for the observed response in the gth model. We assume that $f_g\left(w_{ijt}|P_{ijt},\ E_{it},\ S_{ijt}, D_{it}; \beta_g, \sigma_g\right)$ follows a Gaussian distribution. The parameter G is the number of classes, which is unknown. Considering the presence of mixture, we sequentially compare

models with different values of G. We observe from the dataset that there are months in which households do not purchase soda yielding zero values for the demand of soda. As a result, we employ the Tobit variant of the FMM, because is the simplest way to model a data generating process that allows for zero as well as positive values.

To demonstrate how the FMM works, say for example, our data are generated by a one-class model, which implies that $G = 1$, then the model specification becomes:

(8) $$lnw_{ijt} = \beta_0 + \beta_1 lnP_{ijt} + \beta_2 lnE_{it} + \delta_j lnS'_{ijt} + \tau D'_{it} + \varphi v_{ijt} + \mu_{ijt}\,, \qquad \mu_{it} \sim N\,(0, \sigma^2)$$

In contrast, if we suppose that the data are better generated by two different classes of price elasticities, where $G = 2$, then the model specification is expressed as follows:

Class 1: $$lnw_{ijt} = \beta_{01} + \beta_{11} lnP_{ijt} + \beta_{21} lnE_{it} + \delta_{j1} lnS'_{ijt} + \tau_1 D'_{it} + \varphi_1 v_{ijt} + \mu_{1ijt}\,, \quad \mu_{1ijt} \sim N\,(0, \sigma_1^2)$$

Class 2: $$lnw_{ijt} = \beta_{02} + \beta_{12} lnP_{ijt} + \beta_{22} lnE_{it} + \delta_{j2} lnS'_{ijt} + \tau_2 D + \varphi_2 v_{ijt} + \mu_{2ijt}\,, \quad \mu_{2ijt} \sim N\,(0, \sigma_2^2)$$

The error terms μ_{1ijt} and μ_{2ijt} are assumed to be independent. The elasticities of demand may vary across classes because the context in which the demand for CSBs occurs may be different and unique to each class. This implies that for each class, households are heterogenous and respond to the demand for CSBs based on their income, own price changes of CSBs, prices of close substitutes and demographic variables. Therefore, ignoring the existence of the different circumstances peculiar to each class may lead to wrong conclusions on the elasticities of demand.

The choice of the number of latent classes (G) is important. We rely on the information criteria (IC) – the Akaike information criterion (AIC) and the Bayesian information criterion (BIC) – as a goodness-of-fit measure to determine the optimal G (Leroux, 1992; Konte, 2018). These model selection criteria are based on the maximized log-likelihood values, which penalizes the number of parameters in the model as follows (Deb & Holmes, 2000):

(9) $$AIC = -2\,log\,L + 2K$$

and $$BIC = -2\ log\ L + K\ log(N)$$

where $log\ L$ represents the maximized log-likelihood values, K represents the number of parameters in the model and N is the sample size. The preferred model will be the one that minimizes both the AIC and BIC. FMM employs the multinomial logistic distribution to compute the posterior probability of each household being assigned to a given latent class, using the Bayes rule as follows: (Konte, 2018; Dhakal, Escalanate & Dodson, 2019):

(10) $$\hat{\pi}_g = \frac{\hat{\pi}_g f_g(w_{ijt}|P_{ijt},E_{it},S_{ijt},D_{it};\beta_g,\sigma_g)}{\sum_{g=1}^{G}\hat{\pi}_g f_g(w_{ijt}|P_{ijt},E_{it},S_{ijt},D_{it};\beta_g,\sigma_g)}$$

4.0 Results

4.1 Descriptive Statistics

In Table 1, the summary statistics for the variables are presented. The average monthly demand for CSBs is 113.11 ounces, with a standard deviation of 273.07 ounces. The average unit price of CSBs is 10 cents per ounce per month.

The average total household expenditure is $4.77, with a standard deviation of $8.57. On average, households consist of 2 members, with a standard deviation of 1. About 64% of households are married, while 36% are unmarried. Among household heads aged between 45 and 54 years, 38% are male, and 48% are female. This proportion is higher than those under 45 years and above 54 years.

There is a higher proportion of head of households (both male and female) with education beyond high school compared to those with education below high school. Moreover, a greater number of head of households (both male and female) are employed in comparison to those who are unemployed. In terms of race, approximately 83% of CSB consumers are Caucasian, followed by African Americans at 13%, while 4% are Asians. The non-Hispanic population constitutes around 96%, while the Hispanic population comprises 4%.

4.2 FMM Regression Results

We model the demand for CSBs as a function of CSB price, and the prices of close substitutes to CSBs. This model is fitted into a finite-mixture-of-regression framework, where we assume that the data may be generated from one or more classes of demand model. All price indices for different products are logarithmically transformed. Likewise, we apply a logarithmic transformation to continuous variables such as total expenditure and household size. Although we predefine a maximum of four classes, the optimal number of classes is selected through the utilization of AIC and BIC.

Table 2 illustrates the goodness of fit when estimating the FMM using different values for the number of classes labeled as G in equation (7). The table provides the Akaike and Bayesian information criteria, which allows us to select our best model. The best model is the one that minimizes these two statistical values (Leroux, 1992; Deb & Trivedi, 1997). Our analysis reveals that the econometric model with two classes yields the lowest AIC (1512737) and BIC (1513466), suggesting that our data is best generated by the two-class model.

Table 3 displays the estimated coefficients for one-class, and two-class models. However, our primary focus is on the two-class model. In the two-class model, the results of the first and sub-groups have a probability weight of 68% and 32% respectively. Additionally, the corresponding mean of the first and second sub-groups is 4.96 and 3.96 respectively. Across all the sub-groups, we observe a negative own-price effect and a positive income effect. With respect to the price of regular CSBs, we identify an inelastic demand, with own-price elasticities for sub-groups 1 and 2 at approximately -0.03% and -0.54% respectively. This means that a one percent increase in the monthly price per ounce of CBS results in a 0.03% reduction in monthly ounce demand for sub-group 1, and a 0.54% reduction for sub-group 2.

On the income elasticity of the demand of CSBs, we find an “elastic” income demand for the two sub-groups. As regards cross elasticities with other close substitutes, we find both inelastic and elastic demand with respect to the prices of the different product categories. The sub-group with relatively low sensitivity to own price changes exhibit inelastic demand with respect to prices of fruit and vegetable beverages,

bottled water and other drinks and conversely exhibit demand prices of alcoholic drinks and coffee/tea/cocoa. On the other hand, the sub-group with relatively high sensitivity to own price changes exhibit elastic demand with respect to prices of fruit and vegetable beverages and inelastic demand with respect to prices of alcoholic drinks, bottled water, coffee/tea/cocoa, dairy, and other drinks. For both sub-groups, we find an elastic demand for low calorie CSB.

With respect to demographic variables, we find that for the sub-group with relatively high sensitivity to own price changes, larger households exhibit a tendency to consume fewer CSBs. The converse is the case for the sub-group with relatively low sensitivity to own price changes. Additionally, married households, in general, tend to consume less soft drinks than their non-married counterparts. In terms of age demographics, a clear pattern emerges for households with male heads. Those with male heads aged between 45 and 54 tend to consume more CSBs than households with male heads under 45 years of age. Similarly, households with male heads above the age of 54 also demonstrate a preference for higher CSBs consumption compared to those with male heads under 45 years of age.

However, the situation is more intricate for households with female heads. In the first sub-group, we find that female heads between the ages of 45 and 54, and those above 54 in the third class, consume fewer CSBs than female heads below 45 years of age. Conversely, in the second sub-group, female heads between the ages of 45 and 54, as well as those above 54, tend to consume more CSBs compared to female heads below 45 years of age.

Additionally, our analysis reveals that both employed male and female household heads tend to consume fewer CSBs compared to their unemployed counterparts. Regarding education, individuals with education levels above high school in the first sub-group regardless of gender, are inclined to consume fewer soft drinks compared to those with less than high school education. The converse is the case for the second group. The impact of race differs among sub-groups. However, most of the non-Caucasian households consume more CSB across all the sub-groups except for Asian household, which demand less CSB in the sub-group of consumers with relatively high sensitivity to price changes.

In Figure 1, we present the probability distributions for the one-class and two-class models. These visual representations reveal that the distributions of sub-groups in all the different models follows a fairly normal distribution.

4.3 Policy Simulation

We use the elasticities from the FMM to simulate the impact of a one percent increase of CSBs in price on the demand for CSBs. We compare the total change in the one-class model to total changes in the two-class model. This comparison allows us to underscore the significance of incorporating heterogeneity in the analysis. We adopt a 100% pass-through rate to consumer prices.

In the one-class model, a one percent increase in the monthly price per ounce of regular CSB will lead to a 0.30% decrease in the consumption of CSB expressed in ounce per month. On the other hand, we find that for the two-class model, a one percent increase in the monthly price per ounce of regular CSB will lead to an 0.03% decrease in the first sub-group, and 0.54% decrease in the second sub-group. From this results, we see that allowing for heterogeneity enables us to tease-out different tax regimes based on the two sub-group in the two-class model as opposed to a single tax on CSB for all consumers. This, therefore, can help in determining an appropriate tax policy that factors on the heterogeneity that exists in the dataset. Our simulation apply price changes to the prices that were observed in household purchases between 2017 and 2019. Consequently, our findings highlight the short-term effects of price changes.

5.0 Conclusion

In this study, we estimate and compare the impact of a one percent increase in price of CSBs on the consumption of CSBs across different distributions of CSB demand. In the analysis, we address several crucial econometrics issues in the single empirical framework. First, we normalize the prices of CSB as well as its close substitutes using the Fisher's price index approach. Second, we address the endogeneity of the prices of CSBs by employing the control function using the Hausmann-type price instrument through the two-stage residual exclusion. Third, we allow for heterogeneity in household responses to

economic incentives by employing the finite mixture demand model that better addresses the potential for heterogeneity thereby classifying consumers into different segments. The finite mixture model (FMM) allows us to identify different classes of models as well as sub-groups within each class, which provides valuable insights for policymaking in a heterogeneous population, as opposed to formulating policies that overlook this heterogeneity. We are able to implement the FMM through the construction of a county level panel data of consumers from the Nielsen Homescan dataset from the Chicago Booth Kilts Centre for Marketing.

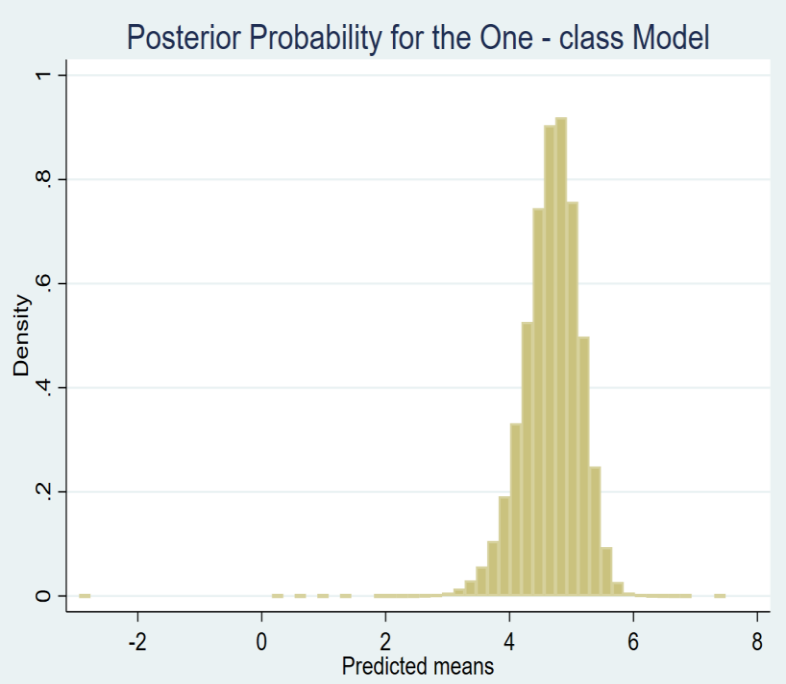
In policy circles, there exists a perception that the effectiveness of taxation policies targeting heavy consumers of carbonated sweetened beverages (CSBs) is questionable. This perception is rooted in the context of high CSB consumption in the U.S. as well as primary concern raised by opponents of CSB taxes regarding its potentially regressive impact. Our results generally show a negative own-price effect on the demand for CSBs across all the models. However, in the two-class model, we find that a sub-groups of consumers whose demand are relatively lowly sensitive to price changes and another sub-groups of consumers whose demand are relatively highly sensitive to price changes. With respect to the heterogeneity across the different sub-group in the two-class model, we also find that several noteworthy disparities emerge regarding the demographic variables.

Our policy simulation suggest a 0.30% reduction in CSB consumption per month due to a one percent increase in the monthly price per ounce of CSB in the one-class model. In contrast, the two-class model reveals that such a price increase leads to an 0.03% decrease in the first sub-group, and a 0.54% decrease in the second sub-group. These findings demonstrate that accounting for heterogeneity allows for the differentiation of tax regimes based on the two sub-groups, aiding in the development of more tailored tax policies that considers the heterogeneity in the dataset. The simulations conducted apply price changes to household purchases observed between 2017 and 2019, thereby offering insights into the short-term effects of price fluctuations.

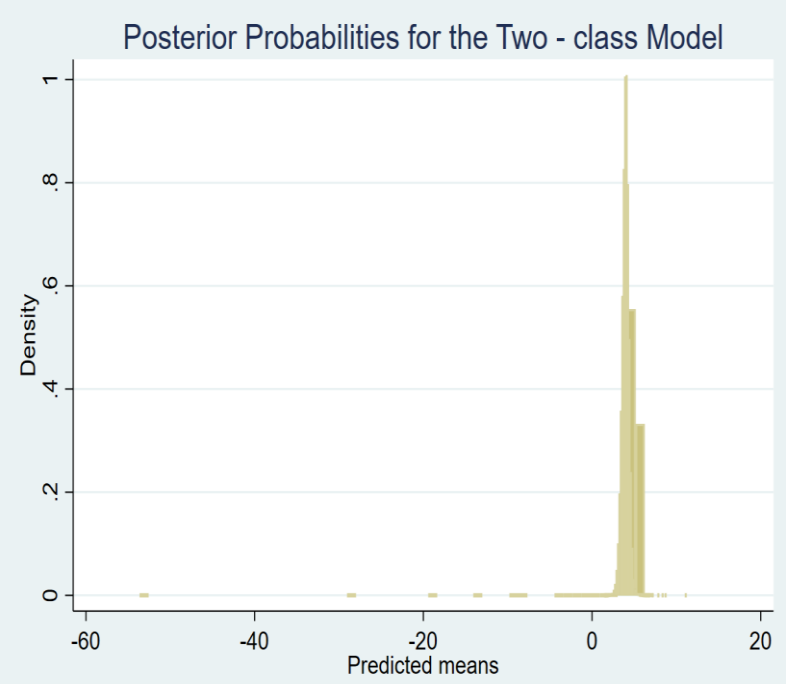
Figures: Estimating the demand for Carbonated Sweetened Beverage in the U.S.: A Finite Mixture Approach

Figure 1: Posterior Probability Distributions

One-class model



Two-class model



Tables: Estimating the demand for Carbonated Sweetened Beverage in the U.S.: A Finite Mixture Approach

Table 1: Descriptive statistics

Variables	Unit	Mean	SD	Min	Max
CSB Demand	oz/month	93.842	180.640	0	9168
CSB Unit price	$/oz/month	0.094	0.067	0	0.5
Total Household expenditure	$/month	4.773	8.574	0	424.84
Regular CSB price index	$/oz/month	1.023	0.593	0.002	373.75
Low calorie CSB price index	$/oz/month	1.039	1.581	0.002	896.667
Fruit and vegetable beverages price index	$/oz/month	1.014	0.318	0.002	63.964
Alcoholic drinks price index	$/oz/month	0.999	0.130	0.014	74.433
Bottled water price index	$/oz/month	1.042	0.855	0.013	71.424
Coffee, Tea, and Cocoa price index	$/oz/month	1.000	0.025	0.006	7.378
Dairy price index	$/oz/month	1.001	0.180	0.007	67.433
Other drinks price index	$/oz/month	1.000	0.002	0.403	2.544
Household income	Median income range	65721.04	32676.69	5000	112500
Household size	#	2.396	1.260	1	9
Married	Binary	0.640	0.479	0	1
Unmarried	Binary	0.359	0.479	0	1
Male under 45 years	Binary	0.132	0.338	0	1
Male between 45 and 54 years	Binary	0.377	0.484	0	1
Male above 54 years	Binary	0.233	0.422	0	1
Female under 45 years	Binary	0.182	0.386	0	1
Female between 45 and 54 years	Binary	0.479	0.499	0	1
Female above 54 years	Binary	0.253	0.435	0	1
Employed male	Binary	0.500	0.500	0	1
Unemployed male	Binary	0.242	0.428	0	1
Employed female	Binary	0.519	0.499	0	1
Unemployed female	Binary	0.395	0.488	0	1
Male with below high school education	Binary	0.224	0.417	0	1
Male with above high school education	Binary	0.517	0.499	0	1

Female with below high school education	Binary	0.235	0.425	0	1
Female with above high school education	Binary	0.679	0.467	0	1
Caucasian	Binary	0.833	0.372	0	1
Asian	Binary	0.038	0.192	0	1
African American	Binary	0.127	0.334	0	1
Hispanic	Binary	0.042	0.202	0	1
Non-Hispanic	Binary	0.957	0.202	0	1

Table 2: Goodness of Fit

The table below presents the goodness of fit for the mixture-of-regression model. The selected model is in bold.

Number of classes	**Number of Observations**	**Log-likelihood model**	**d.f.**	**AIC**	**BIC**
$K = 1$	549, 690	-782,261.9	32	1564588	1564947
$\boldsymbol{K = 2}$	**549, 690**	**-756,303.4**	**65**	**1512737**	**1513466**

Table 3: Finite Mixture-of-Regression Results

	One Class model	Two-class model Class 1	Two-class model Class 2
A. Class mean	4.640***	4.9628***	3.9560***
	(0.0014)	(0.0018)	(0.0109)
B. Posterior probabilities	1.0000***	0.6788***	0.3212***
	(0.0000)	(0.0036)	(0.0036)
C. Own Price and Income Elasticity			
Regular CSB price index	-0.303***	-0.0263***	-0.542***
	(0.00640)	(0.00888)	(0.0188)
Total expenditure	0.436***	0.461***	0.326***
	(0.00135)	(0.00159)	(0.00492)
D. Cross Elasticities with Close Substitutes			
Low calorie CSB price index	0.0293***	0.0188***	0.0385*
	(0.00689)	(0.00701)	(0.0224)
Fruit and Vegetable Beverages price index	-0.00987	-0.0264**	0.0863**
	(0.0128)	(0.0123)	(0.0385)
Alcoholic drinks price index	0.116**	0.725***	-0.244**
	(0.0493)	(0.112)	(0.114)
Bottled water price index	-0.0180**	-0.0134*	-0.0372*
	(0.00743)	(0.00774)	(0.0201)
Coffee, Tea, and Cocoa price index	-0.0329	0.261	-0.406**
	(0.115)	(0.173)	(0.203)
Dairy price index	-0.00821	-0.0325	-0.0163
	(0.0272)	(0.0283)	(0.0884)
Other Drinks	-4.509**	-4.428***	-6.076
	(1.815)	(1.461)	(5.096)
E. Household Level Characteristics			
Household size	-0.0617***	0.0828***	-0.315***
	(0.00357)	(0.00388)	(0.0102)
Married	-0.148***	-0.0903***	-0.250***
	(0.00483)	(0.00513)	(0.0136)
Male between 45 and 54 years	0.173***	0.121***	0.278***
	(0.00422)	(0.00449)	(0.0117)
Male above 54 years	0.194***	0.112***	0.341***
	(0.00503)	(0.00546)	(0.0142)
Female between 45 and 54 years	-0.00713*	-0.0359***	0.0464***

	(0.00384)	(0.00412)	(0.0106)
Female above 54 years	0.0136***	-0.0274***	0.0793***
	(0.00475)	(0.00518)	(0.0133)
Employed male	-0.0436***	-0.0507***	-0.0356***
	(0.00392)	(0.00428)	(0.0113)
Employed Female	-0.0255***	-0.0547***	0.0239***
	(0.00310)	(0.00330)	(0.00858)
Male with above high school education	0.0377***	-0.00696*	0.133***
	(0.00339)	(0.00363)	(0.00950)
Female with above high school education	-0.0219***	-0.0620***	0.0435***
	(0.00330)	(0.00353)	(0.00922)
Asian	-0.0156**	0.0769***	-0.204***
	(0.00742)	(0.00775)	(0.0208)
African-American	0.270***	0.229***	0.292***
	(0.00395)	(0.00419)	(0.0113)
Hispanic	0.0165**	0.0258***	-0.0310*
	(0.00661)	(0.00683)	(0.0186)
Constant	2.652***	2.844***	2.504***
	(0.00732)	(0.00852)	(0.0246)
Observations	549,690	549,690	549,690

Standard errors are in parenthesis
One (*), two (**), three (***) asterisks represent 0.10, 0.05, and 0.01 levels of statistical significance, respectively

Appendix: List of Items selected from the scanner Dataset under different Product Categories

1. **SOFT DRINKS – CARBONATED**
2. **SOFT DRINKS – LOW CALORIE**
3. **FRUIT AND VEGETABLE BEVERAGES:**

   FRUIT DRINKS – CANNED

   FRUIT DRINKS – OTHER CONTAINER

   FRUIT DRINKS & JUICES – CRANBERRY

   FRUIT JUICE - ORANGE - OTHER CONTAINER

   VEGETABLE JUICE AND DRINK REMAINING

   FRUIT JUICE - APPLE

   FRUIT JUICE-REMAINING

   FRUIT JUICE - GRAPE

   FRUIT JUICE - REMAINING - FROZEN

   FRUIT JUICE - UNCONCENTRATED - FROZEN

   FRUIT JUICE - LEMON/LIME

   FRUIT JUICE - APPLE - FROZEN

   FRUIT JUICE - PINEAPPLE

   FRUIT JUICE-PRUNE

   FRUIT JUICE - GRAPE - FROZEN

   FRUIT JUICE - GRAPEFRUIT - FROZEN

   FRUIT JUICE-GRAPEFRUIT-CANNED

   FRUIT JUICE-ORANGE-CANNED

4. **COFFEE/TEA/COCOA:**

   TEA – LIQUID

COFFEE - LIQUID

5. ALCOHOLIC DRINKS:

WINE-SANGRIA

WINE-IMPORTED DRY TABLE

WINE-FLAVORED/REFRESHMENT

WINE-DOMESTIC DRY TABLE

WINE-SPARKLING

WINE-SAKE

WINE-SWEET DESSERT-DOMESTIC

WINE-SWEET DESSERT-IMPORTED

WINE-VERMOUTH

BEER

6. BOTTLED WATER:

WATER-BOTTLED

7. DAIRY:

DAIRY-MILK-REFRIGERATED (COW'S MILK)

DAIRY-FLAVORED MILK-REFRIGERATED

YOGURT-REFRIGERATED – SHAKES & DRINKS

MILK-SHELF STABLE

8. OTHER DRINKS:

REMAINING DRINKS & SHAKES-REFRIGERATED

REMAINING DRINKS & SHAKES-NON REFRIGERATED

WINE - NON ALCOHOLIC

PLANT-BASED MILK (SOY, ALMOND etc.) – NON-DAIRY MILK

BIBLIOGRAPHY

Afriat, S. N., & Milana, C. (2009). *Economics and the price index*. Routledge.

Ahn, S., & Lusk, J. L. (2021a). Non-Pecuniary Effects of Sugar-Sweetened Beverage Policies. *American Journal of Agricultural Economics*, *103*(1), 53–69. https://doi.org/10.1111/ajae.12134

Ahn, S., & Lusk, J. L. (2021b). Non-Pecuniary Effects of Sugar-Sweetened Beverage Policies. *American Journal of Agricultural Economics*, *103*(1), 53–69. https://doi.org/10.1111/ajae.12134

Aitkin, M., & Rubin, D. B. (1985). Estimation and Hypothesis Testing in Finite Mixture Models. *Journal of the Royal Statistical Society: Series B (Methodological)*, *47*(1), 67–75. https://doi.org/10.1111/j.2517-6161.1985.tb01331.x

Alfnes, F. (2004). Stated preferences for imported and hormone-treated beef: Application of a mixed logit model. *European Review of Agriculture Economics*, *31*(1), 19–37. https://doi.org/10.1093/erae/31.1.19

Allcott, H., Lockwood, B. B., & Taubinsky, D. (2019a). Regressive Sin Taxes, with an Application to the Optimal Soda Tax*. *The Quarterly Journal of Economics*, *134*(3), 1557–1626. https://doi.org/10.1093/qje/qjz017

Allcott, H., Lockwood, B. B., & Taubinsky, D. (2019b). Should We Tax Sugar-Sweetened Beverages? An Overview of Theory and Evidence. *Journal of Economic Perspectives*, *33*(3), 202–227. https://doi.org/10.1257/jep.33.3.202

Alpert, A., Powell, D., & Pacula, R. L. (2018). Supply-Side Drug Policy in the Presence of Substitutes: Evidence from the Introduction of Abuse-Deterrent Opioids. *American Economic Journal: Economic Policy*, *10*(4), 1–35. https://doi.org/10.1257/pol.20170082

Andersen, S., Harrison, G. W., Lau, M. I., & Rutström, E. E. (2006). Elicitation using multiple price list formats. *Experimental Economics*, *9*(4), 383–405. https://doi.org/10.1007/s10683-006-7055-6

Angrist, J. D., & Pischke, J. S. (2009). *Most Harmless Econometrics: An Empiricist's Companion*. Princeton University Press.

Angrist, J. D., & Pischke, J. S. (2015). *Mastering Metrics*. Princeton University Press.

Annan, F., & Schlenker, W. (2015). Federal Crop Insurance and the Disincentive to Adapt to Extreme Heat. *American Economic Review*, *105*(5), 262–266. https://doi.org/10.1257/aer.p20151031

Annan, F., Tack, J., Harri, A., & Coble, K. (2014). Spatial Pattern of Yield Distributions: Implications for Crop Insurance. *American Journal of Agricultural Economics*, *96*(1), 253–268. https://doi.org/10.1093/ajae/aat085

Arnot, C., Vizzier-Thaxton, Y., & Scanes, C. G. (2016). Values, trust and science – building trust in today's food system in an era of radical transparency. *Poultry Science*, *95*(9), 2219–2224. https://doi.org/10.3382/ps/pew168

Babcock, B. A., & Hennessy, D. A. (1996). Input Demand under Yield and Revenue Insurance. American Journal of Agricultural Economics, 78(2), 416–427. https://doi.org/10.2307/1243713

Bartus, T. (2005). Estimation of Marginal Effects using Margeff. *The Stata Journal: Promoting Communications on Statistics and Stata*, *5*(3), 309–329. https://doi.org/10.1177/1536867X0500500303

Benavidez, J. R., & Anderson, R. B. (2021). Examining Negotiated Cash Trade Targets. In *The U.S. Beef Supply Chain: Issues and Challenges* (Edited by B.L. Fischer; J.L. Outlaw and D.P. Anderson). Agricultural and Food Policy Center, Texas A&M University.

Cao, P., Lu, C., & Yu, Z. (2018). Historical nitrogen fertilizer use in agricultural ecosystems of the contiguous United States during 1850–2015: Application rate, timing, and fertilizer types. *Earth System Science Data*, *10*(2), 969–984. https://doi.org/10.5194/essd-10-969-2018

Capitanio, F., Adinolfi, F., & Santeramo, F. G. (2014). Crop Insurance Subsidies and Environmental Externalities: Evidence from Southern Italy. *Outlook on Agriculture*, *43*(4), 253–258. https://doi.org/10.5367/oa.2014.0183

Cawley, J., & Frisvold, D. (2023). Review: Taxes on sugar-sweetened beverages: Political economy, and effects on prices, purchases, and consumption. *Food Policy*, *117*, 102441. https://doi.org/10.1016/j.foodpol.2023.102441

Cawley, J., Frisvold, D., Hill, A., & Jones, D. (2019). The impact of the Philadelphia beverage tax on purchases and consumption by adults and children. *Journal of Health Economics*, *67*, 102225. https://doi.org/10.1016/j.jhealeco.2019.102225

Chang, H.-H., & Mishra, A. K. (2012). Chemical usage in production agriculture: Do crop insurance and off-farm work play a part? *Journal of Environmental Management*, *105*, 76–82. https://doi.org/10.1016/j.jenvman.2012.03.038

Chang, K.-L., Xu, P., Underwood, K., Mayen, C., & Langelett, G. (2013). Consumers' Willingness to Pay for Locally Produced Ground Beef: A Case Study of the Rural Northern Great Plains. *Journal of International Food & Agribusiness Marketing*, *25*(1), 42–67. https://doi.org/10.1080/08974438.2013.724002

Chavas, J.-P. (2004). *Risk Analysis in Theory and Practice*. Elsevier Academic Press.

Claassen, R., Langpap, C., & Wu, J. (2017). Impacts of Federal Crop Insurance on Land Use and Environmental Quality. *American Journal of Agricultural Economics*, *99*(3), 592–613. https://doi.org/10.1093/ajae/aaw075

Coble, K. H., Knight, T. O., Pope, R. D., & Williams, J. R. (1997). An Expected-Indemnity Approach to the Measurement of Moral Hazard in Crop Insurance. *American Journal of Agricultural Economics*, *79*(1), 216–226. https://doi.org/10.2307/1243955

Colantuoni, F., & Rojas, C. (2015). The impact of soda sales taxes on consumption: Evidence from scanner data: impact of soda sales taxes. *Contemporary Economic Policy*, *33*(4), 714–734. https://doi.org/10.1111/coep.12101

Congressional Research Service (1996). *Crop Insurance and Risk Management: Provisions in the Enacted 1996 Farm Bill.* CRS Report for Congress, 96-477 ENR. Environment and Natural Resources Policy Division. https://www.everycrsreport.com/reports/96-477.html

Connor, L., & Katchova, A. L. (2020). *Crop Insurance Participation Rates and Asymmetric Effects on U.S. Corn and Soybean Yield Risk*. https://doi.org/10.22004/AG.ECON.298431

Cornaggia, J. (2013). Does risk management matter? Evidence from the U.S. agricultural industry. *Journal of Financial Economics*, *109*(2), 419–440. https://doi.org/10.1016/j.jfineco.2013.03.004

Cox, T. L., & Wohlgenant, M. K. (1986). *Prices and Quality Effects in Cross-Sectional Demand Analysis*. *68*, 908–919.

Cragg, J. G. (1971). Some Statistical Models for Limited Dependent Variables with Application to the Demand for Durable Goods. *Econometrica*, *39*(5), 829. https://doi.org/10.2307/1909582

Cunningham, J., & Goodman-Bacon, A. (2020). *Changes in Family Structure and Welfare Participation since the 1960s: The Role of Legal Services* (pp. 1–58) [Unpublished Manuscript]. Department of Economics, University of Memphis.

de Chaisemartin, C., & D'HaultfŒuille, X. (2018). Fuzzy Differences-in-Differences. *The Review of Economic Studies*, *85*(2), 999–1028. https://doi.org/10.1093/restud/rdx049

Deaton, A., S. (1988). *Quality, Quantity, and Spatial Variation of Price*. *78*, 418–430.

Deb, P., & Holmes, A. M. (2000). Estimates of use and costs of behavioural health care: A comparison of standard and finite mixture models. *Health Economics*, *9*(6), 475–489. https://doi.org/10.1002/1099-1050(200009)9:6<475::AID-HEC544>3.0.CO;2-H

Deb, P., & Trivedi, P. K. (1997). Demand for Medical Care by the Elderly: A Finite Mixture Approach. *Journal of Applied Econometrics*, *12*(3), 313–336.

Debnam, J. (2017). Selection Effects and Heterogeneous Demand Responses to the Berkeley Soda Tax Vote. *American Journal of Agricultural Economics*, *99*(5), 1172–1187. https://doi.org/10.1093/ajae/aax056

DeLong, K. L., Jensen, K. L., Griffith, A. P., & McLeod, E. (2019). Beef cattle farmers' marketing preferences for selling local beef. *Agribusiness*, *35*(3), 343–357. https://doi.org/10.1002/agr.21579

Deryugina, T., & Konar, M. (2017). Impacts of crop insurance on water withdrawals for irrigation. *Advances in Water Resources*, *110*, 437–444. https://doi.org/10.1016/j.advwatres.2017.03.013

Dhakal, C. K., Escalante, C. L., & Dodson, C. (2019). Heterogeneity of farm loan packaging term decisions: A finite mixture approach. *Applied Economics Letters*, *26*(18), 1528–1532. https://doi.org/10.1080/13504851.2019.1584360

Dobbs, L. M., Jensen, K. L., Leffew, M. B., English, B. C., Lambert, D. M., & Clark, C. D. (2016). Consumer Willingness to Pay for Tennessee Beef. *Journal of Food Distribution Research*, *47*(2). https://doi.org/10.22004/AG.ECON.240768

Dubois, P., Griffith, R., & O'Connell, M. (2020). How Well Targeted Are Soda Taxes? *American Economic Review*, *110*(11), 3661–3704. https://doi.org/10.1257/aer.20171898

Elhorst, P. J. (2010). Spatial Panel Data Models. In *Handbook of Applied Spatial Analysis: Software Tools, Methods and Applications*. Springer.

Etilé, F., & Sharma, A. (2015). Do High Consumers of Sugar-Sweetened Beverages Respond Differently to Price Changes? A Finite Mixture IV-Tobit Approach. *Health Economics*, *24*(9), 1147–1163. https://doi.org/10.1002/hec.3157

Evans, M. F., Harris, M., & Kessler, L. (2020). *The hazards of unwinding the prescription opioid epidemic: Implications for child abuse and neglect* (Claremont McKenna College Robert Day School of Economics and Finance Research Paper No. 3582060).

Feldkamp, T. J., Schroeder, T. C., & Lusk, J. L. (2005). Determing Consumer Valuation of Differentiated Beef Steak Quality Attributes. *Journal of Muscle Foods*, *16*(1), 1–15. https://doi.org/10.1111/j.1745-4573.2004.05303.x

Fields, D., Prevatt, J. W., Lusk, J. L., & Kerth, C. R. (2006). *Forage-fed beef attributes: Consumer preferences and willingness-to-pay* (Bulletin 664; Alabama Agricultural Experiment Station). Auburn University.

Fox, J. A., Shogren, J. F., Hayes, D. J., & Kliebenstein, J. B. (1998). CVM-X: Calibrating Contingent Values with Experimental Auction Markets. *American Journal of Agricultural Economics*, *80*(3), 455–465. https://doi.org/10.2307/1244548

Freyaldenhoven, S., Hansen, C., Pérez, J. P., & Shapiro, J. M. (2021). *Visualization, Identification, and Estimation in the Linear Panel Event-Study Design* (NBER Working Papers No. 29170). National Bureau of Economic Research, Inc. https://ideas.repec.org/p/nbr/nberwo/29170

Froehlich, E. J., Carlberg, J. G., & Ward, C. E. (2009). Willingness-to-Pay for Fresh Brand Name Beef. *Canadian Journal of Agricultural Economics/Revue Canadienne d'agroeconomie*, *57*(1), 119–137. https://doi.org/10.1111/j.1744-7976.2008.01141.x

Fuglie, K. O., & Bosch, D. J. (1995). Economic and Environmental Implications of Soil Nitrogen Testing: A Switching-Regression Analysis. *American Journal of Agricultural Economics*, *77*(4), 891–900. https://doi.org/10.2307/1243812

Galloway, J. N., & Cowling, E. B. (2002). Reactive Nitrogen and The World: 200 Years of Change. *AMBIO: A Journal of the Human Environment*, *31*(2), 64–71. https://doi.org/10.1579/0044-7447-31.2.64

Ganong, P., Greig, F., Noel, P., Sullivan, D., M., & Vavra, J. (2021). *Micro and Macro Disincetive Effects of Expanded Unemployment Benefits*. University of Chicago. https://ssrn.com/abstract=3784008

García, B. (2013). Implementation of a Double-Hurdle Model. *The Stata Journal: Promoting Communications on Statistics and Stata*, *13*(4), 776–794. https://doi.org/10.1177/1536867X1301300406

Gillespie, J., Sitienei, I., Bhandari, B., Scaglia, G., Gillespie, J., Sitienei, I., Bhandari, B., & Scaglia, G. (2016). Grass-Fed Beef: How is it Marketed by US Producers? *International Food and Agribusiness Management Review*, *19*(2). https://doi.org/10.22004/AG.ECON.234961

Gilliam, J. W., Logan, T. J., & Broadbent, F. E. (2015). Fertilizer Use in Relation to the Environment. In O. P. Engelstad (Ed.), *Fertilizer Technology and Use* (pp. 561–588). Soil Science Society of America. https://doi.org/10.2136/1985.fertilizertechnology.c16

Goodman-Bacon, A. (2021). Difference-in-differences with variation in treatment timing. *Journal of Econometrics*, S0304407621001445. https://doi.org/10.1016/j.jeconom.2021.03.014

Goodsell, M., Stanton, T., & McLaughlin, J. (2010). *A Resource Guide to Direct Marketing Livestock and Poultry*. Cornell University. https://blog.uvm.edu/farmvia/files/2014/07/cornell-Resource-Guide-to-Direct-Marketing-Meat-and-Poultry.pdf

Goodwin, B. K., Vandeveer, M. L., & Deal, J. L. (2004). An Empirical Analysis of Acreage Effects of Participation in the Federal Crop Insurance Program. *American Journal of Agricultural Economics*, *86*(4), 1058–1077. https://doi.org/10.1111/j.0002-9092.2004.00653.x

Gospodinov, N., & Irvine, I. (2009). Tobacco taxes and regressivity. *Journal of Health Economics*, *28*(2), 375–384. https://doi.org/10.1016/j.jhealeco.2008.10.010

Griffith, A. P., Kimberly, J. L., DeLong, K. L., & McCleod, E. (2017). *Tennessee Branded Beef Program: The Producers' Perspective and Willingness to Participate*. University of Tennessee Extension. https://ageconsearch.umn.edu/record/302906/

Grogger, J. (2017). Soda Taxes and the Prices of Sodas and Other Drinks: Evidence from Mexico. *American Journal of Agricultural Economics*, *99*(2), 481–498. https://doi.org/10.1093/ajae/aax024

Hamid, F., Yazdanpanah, M., Baradaran, M., Khalilimoghadam, B., & Azadi, H. (2021). Factors affecting farmers' behavior in using nitrogen fertilizers: Society vs. farmers' valuation in southwest Iran. *Journal of Environmental Planning and Management*, *64*(10), 1886–1908. https://doi.org/10.1080/09640568.2020.1851175

Hayes, D. J., Shogren, J. F., Shin, S. Y., & Kliebenstein, J. B. (1995). Valuing Food Safety in Experimental Auction Markets. *American Journal of Agricultural Economics*, *77*(1), 40–53. https://doi.org/10.2307/1243887

He, J., Zheng, X., Rejesus, R. M., & Yorobe, J. M. (2019). Moral hazard and adverse selection effects of cost-of-production crop insurance: Evidence from the Philippines. *Australian Journal of Agricultural and Resource Economics*, *63*(1), 166–197. https://doi.org/10.1111/1467-8489.12290

Heckman, J., & Singer, B. (1984). A Method for Minimizing the Impact of Distributional Assumptions in Econometric Models for Duration Data. *Econometrica*, *52*(2), 271. https://doi.org/10.2307/1911491

Heisey, P. W. (2015). Crop Yields and Global Food Security: Will Yield Increase Continue to Feed the World? *American Journal of Agricultural Economics*, *97*(2), 661–663. https://doi.org/10.1093/ajae/aau121

Hobbs, J. E., Sanderson, K., & Haghiri, M. (2006). Evaluating Willingness-to-Pay for Bison Attributes: An Experimental Auction Approach. *Canadian Journal of Agricultural Economics/Revue Canadienne D'Agroeconomie*, *54*(2), 269–287. https://doi.org/10.1111/j.1744-7976.2006.00049.x

Horowitz, J. K., & Lichtenberg, E. (1993). Insurance, Moral Hazard, and Chemical Use in Agriculture. *American Journal of Agricultural Economics*, *75*(4), 926–935. https://doi.org/10.2307/1243980

Howarth, R. W., Boyer, E. W., Pabich, W. J., & Galloway, J. N. (2002). Nitrogen Use in the United States from 1961–2000 and Potential Future Trends. *AMBIO: A Journal of the Human Environment*, *31*(2), 88–96. https://doi.org/10.1579/0044-7447-31.2.88

Huseynov, S., Palma, M., & Segovia, M. (2022). *Distributional Effects of Perceptional Financial Scarcity and Abundance on Food Choices*. https ://samirhuseynov.com/research/price_salience.pdf

Jithitikulchai, T., & Andreyeva, T. (2018). Sugar-Sweetened Beverage Demand and Tax Simulation for Federal Food Assistance Participants: A Case of Two New England States. *Applied Health Economics and Health Policy*, *16*(4), 549–558. https://doi.org/10.1007/s40258-018-0399-1

Jones, A. M., & Yen, S. T. (2000). A Box-Cox Double-hurdle Model. *The Manchester School*, *68*(2), 203–221. https://doi.org/10.1111/1467-9957.00190

Kahneman, D., Knetsch, J. L., & Thaler, R. H. (1990). Experimental Tests of the Endowment Effect and the Coase Theorem. *Journal of Political Economy*, *98*(6), 1325–1348. https://doi.org/10.1086/261737

Khandker, S. R., Koolwal, G. B., & Samad, H. A. (2010). *Handbook on Impact Evaluation: Quantitative Methods and Practices*. The World Bank.

Kiesel, K., Lang, H., & Sexton, R. J. (2023). A New Wave of Sugar-Sweetened Beverage Taxes: Are They Meeting Policy Goals and Can We Do Better? *Annual Review of Resource Economics*, *15*(1), 407–432. https://doi.org/10.1146/annurev-resource-111522-111325

Kim, J. (2018). The timing of exemptions from welfare work requirements and its effects on mothers' work and welfare receipt around childbirth: The effects of welfare work exemptions on work and welfare. *Economic Inquiry*, *56*(1), 317–342. https://doi.org/10.1111/ecin.12496

Konte, M. (2018). Do remittances not promote growth? A finite mixture-of-regressions approach. *Empirical Economics*, *54*(2), 747–782. https://doi.org/10.1007/s00181-016-1224-z

Laird, N. (1978). Nonparametric Maximum Likelihood Estimation of a Mixing Distribution. *Journal of the American Statistical Association*, *73*(364), 805–811. https://doi.org/10.1080/01621459.1978.10480103

Leroux, B. G. (1992). Consistent Estimation of a Mixing Distribution. *The Annals of Statistics*, *20*(3). https://doi.org/10.1214/aos/1176348772

Li, W., & Dorfman, J. H. (2019). The implications of heterogeneous habit in consumer beverage purchases on soda and sin taxes. *Food Policy*, *84*, 111–120. https://doi.org/10.1016/j.foodpol.2019.03.003

Li, X., Jensen, K. L., Clark, C. D., & Lambert, D. M. (2016). Consumer willingness to pay for beef grown using climate friendly production practices. *Food Policy*, *64*, 93–106. https://doi.org/10.1016/j.foodpol.2016.09.003

Li, Y., Miao, R., & Khanna, M. (2019). Effects of Ethanol Plant Proximity and Crop Prices on Land-Use Change in the United States. *American Journal of Agricultural Economics*, *101*(2), 467–491. https://doi.org/10.1093/ajae/aay080

Lin, B.-H., Padgitt, M., Bull, L., Delvo, H., Shank, D., Taylor, H., Lin, B.-H., Padgitt, M., Bull, L., Delvo, H., Shank, D., & Taylor, H. (1995). *Pesticide and Fertilizer Use and Trends in U.S. Agriculture*. https://doi.org/10.22004/AG.ECON.308423

Linea, L. (2021). *The Steaks are High: COVID-19's Impact on Direct-to-Consumer Marketing in the Oklahoma Beef Industry* (pp. 1–97) [Unpublished Manuscript]. Oklahoma State University.

Long, M. W., Gortmaker, S. L., Ward, Z. J., Resch, S. C., Moodie, M. L., Sacks, G., Swinburn, B. A., Carter, R. C., & Claire Wang, Y. (2015). Cost Effectiveness of a Sugar-Sweetened Beverage Excise Tax in the U.S. *American Journal of Preventive Medicine*, *49*(1), 112–123. https://doi.org/10.1016/j.amepre.2015.03.004

Loureiro, M. L., & Umberger, W. J. (2003). Estimating Consumer Willingness to Pay for country-of-Origin Labeling. *Journal of Agricultural and Resource Economics*, *28*(2), 287–301. https://www.jstor.org/stable/40987187

Lu, C., Zhang, J., Cao, P., & Hatfield, J. L. (2019). Are We Getting Better in Using Nitrogen?: Variations in Nitrogen Use Efficiency of Two Cereal Crops Across the United States. *Earth's Future*, *7*(8), 939–952. https://doi.org/10.1029/2019EF001155

Lu, X., Che, Y., Rejesus, R. M., Goodwin, B. K., Ghosh, S. K., & Paudel, J. (2023). Unintended environmental benefits of crop insurance: Nitrogen and phosphorus in water bodies. Ecological Economics, 204, 107657. https://doi.org/10.1016/j.ecolecon.2022.107657

Lusk, J. L., Fox, J. A., Schroeder, T. C., Mintert, J., & Koohmaraie, M. (2001). In-Store Valuation of Steak Tenderness. *American Journal of Agricultural Economics*, *83*(3), 539–550. https://doi.org/10.1111/0002-9092.00176

Lusk, J. L., Tonsor, G. T., & Schulz, L. L. (2021). Beef and Pork Marketing Margins and Price Spreads during COVID -19. *Applied Economic Perspectives and Policy*, *43*(1), 4–23. https://doi.org/10.1002/aepp.13101

Lusk, J., & Shogren, J. F. (2007). *Experimental auctions: Methods and applications in economic and marketing research*. Cambridge University Press.

Lustig, R. H., Schmidt, L. A., & Brindis, C. D. (2012). The toxic truth about sugar. *Nature*, *482*(7383), 27–29. https://doi.org/10.1038/482027a

Masiza, W., Chirima, J. G., Hamandawana, H., Kalumba, A. M., & Magagula, H. B. (2021). Linking Agricultural Index Insurance with Factors That Influence Maize Yield in Rain-Fed Smallholder Farming Systems. *Sustainability*, *13*(9), 5176. https://doi.org/10.3390/su13095176

Maynard, L. J., Hartell, J. G., Meyer, A. L., & Hao, J. (2004). An experimental approach to valuing new differentiated products. *Agricultural Economics*, *31*(2–3), 317–325. https://doi.org/10.1111/j.1574-0862.2004.tb00268.x

McCarl, B. A., Villavicencio, X., & Wu, X. (2008). Climate Change and Future Analysis: Is Stationarity Dying? *American Journal of Agricultural Economics*, *90*(5), 1241–1247. https://doi.org/10.1111/j.1467-8276.2008.01211.x

McFadden, D. (1974). Conditional Logit Analysis of Qualitative Choice Behavior. In *Frontiers in Econometrics* (Zarembka, P., pp. 105–142).

McKay, L. C., DeLong, K. L., Jensen, K. L., Griffith, A. P., Boyer, C. N., & Lambert, D. M. (2019). Estimating restaurant willingness to pay for local beef. *Agribusiness*, *35*(4), 610–624. https://doi.org/10.1002/agr.21605

Melton, B. E., Huffman, W. E., Shogren, J. F., & Fox, J. A. (1996). Consumer Preferences for Fresh Food Items with Multiple Quality Attributes: Evidence from an Experimental Auction of Pork Chops. *American Journal of Agricultural Economics*, *78*(4), 916–923. https://doi.org/10.2307/1243848

Merritt, M. G., DeLong, K. L., Griffith, A. P., & Jensen, K. L. (2018). Consumer Willingness to Pay for Tennessee Certified Beef. *Journal of Agricultural and Applied Economics*, *50*(2), 233–254. https://doi.org/10.1017/aae.2017.35

Miao, R., Khanna, M., & Huang, H. (2016). Responsiveness of Crop Yield and Acreage to Prices and Climate. *American Journal of Agricultural Economics*, *98*(1), 191–211. https://doi.org/10.1093/ajae/aav025

Miranda, M. J. (1991). Area-Yield Crop Insurance Reconsidered. *American Journal of Agricultural Economics*, *73*(2), 233–242. https://doi.org/10.2307/1242708

Napolitano, F., Braghieri, A., Piasentier, E., Favotto, S., Naspetti, S., & Zanoli, R. (2010). Effect of information about organic production on beef liking and consumer willingness to pay. *Food Quality and Preference*, *21*(2), 207–212. https://doi.org/10.1016/j.foodqual.2009.08.007

Nielsen Consumer Panel Dataset Manual. (2011). *Consumer Panel Dataset Manual: The Kilts Center Archive of the Nielsen Company*. Kilts Center for Marketing: Chicago Booth.

Peel, D. (2021). Beef supply chains and the impact of the COVID-19 pandemic in the United States. *Animal Frontiers*, *11*(1), 33–38. https://doi.org/10.1093/af/vfaa054

Peel, D. S., Anderson, D., Anderson, J., Bastian, C., Brown, S., Koontz, S. R., & Maples, J. (2020). *Fed Cattle Price Discovery Issues and Considerations* (E-1053; Division of Agricultural Sciences and Natural Resources, pp. 1–20). Oklahoma State University. https://extension.okstate.edu/fact-sheets/print-publications/e/fed-cattle-price-discovery-issues-and-considerations-e-1053.pdf

Phillips, J. L. (2017). *Essays on the Impact of Crop Insurance on Chemical and Fertilizer Use* (pp. 1–133) [Unpublished Manuscript]. North Carolina State University.

Pigou, A. C. (1920). *The Economics of Welfare*. London: Macmillan.

Qaim, M. (2016). *Genetically modified crops and agricultural development*. Palgrave Macmillan.

Ramsey, F. L., & Schafer, D. W. (2013). *The statistical sleuth: A course in methods of data analysis* (3rd ed). Brooks/Cole, Cengage Learning.

Ricker-Gilbert, J., Jayne, T. S., & Chirwa, E. (2011). Subsidies and Crowding Out: A Double-Hurdle Model of Fertilizer Demand in Malawi. *American Journal of Agricultural Economics*, *93*(1), 26–42. https://doi.org/10.1093/ajae/aaq122

Risius, A., & Hamm, U. (2017). The effect of information on beef husbandry systems on consumers' preferences and willingness to pay. *Meat Science*, *124*, 9–14. https://doi.org/10.1016/j.meatsci.2016.10.008

Schlenker, W., & Roberts, M. J. (2009). Nonlinear temperature effects indicate severe damages to U.S. crop yields under climate change. *Proceedings of the National Academy of Sciences*, *106*(37), 15594–15598. https://doi.org/10.1073/pnas.0906865106

Schroeder, T. C., Coffey, B. K., & Tonsor, G. T. (2021). Enhancing Supply Chain Coordination through Marketing Agreements: Incentives, Impacts, and Implications. In *The U.S. Beef Supply Chain: Issues and Challenges* (Edited by B.L. Fischer; J.L. Outlaw and D.P. Anderson). Agricultural and Food Policy Center, Texas A&M University.

Sharma, N., & Singhvi, R. (2017). Effects of Chemical Fertilizers and Pesticides on Human Health and Environment: A Review. *International Journal of Agriculture, Environment and Biotechnology*, *10*(6), 675. https://doi.org/10.5958/2230-732X.2017.00083.3

Shields, D. A. (2015). *Federal Crop Insurance: Background* (CRS Report No. R40532). Congressional Research Service. https://fas.org/sgp/crs/misc/R40532.pdf

Shogren, J. F., Shin, S. Y., Hayes, D. J., & Kliebenstein, J. B. (1994). Resolving Differences in Willingness to Pay and Willingness to Accept. *American Economic Review*, *84*(1), 255–270. https://www.jstor.org/stable/2117981

Smith, V. H., & Goodwin, B. K. (1996). Crop Insurance, Moral Hazard, and Agricultural Chemical Use. *American Journal of Agricultural Economics*, *78*(2), 428–438. https://doi.org/10.2307/1243714

Thilmany, D. D., Grannis, J. L., & Sparling, E. (2003). Regional Demand for Natural Beef Products in Colorado: Target Consumers and Willingness to Pay. *Journal of Agribusiness*, *21*(2), 149–165. https://doi.org/10.22004/AG.ECON.14667

Tobin, J. (1958). Estimation of Relationships for Limited Dependent Variables. *Econometrica*, *26*(1), 24. https://doi.org/10.2307/1907382

Tonsor, G. T., Lusk, J. L., & Schroeder, T. C. (2022). Market potential of new plant-based protein alternatives: Insights from four US consumer experiments. *Applied Economic Perspectives and Policy*, 1–18. https://doi.org/10.1002/aepp.13253

U.S. Government Accountability Office (2023). *Farm Bill: Reducing Crop Insurance Costs Could Fund Other Priorities*. https://www.gao.gov/products/gao-23-106228

Umberger, W. J., Thilmany McFadden, D. D., & Smith, A. R. (2009). Does altruism play a role in determining U.S. consumer preferences and willingness to pay for natural and regionally produced beef? *Agribusiness*, *25*(2), 268–285. https://doi.org/10.1002/agr.20194

Verbeke, W., & Ward, R. W. (2006). Consumer interest in information cues denoting quality, traceability and origin: An application of ordered probit models to beef labels. *Food Quality and Preference*, *17*(6), 453–467. https://doi.org/10.1016/j.foodqual.2005.05.010

Verbeke, W., Rutsaert, P., Bonne, K., & Vermeir, I. (2013). Credence quality coordination and consumers' willingness-to-pay for certified halal labelled meat. *Meat Science*, *95*(4), 790–797. https://doi.org/10.1016/j.meatsci.2013.04.042

Wada, R., Han, E., & Powell, L. M. (2015). Associations between soda prices and intake: Evidence from 24-h dietary recall data. *Food Policy*, *55*, 54–60. https://doi.org/10.1016/j.foodpol.2015.05.009

Wang, E. Y. (2015). The impact of soda taxes on consumer welfare: Implications of storability and taste heterogeneity. *The RAND Journal of Economics*, *46*(2), 409–441. https://doi.org/10.1111/1756-2171.12090

Wang, E., Rojas, C., & Colantuoni, F. (2017). Heterogeneous Behavior, Obesity, and Storability in the Demand for Soft Drinks. *American Journal of Agricultural Economics*, *99*(1), 18–33. https://doi.org/10.1093/ajae/aaw048

Wang, M., & Fischbeck, P. S. (2004). Incorporating Framing into Prospect Theory Modeling: A Mixture-Model Approach. *Journal of Risk and Uncertainty*, *29*(2), 181–197. https://doi.org/10.1023/B:RISK.0000038943.63610.16

Wang, Y. C., Coxson, P., Shen, Y.-M., Goldman, L., & Bibbins-Domingo, K. (2012). A Penny-Per-Ounce Tax On Sugar-Sweetened Beverages Would Cut Health And Cost Burdens Of Diabetes. *Health Affairs*, *31*(1), 199–207. https://doi.org/10.1377/hlthaff.2011.0410

Ward, C. E., & Ward, C. E. (2002). A Review of Causes for and Consequences of Economic Concentration in the U.S. Meatpacking Industry. *Journal of the Canadian Agricultural Economics Society*, *2*, 1–28. https://doi.org/10.22004/AG.ECON.45696

Ward, Z. J., Bleich, S. N., Long, M. W., & Gortmaker, S. L. (2021). Association of body mass index with health care expenditures in the United States by age and sex. *PLOS ONE*, *16*(3), e0247307. https://doi.org/10.1371/journal.pone.0247307

Weber, J. G., Key, N., & O'Donoghue, E. (2016). Does Federal Crop Insurance Make Environmental Externalities from Agriculture Worse? *Journal of the Association of Environmental and Resource Economists*, *3*(3), 707–742. https://doi.org/10.1086/687549

Wedel, M., & Kamakura, W. A. (2001). *Market Segmentation—Conceptual and Methodological Foundations* (2nd Edition). Kluwer Academic Publishers.

Wedel, M., Desarbo, W. S., Bult, J. R., & Ramaswamy, V. (1993). A latent class poisson regression model for heterogeneous count data. *Journal of Applied Econometrics*, *8*(4), 397–411. https://doi.org/10.1002/jae.3950080407

Wooldridge, J. (2016). *Introductory Econometrics* (6th Edition). Cengage Learning.

Wooldridge, J. M. (2002). *Econometric analysis of cross section and panel data*. MIT Press.

Wooldridge, J. M. (2020). *Introductory econometrics: A modern approach* (Seventh edition). Cengage Learning.

World Bank. (2020). *Taxes on sugar-sweetened beverages: International evidence and experiences.* World Bank Group: Washington, D.C.

Wu, J. (1999). Crop Insurance, Acreage Decisions, and Nonpoint-Source Pollution. *American Journal of Agricultural Economics*, *81*(2), 305–320. https://doi.org/10.2307/1244583

Xu, Z., Hennessy, D. A., Sardana, K., & Moschini, G. (2013). The Realized Yield Effect of Genetically Engineered Crops: U.S. Maize and Soybean. Crop Science, 53(3), 735–745. https://doi.org/10.2135/cropsci2012.06.0399

Yoo, J., Kim, S., & Yoo, J. (2018). Factors affecting Consumers' Preferences for U.S. Beef. *Korean Journal of Agricultural Science*, *45*(4), 905–916. https://doi.org/10.7744/KJOAS.20180092

Yu, J., Smith, A., & Sumner, D. A. (2018). Effects of Crop Insurance Premium Subsidies on Crop Acreage. *American Journal of Agricultural Economics*, *100*(1), 91–114. https://doi.org/10.1093/ajae/aax058

Zhang, J., Cao, P., & Lu, C. (2021). Half-Century History of Crop Nitrogen Budget in the Conterminous United States: Variations Over Time, Space and Crop Types. Global Biogeochemical Cycles, 35(10). https://doi.org/10.1029/2020GB006876

Zhang, W., Liu, D., Liu, Y., Chen, X., & Zou, C. (2017). Overuse of Phosphorus Fertilizer Reduces the Grain and Flour Protein Contents and Zinc Bioavailability of Winter Wheat (Triticum aestivum L.). *Journal of Agricultural and Food Chemistry*, *65*(8), 1473–1482. https://doi.org/10.1021/acs.jafc.6b04778

Zhen, C., Wohlgenant, M. K., Karns, S., & Kaufman, P. (2011). Habit Formation and Demand for Sugar-Sweetened Beverages. *American Journal of Agricultural Economics*, *93*(1), 175–193. https://doi.org/10.1093/ajae/aaq155

Zhu, W., Chen, Y., Zhao, J., & Wu, B. (2021). Impacts of household income on beef at-home consumption: Evidence from urban China. *Journal of Integrative Agriculture*, *20*(6), 1701–1715. https://doi.org/10.1016/S2095-3119(20)63582-1.