ESSAYS ON ANALYZING ECONOMICS IN LIVESTOCK PRODUCTION AND MEAT PRICE RELATIONSHIPS

A Dissertation

by

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ABSTRACT

These essays cover the economics of shrink in cattle and explore price relationships of the wholesale meat market for beef, pork, lamb, and poultry. The first essay utilizes a mixed effects model to analyze factors that affect shrink on cattle in the Southern Region of the United States. The second essay identifies structural breaks in the wholesale meat market and utilizes Vector Autoregression Models to analyze changing price relationships in graded beef, pork, poultry and, lamb. The third essay employs Structural Vector Autoregression Models to analyze the wholesale pork industry, in particular belly price relationships compared to other cuts of pork.

DEDICATION

I dedicate this page to Vanessa. You were the backbone/the person who was there and supported me every step of the way. Not to mention, financially supported me during this journey. We started this journey with only 2 years in mind and that slightly grew to 5 and a half years. When we started this journey you were my girlfriend, then you became my wife and now we are ending this chapter of our lives with you as the mother of our son, Henry. I don’t know how many more kids we will be blessed to have moving forward but this journey was to better their lives and ours.

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Contributors

This work was supervised by a dissertation committee consisting of Professor John L. Park (advisor), Professor David P. Anderson (advisor) and Dr. Reid Stevens of the Department of Agricultural Economics and Professor Ky Pohler of the Department of Animal Science.

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The data analyzed for Chapter 2-4 was provided by Professor David P. Anderosn and the Livestock Marketing Information Center.

All other work conducted for the dissertation was completed by the student independently.

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NOMENCLATURE

VAR	Vector Autoregressive Model
SVAR	Structural Vector Autoregressive Model
DAG	Directed Acyclic Graphs
COG	Cost of Gain
TX	Texas
AL	Alabama
GA	Georgia
CO	Colorado
KS	Kansas
OK	Oklahoma
USDA	United States Department of Agriculture

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

1. INTRODUCTION

Livestock producers make choices and decisions based on current trends and future projections at all stages of production. Understanding the risk and causality of their multifaceted industry is crucial when making decisions concerning a firm or a producer's bottom line. Deciding how to quantify the risk and direction of causality in an industry is even more complex. Economic models aid in the understanding and quantifying of inherited risk.

The United States (US) livestock industry sector (shown in figure 1) in particular, presents many factors for which producers need to account, such as prices fertility of females, weather, and transportation costs, to name a few. Producers, regardless of specie, all raise offspring that are sent down the supply chain. Calves, piglets, lamb kids, and chicks are sent to the feeder sector to be fed out to market weights. Once fed to market weight, the animals are then sent to packers, who process the animals into beef, pork, lamb and chicken for the fourth sector, the consumers. The consumer sector creates tastes and preferences to which the beef chain has adjust, both in the short-run and long-run.

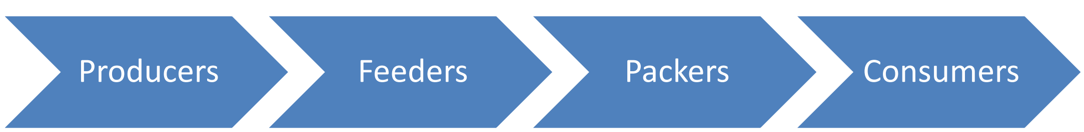

Figure 1.1 Flow Chart of the US Livestock Industry

Every specie has its own supply chain and the members (producers, feeders, and packers) are susceptible to the "downstream" actions of other sections of their industry.

Each protein has factors in their industry that affect itself. A key factor for all proteins are interactions of the beef, chicken, lamb, and pork at the consumer level. Understanding how beef, chicken, lamb and pork demand interact with each other is crucial for achieving profitability in the livestock industry.

This proposal outlines three essays concerning the beef and livestock industry at three different stages: transportation, wholesale marketing and pork marketing analysis.

The first essay evaluates factors that affect shrink of feeder cattle. Shrink refers to the weight lost by cattle while in transit (time on trailer and stops). Using a proprietary set of pre and post-transportation cattle weights on 407 loads (26,464 total head of cattle), as well as characteristics of the individual truckloads, this study analyzes factors that affect shrink during transportation from cow/calf producers in the South Eastern Region of the United States to feed yards (feeders) in central United States. Cattle producers have to manage not only costs associated with transportation, but also the shrink of the cattle that are marketed. Thus, understanding the factors that contribute to shrink is an important component in profit calculations. The data contains trips throughout a year, allowing for multiple trips for a specific route. This study will utilize a mixed effects model to analyze the factors that impact shrink. The model allows for economic implications that producers can utilize for management decisions regarding trips in the future.

The second essay analyzes the meat demand for beef, chicken, lamb and pork. National prices for wholesale cuts of beef (graded), chicken, lamb and pork are utilized to analyze price relationships of the 4 proteins at the wholesale level. The wholesale demand literature is rich with sole demand estimations for beef, chicken, lamb and pork but thin in models that incorporate all four proteins in an estimation. Understanding how these proteins interact through prices with each other at the wholesale level will allow for packers and retailers to make better management decisions. Following similar framework of Bessler and Akleman (1998), our study builds Directed Acyclic Graphs to better understand co-integration of the wholesale cuts, while also investigating separability of the wholesale cuts.

The third essay analyzes price interactions at the wholesale level for the pork industry. This study uses the same wholesale cuts from the second essay but use a different model to analyze the relationships of the wholesale cuts and pork production and trimmings. Our study takes a closer look specifically at the pork industry and specifically at bellies. The belly wholesale cut has become a highly demanded cut in recent years due the “bacon” crave. This essay follows similar framework of the SVAR model from Sims (1995) and the results are presented in Directed Acyclic Graphs.

2. FEEDER CATTLE SHRINK IN THE SOUTHERN REGION OF THE UNITED STATES

2.1. Introduction

Shrink refers to the weight lost by cattle while in transit or the weight lost between delivery by a seller at an auction market and the weight received by the buyer. Cattle producers are paid a price for feeder cattle that is based on an adjustment to approximate the expected shrink. Delivered weight, on a per head basis, is lower at the time of the delivery due to shrink. It is common for a "pencil shrink" to be applied to the sale price based on an expectation of shrink. Understanding the factors that contribute to an increase or a decrease in shrink can prove important to the profitability of the transaction for both a buyer and seller of cattle.

There has been much study given to shrink of livestock from a biology perspective and to the impacts of shrink on the performance of dairy and beef cattle (Bristol, 1966; Meyer, Judy and Armstrong, 1970; Preston, Vance and Smith, 1970; Wood et al., 1972 and 1973; Cole, 1979, Camp et al., 1981; Fike and Spire). These studies include research on calves, fat cattle, and breeding age stock for both dairy and beef cattle. These studies have led to pre-and post-travel protocols (feeding strategies, and rest) being used by producers to manage shrink of their cattle while in transport (Gonzalez et al., 2012). However, few economic impact studies have analyzed the direct factors that influence shrink on livestock, in particularly, beef cattle. While biological research on the effects of shrink and how it relates to the performance of cattle is important, quantifying the variables that influence the shrink of cattle while on the trailer is just as important for a buyer or seller.

The lack of empirical economic research is due, in part, to a lack of accessibility of a dense data set. This study uses a proprietary data set on feeder cattle provided by a Texas based cattle trucking company. The data set details on and off truck weights of feeder cattle that originate in the South East Region of the United States. This data includes multiple individual trips from single locations. The purpose of this study is to provide a model that will analyze trip specific characteristics that influence shrink and their importance. The specified framework from the model can then be used for future analysis of other feeder cattle data sets and could also be used to evaluate pencil shrink and other contract provisions. Other extensions could be ramifications of the new electronic logging device mandate and its effect on shrink in cattle transportation.

2.2. Review of Literature

Shrink in cattle and in particular, feeder cattle, has been a subject of interest in both animal science and applied economics. In general, shrink has been investigated with two research objectives: conditioning (pre and post) and pricing of feeder cattle. Animal science studies have shown pre- and post-conditioning programs help minimize shrink, improve animal welfare and improve performance not only in feeder cattle, but also livestock in general (Bristol, 1966; Meyer, Judy and Armstrong, 1970; Preston, Vance and Smith, 1970; Wood et al., 1972 and 1973; Cole, 1979, Camp et al., 1981; Fike and Spire, 2006; Grandin and Gallo, 2007; Greger, 2007).

From an applied economic perspective, the slight amount of shrink literature has mainly centered around the marketing and pricing of feeder cattle. Turner, Dykes and

McKissick (1991) used a hedonic model to show correct shrink estimation increased profits for producers. Coatney, Menkhaus, and Schmitz (1996) used a hedonic model to show that high shrink in feeder cattle can negatively impacts net price.

As some marketing strategies have shifted from sale barns to online platforms, hedonic models (Zimmerman et al., 2012) and input characteristic models (Williams et al., 2012) have been used to show that profits can increase from online marketing, but high arrival shrink values can negatively impact price. Pencil shrink is generally 2% in Alabama (Kelly, 2019) and 2-4% in Texas (Machen and Gill, 2014).

Literature regarding the economic impacts while cattle are in transport is relatively unexplored. Studies have been conducted to look at the impact of temperature, space, and miles on shrink (Petherick and Phillips, 2009; Cernicchiaro et al., 2012; Theurer et al., 2013; Goldhawk, 2014 and 2015). But economic studies regarding factors that affect shrink have been minimal. The main reason is that industry data is readily not available, a solution, although costly, to this could be surveys. A study conducted surveys of feeder cattle trips in Canada and used a mixed effects model to investigate some shrink factors such as: driver experience, time at loading and unloading, company, miles, temperature, and seasonality (Gonzalez et al., 2012). This study adds to the literature by utilizing a mixed effects model of distinct trips in the Southeast region of the United States.

2.3. Data & Methodology

The data for this research is a proprietary set of pre- and post-transportation cattle weights on 407 truckloads of cattle (26,464 head of cattle), and characteristics of the individual truckloads (number of head, miles, pick up and drop off locations).

The supply locations (figure 3.1) are in the states of Alabama, Georgia, and Texas. Texas divided into three regions: TX 1, TX 2 and TX 3. Texas was regionalized due to the state's size. Exact delivery locations in our dataset were withheld for privacy reasons, but the general area of feed yards in the region for delivery is known. The delivery locations (green circle in figure 3.1) are in the states of Colorado, Kansas, Nebraska, Oklahoma, and the Texas panhandle. Cattle from each supply region are similar in their preparation leading up to transport.

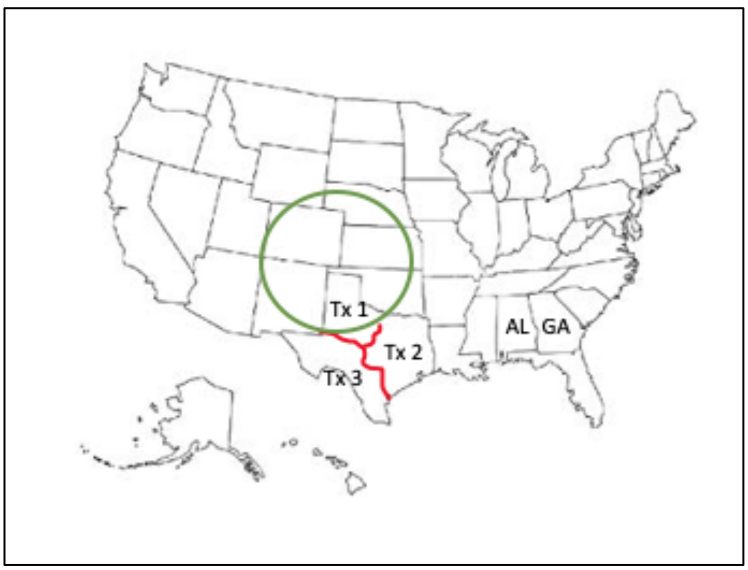

Figure 2.1 Map of Supply and Delivery locations

The loads of cattle were mixed cattle, meaning that there were males and females on the trip (e.g. cattle were not sorted by sex prior to shipment). Table 2.1 contains the summary statistics for the supply locations.

Table 2.1 Summary Statistics of Pickup Routes

Alabama	Miles	Hours	Avg Wt	Avg Off Truck	Shrink (%)
Min	1,020	20	560	523	3.763
Max	1,478	30	867	801	10.020
Avg	1,235	25	676	631	6.597

Georgia	Miles	Hours	Avg Wt	Avg Off Truck	Shrink (%)
Min	1,200	24	439	412	3.93
Max	1,580	32	987	917	12.36
Avg	1,369	27	714	665	6.85

TX 1	Miles	Hours	Avg Wt	Avg Off Truck	Shrink (%)
Min	450	9	611	582	2.85
Max	870	17.4	794	755	6.45
Avg	535	11	721	690	4.29

TX 2	Miles	Hours	Avg Wt	Avg Off Truck	Shrink (%)
Min	455	9	518	484	0.22
Max	1,390	28	954	910	9.06
Avg	612	12	787	756	3.90

TX 3	Miles	Hours	Avg Wt	Avg Off Truck	Shrink (%)
Min	484	10	439	421	1.97
Max	850	17	859	818	8.11
Avg	659	13	710	681	4.21

The average temperature, high temperature, low temperature, and the dew point on the shipping date was recorded from wunderground.com.

Each distinct route will have a unique ID, Table 2.2 contains the route numbers. Each specified route then has an individual trip. This lends to a natural "level" nature in the data (figure 2.2).

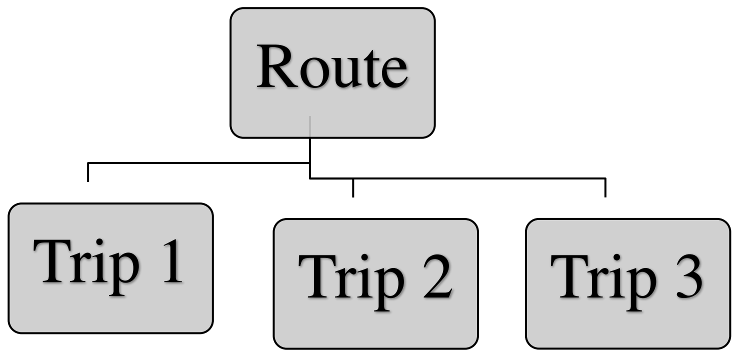

Figure 2.2 Level Nature for Each Route

This allows for the study to utilize a mixed effects model, with similar framework that Gonzalez et al. (2012) utilized.

Table 2.2 Unique ID (Route Numbers) for Individual Cattle Hauling Trips

State	CO	KS	TX	OK
AL	1	2	3	4
GA	5	6	7	8
TX 1	9	10	11	12
TX 2	13	14	15	16
TX 3	17	18	19	20

The model utilizes the following formula:

$$Shrink_{ij} = \beta_0 + \beta_1 AverageTemperature + \beta_2 Average\ beginінng\ weight_{ij} + \alpha \sum_{j=1}^{J-1} U_{ij} D_j + \varepsilon_{ij} \quad (2.1)$$

where *shrink* is actual pounds lost, *temperature* is the average temperature (Fahrenheit) at the location on the day the cattle are loaded, *average beginning weight* is the average weight of cattle at loading. The random effects parameter is captured by $\alpha \sum_{j=1}^{J-1} U_j D_j$.

The subscript i, represents the individual trip of distinct route j. Average temperature was used as the other weather data collected (dew pint and high/low temperature was not found to be significant.

In previous studies, the number of head of cattle on a trailer was used as an explanatory variable, but due to the collinearity (table 2.3) with average beginning weight, this study chose to exclude the use of headcount in the model. Trailer space is limited when transporting cattle, thus there is a capacity constraint and using average beginning weight allows the model to avoid an unaccounted space constraint.

Table 2.3 Head Count/Average on Weight Correlation

	Avg On Weight	**HC Per Truck**
Avg On Weight	1	
HC Per Truck	-.0765	1

2.4. Results

Table 2.4 exhibits the output from the mixed effects model. The left-hand side of the model uses actual shrink in terms of pounds which means the left-hand side is negative (begging weight- ending weight), meaning a coefficient with a negative sign increases the amount of shrink.

Table 2.4 Mixed Effects Output

Shrink	Coef.	Std.Err	p-value
Temp	-0.322	0.0591	0.000
AvgOnWt	-0.039	0.0086	0.000
Cons	12.94	8.55	0.130

Temperature and average beginning weight were both found to be statistically significant. The *Temp* coefficient (table 2.4) indicates that as temperature increases one degree, the amount of weight lost increases by 0.32 pounds.

In the weather data, the hottest and coldest days were 102 degrees Fahrenheit and 28 degrees Fahrenheit. Applying the temperature coefficient (-.322) to these hot and cold days yields 32.84lbs/hd (hot day) and 9.016lbs/hd (cold day) that difference is 23.82lbs/hd. Applying that difference to cost of gain (COG) will yield the value lost or to be gained back on a per head basis. The cost of gain can be broken into a high cost ($0.70/lb.) and low cost ($0.40/lb.). Using the following equation would yield the value lost or to be gained back.

$$Value\ lost\ or\ to\ be\ gained\ back = weight\ difference * COG \tag{2.2}$$

Value to be lost or gained back with high cost of gain would cost $16.67 (high COG) and $9.53 (low COG).

The temperature result agrees with previous studies surrounding ambient temperature inside the trailer, which indicates that higher ambient temperatures increase weight lost (Gonzalez et al., 2012).

The average beginning weight $AvgOnWt$ coefficient indicated that as on-weight increases by a pound, the amount of weight lost increases by .03 pounds.

In the shipping data, the heaviest and lightest on weight were 987 lbs. and 421 lbs. Applying the weight coefficient (-0.03) to these weights yields 38.49 lbs/hd (heavy) and 16.42lbs/hd (light) that difference is 22.07 lbs. Using equation 2.2 with the same COG values yields $15.45 (heavy) and $8.83 (light).

The random effects parameter was also found to be significant as indicated by a calculated p-value. To better understand the explanatory power of the random effects, the residual intraclass correlation (ICC) is calculated (table 2.5) for the unique trips.

Table 2.5 Intraclass Correlation Output

Level	ICC	Std. Err.
Routes	.447	.1142

The ICC revealed that 44% of the variance of shrink between trips of a route could be explained through random events between trips. Meaning that random events/variables that happen during a trip (e.g. driver, traffic jams, stops, construction, breakdowns, and storms) accounts for the variability of shrink between trips for a given route.

Taking a shrink of 3.5% and applying the ICC coefficient to that 3.5% yields 4.9% shrink to a truck load (50,000 lbs.). The shrink of 3.5% is a good trip and 4.9% is a bad trip for a truckload. A good trip that shrinks 3.5% yields 1,750 lbs. lost and a bad trip that shrinks 4.9% yields 2,450 lbs. lost. The difference is 700 pounds for the truck load. Using equation 2.2 and the same COG values yields $490 dollars (high COG) and $280 (low COG).

The value to be lost or gained back gives decision makers an indication (in dollars) of the factors (temperature, weight and the individual trip) on shipping cattle.

2.5. Conclusions

The results revealed factors that buyers and sellers can take into account when they ship cattle in the Southeast Region of the United States. Temperature can be taken into account to adjust pre- and post-transport preparations. High temperatures on the day of shipping may prompt management practices by the buyer to prepare unloading pens to account for the additional pounds lost due to the weather. The seller and/or the buyer might also adjust the negotiated pencil shrink of the load given an increase/decrease in temperature on the day the cattle are shipped. With the temperature coefficient result, further research conducted into the feasibility of shipping cattle at a later date when temperature is known to be cooler (seasonality) could yields a value to be gained or lost for a decision maker.

If cattle are being shipped and on average they are above or below their contracted weight specifications, the model indicated that the average on weight coefficient could be used to adjust pencil shrink as well. These results might suggest some variable shrink contract specifications. However, sellers might refuse this as they would be asked to share a risk that is out of their control.

The explanatory power of the random effect parameter provided some insight for the individual routes and possible opportunities for future research. The 44% indicates that the randomness of the trips could be dissected more and that management techniques on cattle are only part of the shrink causation. The random events sector could be broken down into another level if the driver or driver characteristics were known. Improved driver information would provide information on the trailer used, truck used, and stops made. These variables could then be used inside the model to evaluate practices further reducing shrink.

The results of this study add to the economic literature of cattle transportation and the factors associated with the costs of shipping. Our data set included Southern States but not all, this model could be used to evaluate the missing states and add even more to the literature.

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3. ESTIMATING WHOLESALE PRICE RELATIONSHIPS BETWEEN BEEF, CHICKEN, PORK, AND LAMB

3.1. Introduction

Meat demand is an extensively researched topic in the agricultural economics literature. Understanding the demand for meats such as beef, chicken, pork and lamb, are not only important for packers and retailers, but also producers. Demand analysis is foundational to economic study and is the basis for exploring the effects of advertising, checkoff programs, new market entrants, animal disease and food safety impacts, just to name a few. Understanding price relationships within and between livestock species is critical to understanding demand. Own price and the price of other goods are key constructs of consumer demand theory. Most consumer demand studies have used monthly retail price data gathered by the Bureau of Labor Statistics (BLS) at grocery stores, or grocery store scanner data.

Since the 1970s there has been a growing trend of consumers eating more meals away from home, known as Food-Away-From-Home (FAFH) consumption (USDA, 2016). Many notable studies have investigated this trend using BLS data. The BLS data commonly used in demand studies are retail grocery store prices collected in the second week of a month and therefore do not capture prices paid for foods purchased and consumed away from home at places such as hotels and restaurants. Nor do they capture prices of products being bought and sold for institutional facilities or export sales. Because of these data limitations, the vast majority of demand research does not fully capture the price relationships among meats.

Almost all meat demand research has treated beef, pork, and poultry as if they are each a homogeneous product within species. Clearly, all cuts from a carcass are not the same. Ribeyes and Chucks are beef, but they are not the same cut and likely have different demand structures. The same would hold for pork bellies and hams or chicken wings and breasts.

There is growing evidence of weakening demand relationships between cuts from different species in the form of smaller cross-price elasticities. Other research suggests there are more consumer purchasing pattern changes within species than between. For example, market observers discussed consumers buying cheaper beef cuts in place of steaks during and after the recession rather than switching to cuts from other species (Kay, 2019).

This study revisits meat price relationships using wholesale level price data. The wholesale market is where all buyers interact – restaurants, grocery stores, and exporters. This study aims to capture causal price relationships between wholesale meat cuts, testing the hypothesis that wholesale cut prices between species and within species have changed over time. Price relationships between cuts and species are explored. The hypothesis that some cuts have no price relationship (are separable) to other cuts will provide some future direction for further demand analysis.

3.2. Literature Review

It is likely more difficult to find a more researched area in agricultural economics than demand. Many studies that have focused on demand shifters and own and cross-price elasticities. Demand estimation has been investigated with nontraditional and traditional demand models (Lusk and Tonsor, 2016). Shifts in consumer demand have been investigated extensively regarding health, income, advertising, and other determinants (Brown and Schrader, 1990; Chang and Kinnucan, 1991; Kinnucan et al.; 1997; Rickertsen, 1998; Piggott et al., 1996; Park and Capps, Jr., 2002; Piggott and Marsh, 2004; Marsh, Schroeder, and Mintert, 2004; Mazzocchi, 2006; Tonsor, Mintert and Schroeder, 2010). While some of this research does not estimate meat price relationships explicitly, these studies all arrive at price effects by analyzing demand through their selected consumer demand models. Theoretical underpinnings of these models are useful for the design of this study and give merit to the results.

Piggott et al. (1996) examined demand response from producer groups, checkoff programs, and government advertising in the Australian meat industry. The authors used single equation and Almost Ideal Demand System models to test which would be "best" to test their hypothesis. With mixed results, they found price effects to be significant in beef and chicken but acknowledged that the exclusion of export prices was a limitation to their study due to the heavy reliance on exports in the Australian meat industry.

Piggott and Marsh (2004) examined pork beef and poultry demand interactions by using a Generalized Almost Ideal Demand model. The authors investigated demand for the three meats during health concern outbreaks. The price relationships that were estimated were in the form of own price and cross price elasticities. The found that price effects have a greater effect and last longer than responses to food safety concerns. The data used were aggregated monthly, thus making the data a shortcoming of the study.

Similar results were found when investigating the same issue by Marsh, Schroeder and Mintert (2004). They investigated the effects of disease outbreaks on demand using a Rotterdam mode. They also found that price effects outweigh the outbreak effects. But once again, as seen in Piggott and Marsh, the demand was estimated using monthly data.

Mazzocchi (2006) used the same data as Piggott and marsh (2004) to explore meat demand effects following a food scare. Mazzocchi utilized an AIDS, model as, well but with a dynamic intercept shifter which made it a stochastic parameter model. The demand shifter was a simple time-varying intercept (SIV) and was found to estimate the demand changes due to a food scare. But the shortcoming of this study remained the aggregate data used for estimation.

Rickertsen (1998) estimated demand for food and beverages in Norway. Using an AIDS model with differenced and lagged differenced consumption data. The model included lagged expenditures shares for each equation in the model. Due to the nature of the model, Rickertsen could examine separability between the meats. This study used data that was "directly derived from the expenditures while the prices of some representative items have to be used with the disappearance data" (Rickertsen). While the data tried to address the meat aggregation issue, the meat variable incorporated all meats (beef, chicken, pork) as one variable. Thus, the price relationships found were only between “meats” and everything else. Rickertsen also included fish in his model, but “fish” was not specified as to what products they referenced.

Capps and Park (2002) estimated pork demand using a double-hurdle model. Their approach to estimating demand was different than the studies above not only because of model selection but also the data that was used. Capps and Park used survey data from the 1994-1996 Continuing Survey of Food Intakes for Individuals (CSFII) and the 1994-1996 Diet Health and Knowledge Survey (DHKS). They cite the reason for using this data was due to the short comings of aggregate time series data. Using this model and “better” data, the authors estimated pork demand estimates, beef advertisement elasticities on pork demand, and the effects of advertising, health, lifestyles, visible fat, region, urbanization, race, age, income, and seasonality on pork demand. This study is unique in that it examined the non-price relationships between pork and beef; however, it didn’t incorporate poultry.

Tonsor, Mintert and Schroeder (2010) estimated health concern effects on U.S. meat demand using a Rotterdam model and an iterative three- stage least squares model (IT3SLS) for the time period of 1982-2007. They incorporated unique information such as a FAFH (45%), female participation in the female work force, nutrient indices (zinc, iron, and protein), and an index for the Atkins diet. This study was one of the few that acknowledged that previous consumer demand studies had not incorporated the FAFH variable. The authors found similar price interactions as previous studies, but the unique finding revolved around the FAFH variable. The authors found that while FAFH expenditures benefited pork and chicken, they could not directly explain these findings, but hypothesized that this could be due to underlying menu changes. While the data used was quarterly aggregated data, the hypotheses of menu changes by restaurants, give validity to the idea of examining the meat price relationships in the wholesale markets where restaurants purchase their meat. The data used in this study covers part of the time period that Tonsor, Mintert and Schroeder analyzed (2003-2007), but with more data points as the data is weekly and disaggregated by primal cut.

Wohlgenant and Mullen (1987) was one of the few studies to examine beef by quality grade rather than all beef together. Wohlgenant and Mullen investigated the farm-retail spread for Choice beef using a relative price spread model. The retail prices and output production were based on Choice beef. Their model rejected retail markup pricing compared to relative price spread specifications due to changes in farm supply and retail demand change. A by-product of their model was that they could derive Choice beef own-price elasticities of demand. They found similar elasticities to the George and King model and suggested relative price spread model was better for policy driven questions, Wohlgenant and Mullen also mention that when using pricing data,

Lemieux and Wohlgenant (1989) studied the impact of a new growth hormone in the pork industry. The authors used demand and supply elasticity estimates from a complete demand system model for pork, beef, and poultry in a linear elasticity model to examine demand change at the retail level for U.S. pork. The authors used aggregated hog prices in their model and indicate that prices would fall due to the technology increasing pork supply. While this study analyzes retail demand, the authors used an aggregated price for pork and derived demand estimates. Although this study provides insight to the demand changes for consumers, the use of aggregated prices and trade quantities has some issues because the U.S. doesn't export or import all pork cuts.

Eales and Unnevehr (1993) used an inverse AIDS model to investigate endogeneity prices and quantities of the U.S. meat system for the years 1962-1989. To test endogeneity for each meat market (pork, beef, and poultry), the authors estimated each species' price and quantity separately. Price and quantity were assumed predetermined in each model, respectively. The authors find that prices cannot be taken as predetermined in models, meaning that demand systems that include prices as predetermined lead to misspecification and could provide misleading parameter estimates. Eales and Unnevehr provide a foundation that price relationships can be investigated solely without supply being included into a model. The authors also find that structural changes found through AIDS models can be misleading because of supply shocks from producers provide the same estimates as a demand shift. These two findings allow for investigation of structural changes to be identified in the wholesale prices and also allows for price relationships to be investigated for the time periods that are each side of an identified structural change.

Kinnucan et al. (1997) offered a contradiction to Eales and Unnevehr. Kinnucan et al. used a Rotterdam model to investigate the advertising of health information and trend on meat demand. They concluded that structural change in the demand for poultry, beef and pork is occurring but that supply changes are occurring, as well. They determined that the effects of advertising are uncertain because of the supply and demand structural changes and that more investigation was needed.

A key factor that is addressed by both Eales and Unneverhr and Kinnucan et al. is that structural changes must be accounted for in modeling demand. Structural changes will change price relationships in demand.

Brester and Schroder (1995) added to the meat demand literature by investigating a classic demand shifter, advertising. The authors added a unique feature by taking beef and pork and splitting the species into branded programs and non-branded categories for each species respectively. This would allow for meat demand to be investigated for branded and non-branded beef and pork in a Rotterdam model that included poultry. The authors conclude that demand for branded and non-branded products change when advertising for the meat categories occur. They also mention that although advertising is significant, its impact is smaller than the price elasticities of the respected meat categories. Brester and Schroder show that demand for branded programs differ. Which gives foundation to this study to include branded beef in our price relationship models.

Wholesale demand estimation has been investigated for beef, pork, and poultry (Funk, Meilke and Huff, 1977; Marion and Walker, 1978; Capps et al., 1994, Lusk et al., 2001), and lamb (Bryne, Capps, and Williams, 1993).

Funk, Meilke, and Huff (1977) was one of the earliest papers to go further up the supply chain from aggregated beef demand to more specified demand analysis. The authors investigated sup-primal cuts in the Toronto, Canada market. They utilized supermarket chains data to investigate demand for sub primal cuts of beef (bottom round roast, cross rib roast, eye of round roast, point sirloin roast, point sirloin steak, prime rib roast, rump roast, short rib roast, top round roast, shoulder roast, porterhouse steak, flank steak, rib steak, sirloin steak, wing steak, brisket, and minced beef, chuck, and round), aggregated lamb, and aggregated pork demand. They used a log-log OLS model that also included advertising for each species and dummy variables that accounted for each supermarket chain location. The authors find that demand analysis by individual cuts gives more insight to the effectiveness of advertising at the supermarket and that more research need to be pointed towards individual cuts. While some of these cuts are from the same primal (wholesale cut), the data represents the recognition that all cuts are not created equal.

Marion and Walker (1978) took Funk, Meilke, and Huff's same logic but went a level up the supply chain, wholesale cuts. They investigated short run (weekly) demand for beef primal cuts (round, chuck, rib, loin), pork loin, fryers at two stores. The authors used transactions from the supermarket and the wholesale packer and the data of when the meat was sold at the retail store. The authors included dummy variables for temperature, seasonality, and employee paydays in the community. They found that price and average sales varied week to week. Their work indicated that understanding wholesale pricing can help processors and/or retailers better handle temporary shortages or surpluses to reduce price volatility at the retail level.

Capps et al. (1994) estimated wholesale level elasticities for beef (ribeye, brisket, armbone chuck, knuckle, top inside round, bottom gooseneck, strip loin, top sirloin butt, full tenderloin, flank, fresh 50% ground beef and fresh 90% ground beef), chicken and pork. The authors used a double log functional form model in which monthly USDA prices were used and a supply function was formulated by the authors. Because, weekly national supply cold is difficult to formulate from a research standpoint, the authors were the first to estimate such quantities for beef. But, due to the beef supply aggregation, the authors couldn't break down the beef into grades (Select, Choice and Prime). Another unique contribution to the literature was inclusion of ground beef and the finding that brisket and trimmings had positive cross-products flexibilities. They suggested that further research be done because of the positive cross price flexibility results.

Lusk et al. (2001) took a unique approach in meat demand specifically for beef. The authors used USDA boxed beef cutout values (July 1987-December 1999) for Choice and Select beef to estimate wholesale demand for the two quality grades, pork, and chicken (Georgia Dock). They acknowledge the same supply estimation issue that Capps et al. (1994) commented on, and to correct the data limitation, the authors used the reported USDA Choice and Select prices and production quantities. Because the authors define boxed beef as an intermediary product, the prices can be used as wholesale prices in a profit maximization model for the wholesale buyer (retail chains). The authors also used a fixed supply equation, but the formula accounts for seasonality and a trend variable that accounts for improvements in retailer technology or exogenous retail demand shifts. Their model indicated that Choice and Select beef were substitutes, pork was a substitute for both grades of beef, and that chicken is the only substitute for select beef. The authors suggest that further research and a better understanding of the wholesale market could aid packers in predicting losses or gains in sales associated with relative price changes. Even though their models used the Georgia dock prices, which was found in 2016 to have falsely reported prices and was discontinued, the authors do provide some evidence that interaction between chicken and beef can be different for each grade of beef. The beef prices that were used were the cutout values (aggregation of all beef).

Hahn and Matthews (2007) examined graded beef demand using no roll, Choice, and Select beef prices and quantities at the wholesale and retail levels. They acknowledge that aggregation is an issue in meat demand research and choose to use a hedonic model to estimate demand shifts between Choice and Select beef. Their model results indicated that while in their study period (1988-2004) aggregated beef demand was stable, Choice and Select beef had experienced demand changes with buyers consuming more Choice beef.

Using a dynamic model, Hahn and Green (2000) showed that retail and wholesale meat costs are jointly together. Meaning if costs increase or decrease in either sector of the supply chain, then the opposing sector does the same. They used Choice beef price, pork cutout, and a whole fryer price (chicken) in their model. Lagged prices were included in the time series model with the results that only lagged wholesale prices were significant. All species were modeled together, and the authors found that different lag lengths for each species. They recommended more research in the area of understanding the relationships of the wholesale market should be done.

Parcell (2003) investigated pork wholesale cut flexibilities and elasticities. Parcell used Seemingly Unrelated Regression models to estimate flexibilities and elasticities of pork loin, pork rib, Boston butt, ham, pork belly and picnic prices. The results indicated that elasticities and flexibility estimations were different than previous aggregated research. Another result was that there was no change in wholesale price associated with a quantity demanded change. These two findings led Parcell to suggest that future research should be done for each individual cut.

Lamb demand isn't as extensively researched as the three main proteins in the U.S., but Bryne, Capps, and Williams (1993) examined wholesale lamb demand while including poultry, beef, and pork. Their demand model included aggregated prices for lamb, pork, poultry, beef, income, and a time trend. They found that changes in prices, except for pork, generally didn't effect changes in lamb demand. They comment that the lack of substitutability of lamb and little significance in the traditional demand shifters offers the HRI sector as a venue for lamb sales.

Gardner (1975) examined the price transmission (farm-retail spread) for a competitive food market. While he includes other industries such as sweet potatoes, the basis of his model and study is that when using demand and supply for each market, elasticities can be generated for the demand at the retail level for each good (i.e. beef, pork, and chicken). By understanding price transmission, retailers, packers and producers can better adjust/plan for price swings. Gardner acknowledges and warns that while the theory is correct, aggregation of prices can be an issue for estimating elasticities. The same warning coincides with derived demand using scanner data pointed out by Taylor and Tonsor (2013) and Lensing and Purcell (2006).

When investigating demand, many of the above studies mentioned the need to incorporate structural changes. Moschini and Meilke (1989) used a traditional AIDS model to estimate structural change in U.S. meat demand. Boetel and Liu (2010) investigated structural breaks for the U.S. pork and beef prices. Using unit root tests and cointegration tests, the authors found evidence for 4 structural breaks for cattle (November 1975, July 1981, May 1993, and April 2001) and 3 structural breaks for hogs (October 1978, September 1987, and October 1997).

Similarly, Adachi and Liu (2009) used unit root tests to investigate structural breaks in the Japanese pork industry for the years (1967 to 2008) and identified four structural breaks. Additionally, Adachi and Liu used the time periods to conduct VAR models to forecast and simulate short run dynamics in the Japanese market.

Although demand literature is rich with the theory-based models, cointegration and causality of the proteins is relatively unexplored. Bessler and Akleman (1998) showed that cointegration can help explain causality between beef and pork markets via Directed Acyclic Graphs (DAGSs). They used time series techniques to analyze retail price spreads for pork and beef prices. Their model also included income, wage, gasoline, and CPI. They found that price variation in both meat markets are affected by farm level innovation. Although Bessler and Akleman didn't apply their study to the cuts of meat and aggregation could be a flaw in the price data, cointegration can still help explain directional impacts on cuts of meat prices at the wholesale level.

Tiffin and Dawson (2000) showed how cointegration can help explain links in the United Kingdom lamb industry. The authors used time series techniques to analyze causality of retail and farm level pricing for the UK lamb industry. They found that retail pricing Granger causes farm pricing, thus retail price drives farm pricing variability.

Investigation with cointegration could also reinvestigate separability (Eales and Unnevehr, 1988; Moschini, Moro, and Green 1994; Mutando and Henneberry, 2007) of not only beef but also chicken, pork and lamb.

A known times series technique is known as a Vector Autoregression Model, which is also known as a VAR model. VAR models are a stochastic variation of an Autoregressive Model (AR model). The vector addition to the AR model allows for not only one variable but multiple variables to be analyzed. VAR models presents flexibility as structural assumptions of traditional models (AIDS, Rotterdam, and Linear Regressions) are not needed. Only variables that are hypothesized to influence each other are needed. Others have analyzed the technical nature of the VAR models (Watson, 1994; Waggnor and Zha 1999; Lutkepol, 2005), and showed the advantage of VAR models over traditional structural models in financial data (Hamilton, 1994; Tsay, 2014).

3.2.1. Summary of Literature Review

Past meat demand studies in this literature review section have used traditional structural demand models (AIDS, Rotterdam, hedonic, price transmission) to estimate meat demand elasticities. The data that was used has been known to have aggregation flaws. Our study can add to the meat demand literature, in particularly the wholesale meat demand literature, by taking a different approach. Our study will utilize time series techniques in order to investigate price relationships of beef, chicken and pork. In order to arrive at the DAGs this study will utilize Vector Autoregression (VAR) models that were popularized by Sims (1980). The advantage that Sims points out about VAR models, is that is "theory is not normalized" by the models. Meaning that theory assumptions of traditional models are not needed. Correcting for autocorrelation is crucial for estimating VAR models.

VAR models are often summarized using 3 different types of structural analysis: impulse response functions, forecast error variance decompositions, and Granger causality tests. This study will utilize Granger causality tests, based on Granger (1969).

The Granger tests is defined as follows; a variable x is said to "Granger cause" another variable y, if past lagged variables of x aid in the prediction of variable y. The Granger tests utilizes the null hypothesis that the summation of the estimated coefficients of lagged variable x are jointly zero. Through this test, relationships between variables can be estimated. Granger generalized the difficulty in deciding direction of causality between two variables. He presented testable definitions on how variables can feed each other information (causality). His definitions allow for instantaneous causality to be rejected when using time series data. By using Granger causality tests, the results can provide a better understanding on how the wholesale cuts "feed" each other and provide analysis of the effect of supply on the primals.

Researchers have suggested that more research should be done for particular cuts of beef, pork, lamb, and poultry. This study aims to provide more insight on price relationships for not only the cuts mentioned in the literature review, but also more insight to wholesale cuts of graded beef, poultry, lamb, and pork. This study hypothesizes that beef, lamb, poultry and pork price relationships have changed over time and by using time series techniques, this study can investigate the suggestions from the past literature.

3.3. Data & Methodology

The data used in this research consists of prices from April 2003- February 2019 from AMS, USDA and compiled by the Livestock Marketing Information Center (LMIC). This study examines all cuts together (between species models). Tables 3.2-3.4 show the summary statistics for the three periods of the between species models. Price data for the following cuts were used for beef trimmings (fresh 90); the Chuck, Rib, Loin, Round, Flank, Plate, and Brisket for Prime, Choice, Select, Branded, and ungraded beef; chicken Breasts, Legs, Leg Quarters, Wings, and Thighs; Pork Boston Butts, Picnic Shoulders, Loins, Ribs, Bellys and Hams; and Lamb Racks, Breasts, Shoulders, Foreshanks, Necks, Loins, Flanks, and Legs.

3.3.1. Between Species Model Estimation

Wald tests were performed on the data to examine potential structural breaks in the price data. Due to numerous cuts having potential breaks around the beginning and ending of the recession, the data was broken into three time periods. The beginning of the recession was the first structural break and the end of the recession was the second structural break. Table 3.1 contains the time period breaks. Tables 3.2-3.4 contain the descriptive statistics for each primal cut in each time period. From period 1 to period 2, most cuts increased in price. The pork belly increased by 34% which made it easily the highest increased cut for the swine species. In the poultry industry, the breast stayed the same, but the wings increased compared to the other poultry cuts. From period 2 to period 3, all the beef cuts increased. The ungraded beef cuts had the smallest of increases compared to other grades of beef. The lamb legs increased minimally compared to other lamb cuts. Only the rib and the pork belly increased in average price for the swine industry. In the poultry industry only, the wings increased in average price. With lamb and beef cuts, pork belly, pork rib, and wings increasing, this could be evidence of price relationships changing between periods.

Table 3.1 Time Periods Used for the All Species Models

Period	Start Date	End Date
1	4/11/03	12/28/08
2	1/2/09	12/26/14
3	1/2/15	2/8/19

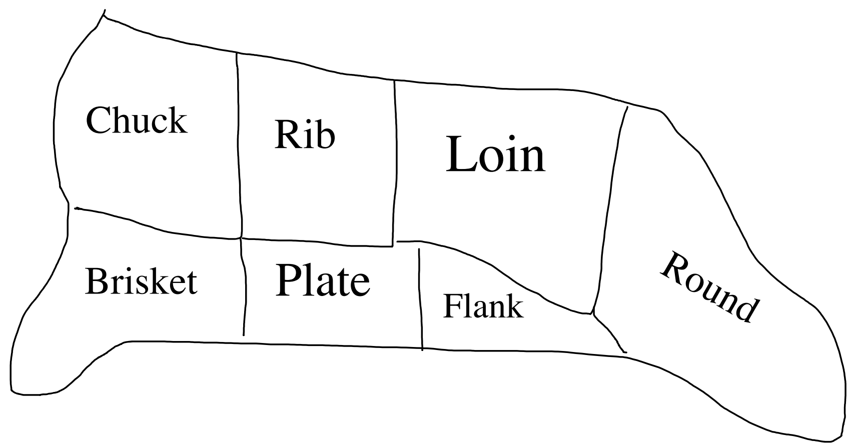

Figure 3.1 Beef Wholesale Cut Diagram

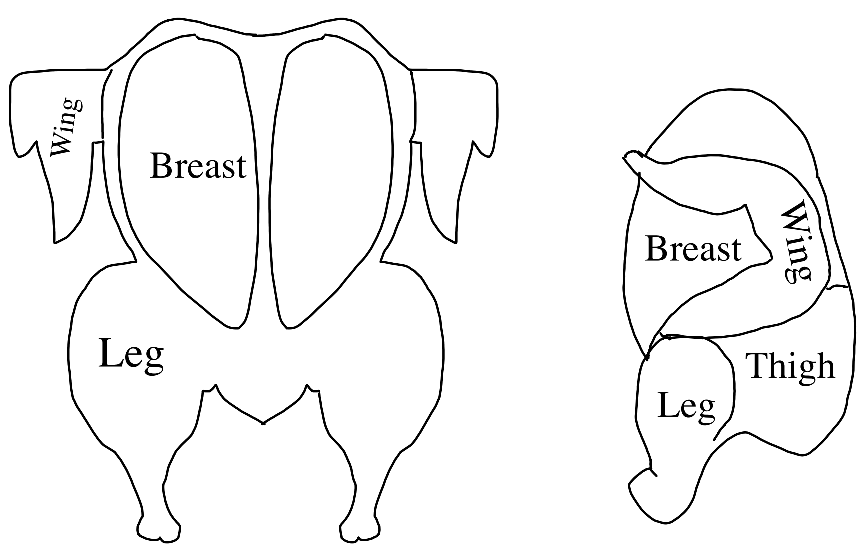

Figure 3.2 Chicken Wholesale Cut Diagram

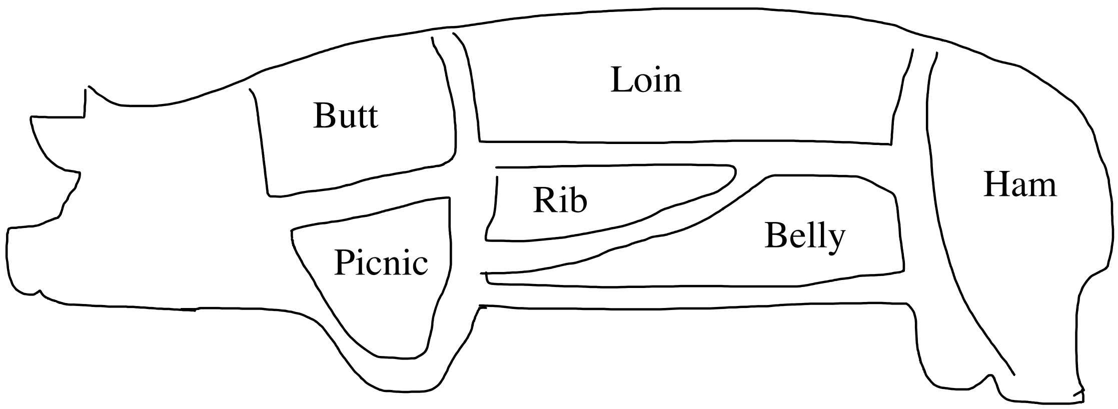

Figure 3.3 Pork Wholesale Cut Diagram

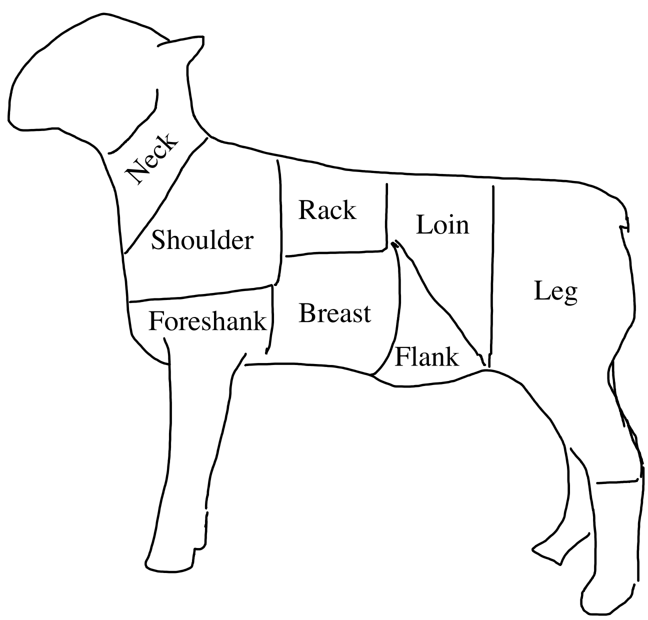

Figure 3.4 Lamb Wholesale Cut Diagram

Table 3.2 Period (4/11/03-12/28/2008) Summary Statistics for Each Species

Lamb Variables	Obs	Mean	Std. Dev.	Min	Max
Rack8RibMedium	298	562.44	62.15	415.40	666.45
Breast	298	68.07	8.30	47.47	92.40
Shoulders	298	170.65	20.73	134.35	229.75
Foreshank	298	259.48	25.41	212.25	315.01
Neck	298	64.95	9.07	38.28	89.65
LoinTrimmed4x4	298	430.09	53.32	302.75	548.45
EFlankUntrimed	298	49.00	10.48	21.62	66.34
ALegTrotteroff	298	240.51	32.25	176.13	333.22
Beef Variables	Obs	Mean	Std. Dev.	Min	Max
FRSH90	298	137.46	15.17	99.94	183.55
PrimalRibSelect	298	203.59	14.60	171.04	248.37
PrimalChuckSelect	298	107.05	10.65	85.16	140.58
PrimalRoundSelect	298	123.14	12.24	89.87	155.29
PrimalLoinSelect	298	194.90	15.51	167.36	241.59
PrimalBrisketSelect	298	83.68	9.06	62.25	107.04
PrimalShortPlateSelect	298	90.35	12.35	61.17	119.73
PrimalFlannkSelect	298	80.72	8.54	62.46	104.69
PrimalRibCH	298	225.80	20.53	176.07	303.78
PrimalChuckCH	298	107.52	10.68	84.94	141.20
PrimalRoundCH	298	125.18	11.75	94.00	166.22
PrimalLoinCH	298	223.45	22.40	181.33	286.38
PrimalBrisketCH	298	84.37	9.35	61.75	107.39
PrimalShortPlateCH	298	90.35	12.35	61.17	119.73
PrimalFlankCH	298	85.51	9.82	64.09	112.93
PrimalRibPR	298	285.60	32.24	211.63	393.76
PrimalChuckPR	298	107.52	10.68	84.94	141.18
PrimalRoundPR	298	125.21	11.75	94.05	166.02
PrimalLoinPR	298	319.48	31.16	222.70	379.25
PrimalBrisketPR	298	84.37	9.35	61.75	107.39
PrimalShortplatePR	298	90.35	12.35	61.17	119.73
PrimalFlankPR	298	85.53	9.82	64.09	112.93
PrimalRibBR	298	238.25	24.42	183.04	328.14
PrimalChuckBR	298	109.15	10.69	85.75	143.37
PrimalRoundBR	298	127.24	11.79	95.55	168.11
PrimalLoinBR	298	240.27	24.99	192.43	310.00

Table 3.2 Continued

Beef Variables	Obs	Mean	Std. Dev.	Min	Max
PrimalBrisketBR	298	86.07	9.25	63.94	110.12
PrimalShortplateBR	298	90.35	12.35	61.17	119.73
PrimalFlankBR	298	86.94	9.46	65.87	113.63
PrimalRibUG	298	191.16	14.27	156.49	236.50
PrimalChuckUG	298	107.30	10.58	85.07	142.41
PrimalRoundUG	298	122.23	12.44	88.44	162.95
PrimalLoinUG	298	183.81	16.02	148.79	222.81
PrimalBrisketUG	298	83.93	9.07	62.24	106.25
PrimalShortplateUG	298	90.35	12.35	61.17	119.73
PrimalFlankUG	298	82.77	8.44	64.11	105.80
Pork Variables	Obs	Mean (cents/lb)	Std. Dev.	Min	Max
Loin	298	84.13	9.86	65.79	115.97
Butt	298	68.71	10.93	44.12	102.91
Picnic	298	45.50	8.92	28.01	74.34
Rib	298	117.92	16.32	85.29	177.16
Ham	298	56.90	11.21	32.85	89.46
Belly	298	86.18	12.22	53.34	122.46
Chicken Variables	Obs	Mean (cents/lb)	Std. Dev.	Min	Max
BreastBS	298	143.67	32.58	93.65	252.79
Legs	298	49.71	12.35	24.23	73.86
LegQuarters	298	36.32	9.36	14.73	56.58
Thighs	298	49.75	11.93	30.33	74.31
WingsWhole	298	101.01	18.57	61.73	132.73

Table 3.3 Period 2 (1/2/2009-12/26/2014) Summary Statistics

Lamb Variables	Obs	Mean	Std. Dev.	Min	Max
Rack8RibMedium	312	663.14	152.45	435.11	920.96
Breast	312	117.20	35.87	72.13	237.99
Shoulders	312	260.64	38.24	201.13	331.70
Foreshank	312	377.42	52.22	293.43	519.25
Neck	312	103.85	30.28	35.21	174.98
LoinTrimmed4x4	312	472.79	71.36	316.29	600.49
EFlankUntrimed	312	67.92	20.31	37.84	128.34
ALegTrotteroff	312	347.88	58.62	245.18	465.14
Beef Variables	Obs	Mean	Std. Dev.	Min	Max
FRSH90	312	194.88	44.60	123.69	300.44

Table 3.3 Continued

Beef Variables	Obs	Mean	Std. Dev.	Min	Max
PrimalRibSelect	312	248.53	38.80	175.59	360.05
PrimalChuckSelect	312	150.46	30.30	102.18	225.30
PrimalRoundSelect	312	159.65	30.58	111.07	255.86
PrimalLoinSelect	312	224.28	34.17	169.72	314.07
PrimalBrisketSelect	312	131.60	30.99	90.83	212.02
PrimalShortPlateSelect	312	127.41	26.38	80.17	194.25
PrimalFlannkSelect	312	103.00	18.35	70.35	149.52
PrimalRibCH	312	272.40	45.82	185.63	400.78
PrimalChuckCH	312	152.08	30.87	101.67	228.06
PrimalRoundCH	312	160.21	30.94	110.85	252.90
PrimalLoinCH	312	244.33	38.98	29.64	324.36
PrimalBrisketCH	312	132.03	31.07	90.88	214.37
PrimalShortPlateCH	312	127.41	26.38	80.17	194.25
PrimalFlankCH	312	106.16	18.18	73.54	153.80
PrimalRibPR	312	371.70	65.14	248.33	507.21
PrimalChuckPR	312	152.31	31.04	101.70	228.22
PrimalRoundPR	312	160.24	30.94	110.87	252.73
PrimalLoinPR	312	340.25	56.84	218.88	452.08
PrimalBrisketPR	312	132.03	31.06	90.88	214.38
PrimalShortplatePR	312	127.41	26.38	80.17	194.25
PrimalFlankPR	312	106.18	18.19	73.55	153.83
PrimalRibBR	312	283.74	48.15	195.31	413.12
PrimalChuckBR	312	153.63	31.21	103.26	231.84
PrimalRoundBR	312	162.50	31.47	112.39	256.83
PrimalLoinBR	312	257.81	37.69	189.86	334.39
PrimalBrisketBR	312	134.66	32.01	91.05	217.30
PrimalShortplateBR	312	127.41	26.38	80.17	194.25
PrimalFlankBR	312	106.98	18.51	74.09	156.98
PrimalRibUG	312	223.75	34.19	154.92	315.97
PrimalChuckUG	312	150.97	30.40	100.05	223.52
PrimalRoundUG	312	158.95	30.86	107.49	255.04
PrimalLoinUG	312	206.69	34.18	148.36	306.69
PrimalBrisketUG	312	131.57	29.90	91.00	212.93
PrimalShortplateUG	312	127.41	26.38	80.17	194.22
PrimalFlankUG	312	104.12	18.49	71.62	153.92

Table 3.3 Continued

Pork Variables	Obs	Mean (cents/lb)	Std. Dev.	Min	Max
Loin	312	96.55	16.46	64.43	146.32
Butt	312	91.74	22.33	51.23	151.75
Picnic	312	63.69	17.23	32.38	111.02
Rib	312	129.85	21.02	78.55	187.06
Ham	312	73.61	19.75	34.32	141.49
Belly	312	116.07	30.63	57.40	199.72
Chicken Variables	**Obs**	**Mean (cents/lb)**	**Std. Dev.**	**Min**	**Max**
BreastBS	312	143.05	22.87	108.18	203.55
Legs	312	62.07	8.81	44.51	81.70
LegQuarters	312	45.55	6.58	30.75	54.00
Thighs	312	70.64	12.73	45.62	89.35
WingsWhole	312	146.09	30.51	79.22	211.78

Table 3.4 Period 3 (1/2/2015-2/8/2019) Summary Statistics

Lamb Variables	Obs	Mean	Std. Dev.	Min	Max
Rack8RibMedium	214	786.30	79.37	644.47	942.28
Breast	214	194.00	27.33	119.93	240.83
Shoulders	214	293.95	20.56	251.69	362.98
Foreshank	214	404.19	20.25	352.40	450.51
Neck	214	157.82	20.40	101.91	205.20
LoinTrimmed4x4	214	543.12	28.97	480.32	623.07
EFlankUntrimed	214	105.58	24.61	39.57	155.10
ALegTrotteroff	214	358.27	20.36	310.23	421.79
Beef Variables	**Obs**	**Mean**	**Std. Dev.**	**Min**	**Max**
FRSH90	214	227.11	32.85	188.50	303.51
PrimalRibSelect	214	312.58	20.77	263.75	369.12
PrimalChuckSelect	214	171.12	18.16	143.64	228.59
PrimalRoundSelect	214	179.96	22.25	148.03	244.68
PrimalLoinSelect	214	264.86	31.51	199.13	349.94
PrimalBrisketSelect	214	161.09	25.23	-	234.41
PrimalShortPlateSelect	214	147.30	21.04	102.83	191.77
PrimalFlannkSelect	214	114.04	16.65	83.57	149.30
PrimalRibCH	214	340.24	25.87	283.63	415.23
PrimalChuckCH	214	173.18	17.27	146.89	229.57
PrimalRoundCH	214	179.25	22.51	141.79	244.11
PrimalLoinCH	214	289.61	34.92	224.05	382.56
PrimalBrisketCH	214	163.24	22.50	125.67	234.59

Table 3.4 Continued

Beef Variables	Obs	Mean	Std. Dev.	Min	Max
PrimalShortPlateCH	214	147.30	21.04	102.83	191.77
PrimalFlankCH	214	116.54	17.13	85.76	150.33
PrimalRibPR	214	413.31	35.82	336.83	538.08
PrimalChuckPR	214	173.33	17.31	146.84	229.67
PrimalRoundPR	214	179.34	22.41	148.08	244.15
PrimalLoinPR	214	361.36	51.74	284.81	455.81
PrimalBrisketPR	214	163.71	22.46	125.96	234.64
PrimalShortplatePR	214	147.30	21.04	102.83	191.77
PrimalFlankPR	214	116.60	17.14	85.79	150.34
PrimalRibBR	214	351.22	29.32	260.97	434.10
PrimalChuckBR	214	174.76	17.78	147.65	233.36
PrimalRoundBR	214	181.77	22.59	150.65	246.79
PrimalLoinBR	214	301.46	35.08	234.16	397.75
PrimalBrisketBR	214	168.44	22.78	132.14	235.52
PrimalShortplateBR	214	147.29	21.04	102.83	191.77
PrimalFlankBR	214	118.10	17.25	86.88	152.52
PrimalRibUG	214	269.94	20.54	224.84	303.73
PrimalChuckUG	214	167.45	19.18	137.03	227.68
PrimalRoundUG	214	178.81	22.23	146.99	243.33
PrimalLoinUG	214	239.84	30.58	183.53	307.78
PrimalBrisketUG	214	160.31	23.03	121.70	230.20
PrimalShortplateUG	214	147.30	21.04	102.83	191.77
PrimalFlankUG	214	114.78	17.07	83.89	149.56
Pork Variables	**Obs**	**Mean (cents/lb)**	**Std. Dev.**	**Min**	**Max**
Loin	214	79.64	8.31	62.63	101.00
Butt	214	89.43	10.50	70.45	119.90
Picnic	214	52.08	7.70	36.80	70.59
Rib	214	133.58	18.63	103.83	197.26
Ham	214	60.83	8.11	40.60	80.39
Belly	214	121.63	30.13	63.85	214.69
Chicken Variables	**Obs**	**Mean (cents/lb)**	**Std. Dev.**	**Min**	**Max**
BreastBS	214	121.94	20.55	83.12	166.95
Legs	214	43.77	6.30	27.59	58.50
LegQuarters	214	33.91	5.63	22.81	46.81
Thighs	214	59.87	9.15	33.47	78.47
WingsWhole	214	173.60	20.70	133.99	217.44

3.3.2. Stand Alone Species Model Specification

In addition to the large all specie model which included all primal cuts for each species, a model for each specie's cuts alone were developed. The goal was to explore structural breaks and price relationships by species and to explore relationships within each specie's cuts. By developing stand-alone specie models, this study can explore any differences and similarities between the large all species model and individual specie models.

To apply time period parameters on the within specie models, structural changes must be accounted for. As with the total species model, this study utilizes a Supremum Wald test in order to find structural break(s), if any, in the time series prices. Quandt (1960) proposed this test originally and it was applied and generalized by numerous studies (Andrews, 1993; Bai, 1993, Andrews and Ploberger, 1994; Vogelsang, 1997). The Supremum Wald tests for an unknown break date using symmetric trimming of 15% of the data series. Each supremum statistic is the maximum value obtained from a series of Wald tests that accounts for multiple break possibility points. The null hypothesis of no structural change in *k* coefficients is given by the following equation:

$$Supremum\ S_T = \sup_{b_1 \leq b \leq b_2} S_T(b) \qquad (3.1)$$

where *b* denotes a possible break data in the range $[b_1, b_2]$ for a sample of size *T*. $S_T(b)$ is the Wald test statistic that's being evaluated at potentially date *b* (STATA, 2013). Once a break is detected, that data is then trimmed to that period. The process is continued until there is no structural break detected by the Supremum Wald test in the remining data set. The Wald test indicated different breaks for each species (table 3.5). A VAR model is specified and estimated for each time period for each species.

When deciding which structural break dates to use for the pork models, all cuts except the loin wholesale cut exhibited a structural break in 2010. The loin cut had a structural break at the end of 2015 thus this study followed similar methodology of Bessler and Akleman and split the data into two time periods to cover both breaks. A similar methodology was used when determining the time periods 2 and 3 for the poultry models as all cuts except whole wings had a structural break at the end of 2011. Whole wings exhibited a structural break in 2015, thus the time period was split into two to cover both break dates. The lamb and beef periods surprisingly had similar structural break dates as the wholesale cuts in both species had breaks close to the same dates for each cut, thus this study chose to use the same time frames analysis. The summary statistics for each period, each cut, and for each species are contained in tables 3.6-3.11.

Table 3.5 Time Periods for Each Species

Lamb		
Period	Date	Date
1	4/11/03	1/7/11
2	1/14/11	12/27/13
3	1/10/14	2/8/19
Beef		
Period	Date	Date
1	4/11/03	1/7/11
2	1/14/11	12/27/13
3	1/10/14	2/8/19
Pork		
Period	Date	Date
1	4/11/03	4/16/10
2	4/23/10	11/6/15
3	11/13/15	9/22/17
4	9/29/17	2/8/19
Poultry		
Period	Date	Date
1	4/11/03	2/16/07
2	2/23/07	12/9/11
3	12/16/11	9/18/15
4	9/25/15	2/8/19

Table 3.6 Lamb Price Summary Statistics for Each Period

Period 1 (4/11/03-1/7/11)					
Variable	Obs	Mean	Std. Dev.	Min	Max
Rack8RibMedium	400	561.39	75.48	415.40	795.31
Breast	400	72.58	12.04	47.47	116.47
Shoulders	400	186.46	34.51	134.35	289.05
Foreshank	400	275.50	35.44	212.25	362.44
Neck	400	66.63	11.99	35.21	112.63
LoinTrimmed4x4	400	425.11	60.70	302.75	548.45
EFlankUntrimed	400	50.57	9.85	21.62	78.00
ALegTrotteroff	400	254.97	42.05	176.13	390.47
Period 2 (1/14/11-12/27/13)					
Variable	Obs	Mean	Std. Dev.	Min	Max
Rack8RibMedium	150	690.03	155.34	475.89	920.96
Breast	150	119.94	22.92	77.34	167.00
Shoulders	150	268.33	36.70	219.30	331.70
Foreshank	150	408.55	43.46	313.63	519.25
Neck	150	115.92	18.17	68.37	174.98
LoinTrimmed4x4	150	507.50	46.54	426.20	600.49
EFlankUntrimed	150	66.20	16.19	37.84	106.57
ALegTrotteroff	150	380.12	53.44	289.07	465.14
Period 3 (1/10/14-2/8/19)					
Variable	Obs	Mean	Std. Dev.	Min	Max
Rack8RibMedium	264	791.17	72.23	644.47	942.28
Breast	264	190.37	27.54	119.93	240.83
Shoulders	264	295.29	19.10	251.69	362.98
Foreshank	264	404.58	19.11	350.14	450.51
Neck	264	153.49	22.13	97.86	205.20
LoinTrimmed4x4	264	535.13	32.11	466.67	623.07
EFlankUntrimed	264	104.72	23.17	39.57	155.10
ALegTrotteroff	264	359.53	19.35	310.23	421.79

Table 3.7 Beef Price Summary Statistics for Period 1 (4/11/03-1/7/11)

Variable	Obs	Mean	Std. Dev.	Min	Max
FRSH90	400	140.12	15.50	99.94	183.55
PrimalRibSelect	400	205.45	15.53	171.04	248.37
PrimalChuckSelect	400	109.88	11.45	85.16	144.09
PrimalRoundSelect	400	124.47	11.95	89.87	155.29
PrimalLoinSelect	400	193.98	15.85	167.36	241.59
PrimalBrisketSelect	400	88.57	11.85	62.25	126.00
PrimalShortPlateSelect	400	92.59	12.10	61.17	121.15
PrimalFlannkSelect	400	81.60	8.60	62.46	108.83
PrimalRibCH	400	225.88	20.30	176.07	303.78
PrimalChuckCH	400	110.36	11.45	84.94	141.25
PrimalRoundCH	400	125.99	11.46	94.00	166.22
PrimalLoinCH	400	219.20	22.65	178.10	286.38
PrimalBrisketCH	400	89.16	11.96	61.75	127.43
PrimalShortPlateCH	400	92.59	12.10	61.17	121.15
PrimalFlankCH	400	86.02	9.54	64.09	112.93
PrimalRibPR	400	289.30	32.93	211.63	393.76
PrimalChuckPR	400	110.38	11.48	84.94	141.35
PrimalRoundPR	400	126.01	11.46	94.05	166.02
PrimalLoinPR	400	308.00	37.07	218.88	379.25
PrimalBrisketPR	400	89.16	11.96	61.75	127.44
PrimalShortplatePR	400	92.59	12.10	61.17	121.15
PrimalFlankPR	400	86.04	9.53	64.09	112.93
PrimalRibBR	400	237.31	23.70	183.04	328.14
PrimalChuckBR	400	111.95	11.47	85.75	143.37
PrimalRoundBR	400	127.97	11.47	95.55	168.11
PrimalLoinBR	400	234.62	25.42	189.86	310.00
PrimalBrisketBR	400	90.93	12.07	63.94	129.19
PrimalShortplateBR	400	92.59	12.10	61.17	121.15
PrimalFlankBR	400	87.25	9.28	65.87	113.63
PrimalRibUG	400	192.17	15.18	154.92	236.50
PrimalChuckUG	400	110.09	11.46	85.07	142.41
PrimalRoundUG	400	123.62	12.16	88.44	162.95
PrimalLoinUG	400	181.29	16.82	148.36	222.81
PrimalBrisketUG	400	88.98	12.12	62.24	127.08
PrimalShortplateUG	400	92.59	12.10	61.17	121.15
PrimalFlankUG	400	83.42	8.54	64.11	109.68

Table 3.8 Beef Price Summary Statistics for Period 2 (1/14/11-12/27/13)

Variable	Obs	Mean	Std. Dev.	Min	Max
FRSH90	155	202.16	13.87	167.31	231.20
PrimalRibSelect	155	253.26	16.43	209.71	293.79
PrimalChuckSelect	155	155.07	6.82	139.41	171.17
PrimalRoundSelect	155	163.01	6.09	150.38	178.97
PrimalLoinSelect	155	229.29	17.69	198.13	266.77
PrimalBrisketSelect	155	132.01	6.98	114.99	148.38
PrimalShortPlateSelect	155	132.48	7.71	113.40	145.87
PrimalFlannkSelect	155	106.83	8.39	85.81	124.50
PrimalRibCH	155	281.71	24.33	231.94	354.77
PrimalChuckCH	155	157.37	7.54	140.13	173.09
PrimalRoundCH	155	163.79	6.52	150.05	180.47
PrimalLoinCH	155	252.00	26.25	29.64	314.66
PrimalBrisketCH	155	132.60	7.08	115.25	148.07
PrimalShortPlateCH	155	132.48	7.71	113.40	145.87
PrimalFlankCH	155	110.22	7.74	89.47	126.30
PrimalRibPR	155	396.98	40.12	325.22	507.21
PrimalChuckPR	155	157.58	7.75	140.25	182.52
PrimalRoundPR	155	163.82	6.52	150.09	180.51
PrimalLoinPR	155	362.75	24.99	311.14	421.25
PrimalBrisketPR	155	132.61	7.08	115.25	148.07
PrimalShortplatePR	155	132.48	7.71	113.40	145.87
PrimalFlankPR	155	110.25	7.74	89.42	126.32
PrimalRibBR	155	294.49	26.49	242.41	359.45
PrimalChuckBR	155	158.68	7.52	140.74	176.56
PrimalRoundBR	155	166.14	7.05	151.50	183.32
PrimalLoinBR	155	267.65	20.53	216.37	328.09
PrimalBrisketBR	155	134.95	7.18	115.40	151.43
PrimalShortplateBR	155	132.48	7.71	113.40	145.87
PrimalFlankBR	155	111.00	7.85	89.06	126.26
PrimalRibUG	155	223.36	14.98	193.93	256.34
PrimalChuckUG	155	156.06	7.05	141.20	174.30
PrimalRoundUG	155	162.01	5.76	148.38	179.28
PrimalLoinUG	155	210.56	15.93	177.76	247.70
PrimalBrisketUG	155	132.15	6.62	115.03	148.48
PrimalShortplateUG	155	132.47	7.73	112.82	145.87
PrimalFlankUG	155	108.07	8.13	87.71	125.68

Table 3.9 Beef Price Summary Statistics for Period 3 (1/10/14-2/8/19)

Variable	Obs	Mean	Std. Dev.	Min	Max
FRSH90	264	235.50	36.05	188.50	303.51
PrimalRibSelect	265	312.69	20.75	263.75	369.12
PrimalChuckSelect	265	177.25	21.73	143.64	228.59
PrimalRoundSelect	265	186.44	25.53	148.03	255.86
PrimalLoinSelect	265	267.38	29.83	199.13	349.94
PrimalBrisketSelect	265	167.48	24.75	125.05	234.41
PrimalShortPlateSelect	265	151.89	22.02	102.83	194.25
PrimalFlannkSelect	265	117.21	17.21	83.57	149.52
PrimalRibCH	265	340.25	26.47	283.63	415.23
PrimalChuckCH	265	179.28	21.04	146.89	229.57
PrimalRoundCH	265	186.05	26.06	141.79	252.90
PrimalLoinCH	265	291.38	32.80	224.05	382.56
PrimalBrisketCH	265	168.54	24.48	125.67	234.59
PrimalShortPlateCH	265	151.89	22.02	102.83	194.25
PrimalFlankCH	265	119.65	17.76	85.76	153.80
PrimalRibPR	265	419.27	35.23	336.83	538.08
PrimalChuckPR	265	179.51	21.14	146.84	229.67
PrimalRoundPR	265	186.13	25.98	148.08	252.73
PrimalLoinPR	265	370.25	51.12	284.81	455.81
PrimalBrisketPR	265	168.91	24.36	125.96	234.64
PrimalShortplatePR	265	151.89	22.02	102.83	194.25
PrimalFlankPR	265	119.71	17.76	85.79	153.83
PrimalRibBR	265	351.55	29.40	260.97	434.10
PrimalChuckBR	265	181.04	21.64	147.65	233.36
PrimalRoundBR	265	188.70	26.29	150.65	256.83
PrimalLoinBR	265	303.12	32.84	234.16	397.75
PrimalBrisketBR	265	173.68	24.60	132.14	235.52
PrimalShortplateBR	265	151.88	22.02	102.83	194.25
PrimalFlankBR	265	121.17	17.94	86.88	156.98
PrimalRibUG	265	272.90	20.60	224.84	315.97
PrimalChuckUG	265	174.28	23.24	137.03	227.68
PrimalRoundUG	265	185.55	25.84	146.99	255.04
PrimalLoinUG	265	244.32	29.83	183.53	307.78
PrimalBrisketUG	265	165.68	24.69	121.70	230.20
PrimalShortplateUG	265	151.89	22.02	102.83	194.22
PrimalFlankUG	265	117.94	17.85	83.89	153.92

Table 3.10 Pork Price Summary Statistics for Each Period

Period 1 (4/11/03-1/7/11)					
Variable	Obs	Mean	Std. Dev.	Min	Max
Loin	366	82.62	10.06	64.43	115.97
Butt	366	67.71	10.50	44.12	102.91
Picnic	366	44.85	8.67	28.01	74.34
Rib	366	114.59	17.05	78.55	177.16
Ham	366	55.79	11.43	32.85	89.46
Belly	366	84.03	12.53	53.34	122.46
Period 2 (4/23/10-11/6/15)					
Variable	Obs	Mean	Std. Dev.	Min	Max
Loin	289	100.00	13.54	79.90	146.32
Butt	289	97.77	18.04	73.73	151.75
Picnic	289	66.75	15.01	39.04	111.02
Rib	289	141.21	16.76	109.95	197.26
Ham	289	76.81	17.29	40.60	141.49
Belly	289	125.35	26.79	63.85	199.72
Period 3 (11/13/15-9/22/17)					
Variable	Obs	Mean	Std. Dev.	Min	Max
Loin	97	80.72	7.32	65.52	96.10
Butt	97	89.58	11.27	71.34	110.60
Picnic	97	53.16	7.54	36.80	69.97
Rib	97	128.88	14.50	103.83	158.42
Ham	97	64.41	8.06	49.46	80.39
Belly	97	127.86	30.68	82.62	214.69
Period 4 (9/29/17-2/8/19)					
Variable	Obs	Mean	Std. Dev.	Min	Max
Loin	72	73.06	5.09	62.63	84.84
Butt	72	90.35	8.25	70.45	113.29
Picnic	72	51.48	7.92	37.40	70.59
Rib	72	124.97	7.77	114.80	149.29
Ham	72	56.72	6.16	45.24	70.86
Belly	72	118.51	21.90	75.39	171.52

Table 3.11 Poultry Price Summary Statistics for Each Period

Period 1 (4/11/03-2/16/07)

Variable	Obs	Mean (cents/lb)	Std. Dev.	Min	Max
BreastBS	201	145.98	37.05	93.65	252.79
Legs	201	43.34	8.57	24.23	64.52
LegQuarters	201	31.93	6.97	14.73	48.30
Thighs	201	43.25	8.00	30.33	66.61
WingsWhole	201	94.80	17.61	61.73	131.34

Period 2 (2/23/07-12/9/11)

Variable	Obs	Mean (cents/lb)	Std. Dev.	Min	Max
BreastBS	250	135.90	17.93	98.17	178.90
Legs	250	59.24	8.31	36.28	73.86
LegQuarters	250	42.85	6.74	26.21	56.58
Thighs	250	61.26	8.37	45.62	79.91
WingsWhole	250	122.10	22.32	79.22	179.89

Period 3 (12/16/11-9/18/15)

Variable	Obs	Mean (cents/lb)	Std. Dev.	Min	Max
BreastBS	197	150.28	22.84	122.34	203.55
Legs	197	62.26	11.70	33.81	81.70
LegQuarters	197	46.37	7.98	22.98	54.00
Thighs	197	78.45	6.82	58.90	89.35
WingsWhole	197	167.49	22.61	114.71	211.78

Period 4 (9/25/15-2/8/19)

Variable	Obs	Mean (cents/lb)	Std. Dev.	Min	Max
BreastBS	176	117.23	19.13	83.12	166.72
Legs	176	44.06	6.26	27.59	55.12
LegQuarters	176	34.23	5.50	22.81	44.42
Thighs	176	58.00	8.69	33.47	78.47
WingsWhole	176	171.85	22.04	133.99	217.44

3.3.3. Model Specifications for the Large All Species Model and the Stand-Alone Specie Models

After arriving at the structural breaks, the next step for each model is to identify the lag length estimation needed for the specified VAR model for each period for between species and within species models.

To estimate the lag, *p,* for the VAR models use the Hamilton (1994) technique.

$$LL = \left(\frac{T}{2}\right)\left\{\ln\left(\left|\widehat{\Sigma^{-1}}\right|\right) - K\ln(2\pi) - K\right\} \quad (3.2)$$

where *T* is the number of observations, K is the number of equations, and $\hat{\Sigma}$ is the maximum likelihood estimate of $E\,[u_t u_t']$, where u_t is the *K* x 1 vector of disturbances. Since

$$\ln\left(\left|\widehat{\Sigma^{-1}}\right|\right) = -\ln\left(\left|\hat{\Sigma}\right|\right) \quad (3.3)$$

then the likelihood equation can be written as

$$LL = \left(\frac{T}{2}\right)\left\{\ln\left(\left|\hat{\Sigma}\right|\right) + K\ln(2\pi) + K\right\} \quad (3.4)$$

which yields

$$LR(j) = 2\{LL(j) - LL(j-1)\} \quad (3.5)$$

and allows LL(j) to be the value of the log likelihood with j lags and yields the LR statistic order j. Once LR stat is reached the lag estimation for that value is chosen, which is p or lag length needed for VAR estimation.

Results for the LR statistic also give information selection criteria stats (AIC, SBIC, HQIC). Lütkepohl (2005) showed the following information criterion equations are used for selection:

$$\text{AIC} = \ln(|\Sigma_u|) + \frac{2pK^2}{T} \tag{3.6}$$

$$\text{SBIC} = \ln(|\Sigma_u|) + \frac{\ln(T)}{T} pK^2 \tag{3.7}$$

$$\text{HQIC} = \ln(|\Sigma_u|) + \frac{2\ln\{\ln(T)\}}{T} pK^2 \tag{3.8}$$

This reseach follows the Bessler and Akleman selection for which information criterion to use. Bessler and Akleman used SBIC and HQIC as their selection criteria and if there is a difference in suggestion on which measure to use, this study follows a parsimonious choice criterion using the lower suggested lag length.

Equation 3.9. describes the VAR model form employed in this research for each model.

$$y_t = v + A_1 y_{t-1} + \cdots + A_p y_{t-p} + B_0 x_{t-1} + \cdots + B_s x_{t-s} + u_t \qquad t \in \{-\infty, \infty\} \tag{3.9}$$

where $y_t = (y_{1t}, \ldots, y_{Kt})'$ is a K x 1 random vector, p is the lag selected through lag estimation, A_1 through A_p are K x K matrices of parameters, x_t is a M x 1 vector of exogenous variables (wholesale cuts), B_0 through B_s are K x M matrices of coefficients, v is a K x 1 vector of parameters, and u_t is assumed to be white noise (STATA, 2013).

3.4. Results

3.4.1. Large Model Results

Due to the size of the results of the three large models that include all species, the results are displayed with tables instead of the DAG directional arrows. This study used a confidence interval of 90% (p-value ≤ .1), chosen a priori. The lag estimation for all the models used 2 lags based on lag length estimation tests. Table A.1, in the appendix contains the wholesale cuts and the Granger caused variables that affected each specific primal cut. Table 3.11 displays the variables that were dropped for each model due to collinearity problems.

Table 3.12 Dropped Variables for the Large All Species Model for Each Period

Period 1(4/11/03-12/28/08)	Period 2 (1/2/09-12/26/08)	Period 3 (1/2/15-2/8/19)
Branded Short Plate	Branded Short Plate	Choice Short Plate
Prime Short Plate		Select Short Plate
Ungraded Short Plate		

Due to the overwhelming amounts of results that could be discussed, this study highlights selected findings from the models.

Rounds and Chucks

A common theme between all 55 primal cuts and in all periods is that the primal cuts of rounds and chucks (all grades of beef) have significant impact on many of the other cuts. Particularly speaking, the round and chuck primal cuts have versatility when they are being processed. A round can be broken down into bottom round, eye of round, sirloin tip, and top round. Chucks can be broken down into chuck tender, chuck roll, shoulder clot, square cut chuck, and flat irons. Both sets of sub-primal cuts can then be processed into many numerous of steaks depending upon customer preferences at the retail level. Another product that is often produced from these cuts is ground beef. The versatility of the primal cuts compounded with the number of chuck and round variables, 10 (round and chuck for each grade of beef), led to the a priori hypothesis that these variables would have a significant impact on many primal cuts beyond other beef cuts. These two sets of sub-primals interacted with many of the other cuts from pork, poultry, and lamb. Generally, periods 1 and 3 were similar in terms of the amount of Granger causal variables for rounds and chucks. Variables that they had interactions with included graded beef rib and loins, and pork cuts. During the second period, the number of primal cuts that affected the chuck and round was relatively lower compared to periods 1 and 3. During period 2, the common Granger causal variables were other grades of chucks and rounds, but also the fresh ground beef variables. The Granger causes for period 3 went back to similar cuts as seen in period 1, as well as graded briskets.

Briskets

Briskets were a surprise as time periods changed. They were affected by graded flanks, short plates, graded briskets, hams, picnics and poultry cuts in the first period. In time periods 2 and 3, the Granger causal variables for briskets began to change from the previously mentioned cuts to higher valued beef cuts (loins and ribs). Beef rib and loins began to have more impact and replaced flanks and short plates. Since 2004, brisket has gone from the least valued primal to the third highest valued cut behind only the rib and loin in all grades. Figure 3.5 contains the value of the brisket as a percent of the cutout for each quality grade.

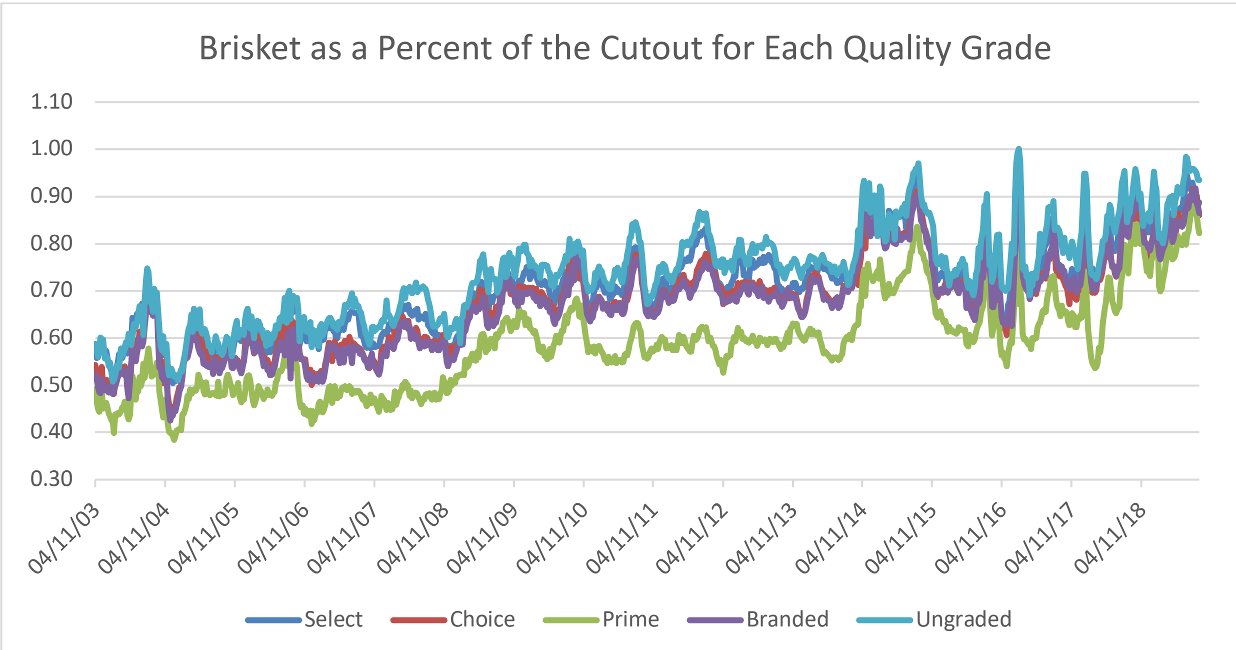

Figure 3.5 Brisket Value as a Percent of the Cutout Value

As briskets values have increased, as too has the effect of brisket prices on the prices of other primal cuts for each species. The results indicate that in period 3, brisket prices are affected by loin and rib prices, the highest valued beef cuts, more so than in period 1 and 2 (table A.1)Briskets have also become effected by the higher end cuts of beef ribs and loins instead of the lower end cuts (flanks and short plates).

Pork Bellies

Table 3.13 Granger Causal Relationships between Pork Belly and other Meat Cuts

Whole Sale Cut	Granger Cause Variable Period 1	p-value	Period 2	p-value	Period 3	p-value
Belly	FRSH90	0.064	PrimalShortPlat~H	0	EFlankUntrimmed	0
	LoinTrimmed4x4	0.063	PrimalChuckCH	0.001	Foreshank	0.094
	PrimalFlankPR	0.059	PrimalBrisketCH	0.002	Ham	0.078
	PrimalRoundselect	0.011	PrimalBrisketPR	0.002	LegQuarters	0.089
	Rack8RibMedium	0.059	PrimalShortPla~PR	0.009	Legs	0.025
			PrimalFlankUG	0.015	LoinTrimmed4x4	0
			PrimalLoinselect	0.018	Neck	0.087
			PrimalChuckselect	0.019	Picnic	0.075
			PrimalFlankselect	0.025	PrimalBrisketBR	0
			PrimalChuckPR	0.045	PrimalBrisketse~t	0
			BreastBS	0.058	PrimalBrisketUG	0
			PrimalRoundPR	0.092	PrimalChuckBR	0.018
			PrimalRibCH	0.1	PrimalFlankBR	0.074
					PrimalFlankUG	0.018
					PrimalLoinPR	0.003
					PrimalRibCH	0.054
					PrimalRibPR	0.066
					PrimalRibselect	0.067
					Rack8RibMedium	0.091
					Rib	0.01
					ShouldersSquare~t	0.031
					WingsWhole	0.087

Pork bellies indicated some interesting relationships in the larger all species models. Table 3.13 contains the variables that were found to feed pork belly prices in the respective periods. In period 1 only 5 variables that affected bellies. Only 90% percent beef trimmings, lamb loins and racks, prime graded flanks, and select graded rounds had a causal relationship with pork bellies. The number of variables with relationships with bellies increased in each following period. In periods 1 and 2, there was no evidence that other pork cuts that fed to the prices of bellies. In period 3, 4 pork variables were found to impact belly prices. This could be due to the nature of the belly primal specifically being used in different ways compared to the rest of the hog primal cuts (roasts and steaks). Because bellies are almost solely used for bacon, the market for bellies could be different at the wholesale level, suggesting very little interaction between pork primal cuts and bellies. In all periods, bellies were found to have impacts on all cuts of other species. Bellies were found to have strong interactions with beef products, rounds, and chucks, and had an impact on the FRSH90 variable in period 3. This follows the logic in the marketplace as ground beef and bacon have become complements in the marketplace.

Chicken Breasts

Table 3.14 Granger Causal Relationships between Chicken Breast and other Meat Cuts

Whole Sale Cut	Granger Cause Variable Period 1	p-value	Period 2	p-value	Period 3	p-value
BreastBS	*	*	Rib	0.001	Butt	0.037
	*	*	PrimalRoundUG	0.002	EFlankUntrimmed	0.075
	*	*	PrimalLoinselect	0.003	Loin	0.084
	*	*	ShouldersSquare~t	0.032	PrimalBrisketCH	0.09
	*	*	LoinTrimmed4x4	0.032	PrimalBrisketse~t	0.001
	*	*	PrimalRoundselect	0.032	PrimalChuckUG	0.064
	*	*	Thighs	0.042	PrimalLoinUG	0.01
	*	*	ALegTrotterOff	0.053	PrimalRibCH	0.025
	*	*	Picnic	0.055	PrimalRoundUG	0.006
	*	*	PrimalFlankselect	0.086	ShouldersSquare~t	0.036
	*	*	PrimalRoundPR	0.093		

The results for the chicken breast (BreastBS), is contained in table 3.14. In period 1, no variables found to Granger cause chicken breast, but chicken breasts were found to impact other primal cuts in all species (all grades of rounds, chucks and briskets, pork ribs, and whole wings). In periods 2 and 3, there were variables found to impact the prices of chicken breast, with the bulk of the variables being beef primal cuts. Chicken breasts were found have no impact ungraded and Prime beef loin and Select and ungraded beef ribs in all three periods. Chicken breasts were found to have impacts on Prime, Choice and Select loins (table A.1) and Branded and Choice ribs in the second period (table A.1), which is hypothesized due to the effects following the Great

Recession. In period 3 chicken breasts were found to have no causal relationship with Branded and Choice ribs and Choice loins, implying recessionary impacts on the price interactions between periods. Interestingly, no other poultry cuts were found to Granger cause chicken breast prices in any of the three periods.

Prime Graded Flanks

Table 3.15 Granger Causal Relationships between Prime Graded Flanks and other Meat Cuts

Whole Sale Cut	Granger Cause Variable Period 1	p-value	Period 2	p-value	Period 3	p-value
PrimalFlankPR	*	*	PrimalFlankselect	0.001	Breast	0.072
	*	*	PrimalChuckselect	0.005	Foreshank	0.068
	*	*	PrimalFlankBR	0.005	Ham	0.029
	*	*	Thighs	0.013	Loin	0.007
	*	*	Rack8RibMedium	0.021	LoinTrimmed4x4	0.039
	*	*	LoinTrimmed4x4	0.023	Neck	0.044
	*	*	PrimalBrisketUG	0.039	PrimalFlankUG	0.003
	*	*	ALegTrotterOff	0.045	PrimalLoinCH	0
	*	*	Butt	0.048	PrimalLoinPR	0.006
	*	*	PrimalBrisketse~t	0.05	PrimalRibBR	0.02
	*	*	PrimalChuckCH	0.051	PrimalRoundBR	0.002
	*	*	ShouldersSquare~t	0.093	PrimalShortPla~BR	0.078
	*	*	PrimalBrisketBR	0.095		
	*	*	PrimalRoundUG	0.1		

Similar to chicken breasts, Prime Flanks (PrimalFlankPR) were found to have the same type of interactions with other cuts of beef, chicken, and pork in the large all meat sector models, table 3.15 contains the Prime graded flank results. In the first period prime flanks had no Granger caused variables impact them, but the prime flank impacted other variables (table A.1). Across all three periods, all grades of flanks interacted with each other (table A.1), which is hypothesized since flanks are often sold as flanks, thus they are the same cut regardless of the quality grade. Another characteristic of the Prime flank was that the higher end cuts of beef (ribs, loin) increased in impact through the periods (table 3.15). In period 3, ribs and loins were found to have impact on prime flank and this possible could be due to the rise of fajitas in HRI trade, which makes fajitas and steaks possibly substitutes.

Lamb Foreshanks

Table 3.16 Granger Causal Relationships between Foreshanks and other Meat Cuts

Whole Sale Cut	Granger Cause Variable Period 1	p-value	Period 2	p-value	Period 3	p-value
Foreshank	Ham	0.002	ALegTrotterOff	0	Belly	0.009
	PrimalRibPR	0.005	PrimalRoundselect	0	LoinTrimmed4x4	0.017
	PrimalBrisketCH	0.013	WingsWhole	0	PrimalBrisketUG	0.034
	PrimalBrisketPR	0.013	ShouldersSquare~t	0.001	PrimalChuckUG	0.035
	Legs	0.017	Rack8RibMedium	0.002	PrimalRoundPR	0.087
	Belly	0.025	PrimalRibBR	0.002		
	PrimalLoinPR	0.034	BreastBS	0.002		
	Neck	0.05	Thighs	0.002		
	PrimalLoinUG	0.063	LegQuarters	0.003		
	PrimalChuckCH	0.079	PrimalChuckUG	0.004		
	PrimalRibUG	0.086	Breast	0.012		
	PrimalChuckPR	0.088	EFlankUntrimmed	0.012		
			PrimalRoundCH	0.014		
			PrimalRibCH	0.015		
			PrimalRoundPR	0.02		
			PrimalShortPlat~H	0.021		
			PrimalChuckselect	0.026		
			PrimalRoundBR	0.03		
			Legs	0.055		
			Picnic	0.072		
			PrimalLoinUG	0.079		
			PrimalBrisketse~t	0.08		
			PrimalShortPla~PR	0.093		

An interesting finding in the lamb primal cuts was in the foreshank cut. The results are contained in table 3.16. In period 1, only the neck was the lone lamb cut that interacted with the foreshank, but more interactions were found in period 2 and 3. Period 2 had a lot of interaction with the other species and the number of cut interactions drastically declined in period 3. In period 3, the only lamb cut to have a relationship with the foreshank was the loin (table 3.16), while foreshank never had an impact on the loin in any of the 3 periods (table a.1). Bellies were found to have impact on the foreshank, which indicates the ability of bellies to have relationships with other cuts in the marketplace. Only ungraded chuck and brisket and prime round was found to impact foreshanks in period 3 from the beef sector.

3.4.2. Specie Specific Model Results

A VAR model for each species was estimated. Each specie specific model involved no cuts from other species. In this subsection of the results, the specie specific results will be presented in order of lamb, beef, pork and poultry. In each figure a blue arrow represents a one-way Granger causal relationship in a Directed Acyclic Graph (DAG). If two variable feed each other, then a red arrow (double headed) represents that relationship in the DAG.

3.4.2.1. Lamb

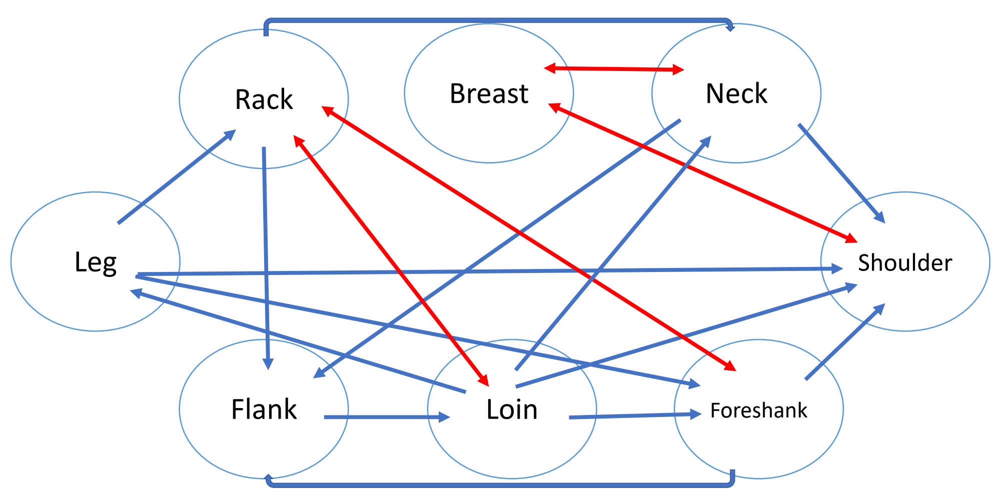

Figure 3.6 Period 1 (4/11/03-1/7/11) Lamb Price Directed Acyclic Graph

In the period 1 model (4/11/03-1/7/11), the lag estimation criterion was 2 lags (figure 3.6). The results indicated that the lamb shoulder has a causal relationship with more cuts than any other. All cuts, except the flank and the rack have direct price relationships with the shoulder. The price interactions for shoulders in the within specie model and when in the larger model present the same causal results, for shoulder prices. During this time the ability of the shoulder primal to impact to other meat cut prices was relatively low, while it was impacted by many cuts. The primal cuts of breast and shoulder do feed each other in this model and in the all species model. When looking at the three highest valued cuts (leg, loin, and rack) they all interact with each other, with the loin Granger causing legs and rack prices. Generally, period 1 for lamb cuts were highly interactive among each other.

In the period 2 (1/14/11-12/27/13) model, the estimation criterion was 1 lag for the lamb primals (figure 3.7), the number of two-way relationships between cuts increased to six compared to four in period 1, while the number of one-way relationships decreased to six form thirteen. Within the lamb model, the loin was found to have no interaction with any other cut during period 2. But in the large, all species model, the loin price was found to be caused by the rack price, but the loin didn't Granger cause the. These robust estimates between the within species and all species model indicate some evidence that loin prices are independent of other cuts. This indicates that during this time period the loin was not affecting the price relationship of any other lamb primal cut.

The first structural break was found to be at the end of 2010 for most primals (rack, shoulders, foreshank, neck, loin, and leg) so this study used the same time frame for the first structural break. This break may signal the impact of the recession on the lamb market. The second structural break was indicated by break in the breast and flank prices at the end of 2013 and the beginning of 2014. Because of the breaks indicated in two primal cuts, this study used these dates as another lamb price structural break.

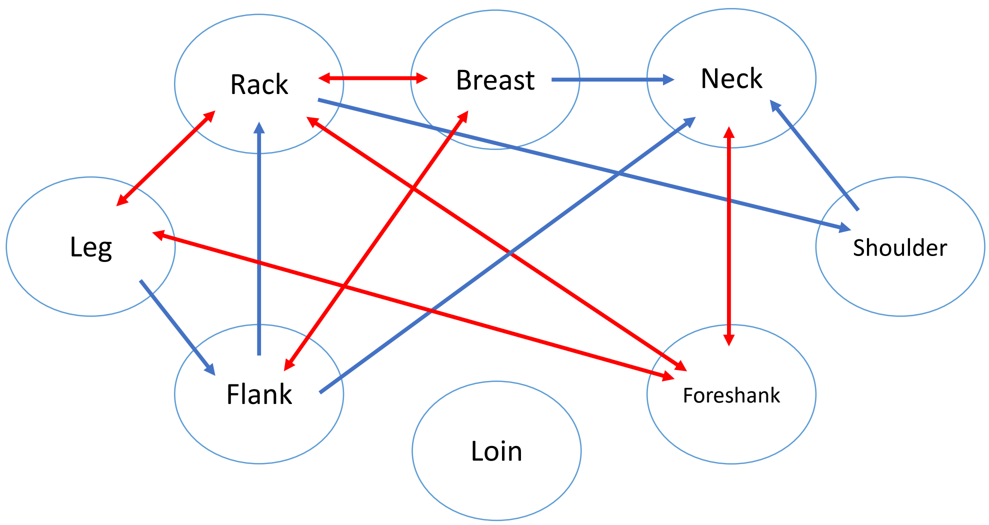

Figure 3.7 Period 2 (1/14/11-12/27/13) Lamb Price Directed Acyclic Graph

Another difference is that the previous relationships of the shoulder with the period 1 cuts changed with only the rack affecting the shoulder. The shoulder lost its two-way relationship with the breast and reversed its relationship with neck. A drastic difference between the rack primal cut in the lamb period 2 model and the large all species period 2 model is that the rack was not Granger caused by other cuts during this time in the large all species model. The rack caused many other cuts in both models.

In period 3 (1/10/14-2/8/19) (figure 3.8) the relationships between the cuts were found to be similar to period 1. The breast and neck two-way relationship was re-established, and the shoulder cut regained leg and foreshank causalities. The shoulder maintained its Granger causality impact on the neck that was found in period 2.

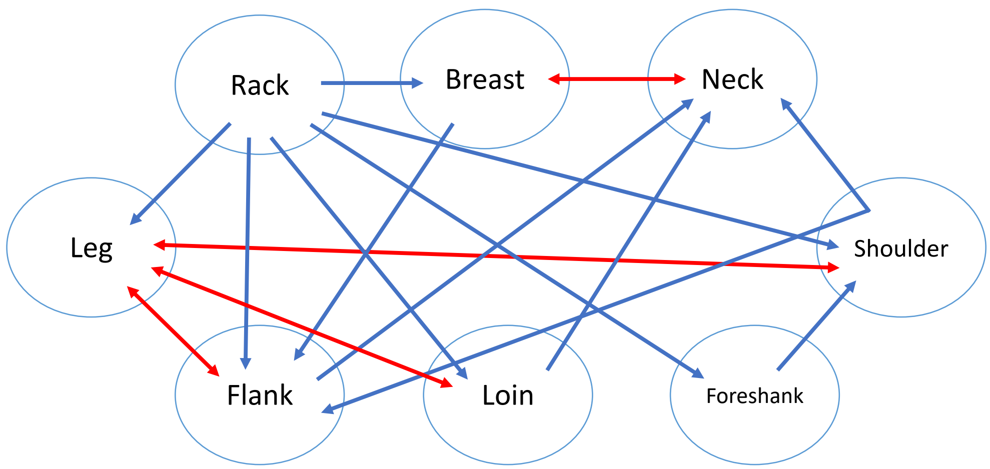

Figure 3.8 Period 3 (1/10/14-2/8/19) Lamb Price Directed Acyclic Graph

One key finding in both the period 3 lamb model and the all species period 3 model was that the rack had no other lamb cuts impacting its price. The rack in both models impacts many of the cuts, but no cut effects its price. In all three periods, the difference in the mean price (from table 4.6) of the rack compared to the next highest valued cut (loin) has steadily increased from $136.28 in period 1, to $182.53 in period 2, to $256.05 in period 3. This drastic increase in the rack price relative to other cuts coincides with the period 3 results of no other lamb cut impacting the rack price. This change in the rack relationship could be due to an increase in demand for the rack of lamb. This could mean that moving forward that racks could be marketed differently compared to the carcass, not separable because is still maintains a relationship with the other cuts, but that it can be marketed in a different way than the other cuts. Anecdotally, a large portion of imported lamb is racks

3.4.2.2. Beef

Similar to the lamb industry, the beef sector exhibited two structural breaks. Due to the size of the beef models having 36 variables, this study presents the two-way DAGS for each period (figure 3.10- figure 3.12) in this section and the total results for each variable interaction can be found by each period in the appendix (table A.2). Test results indicated that prices should be lagged 1 period. Figure 3.9 shows the results for Granger causality relationships that were consistent throughout all three periods.

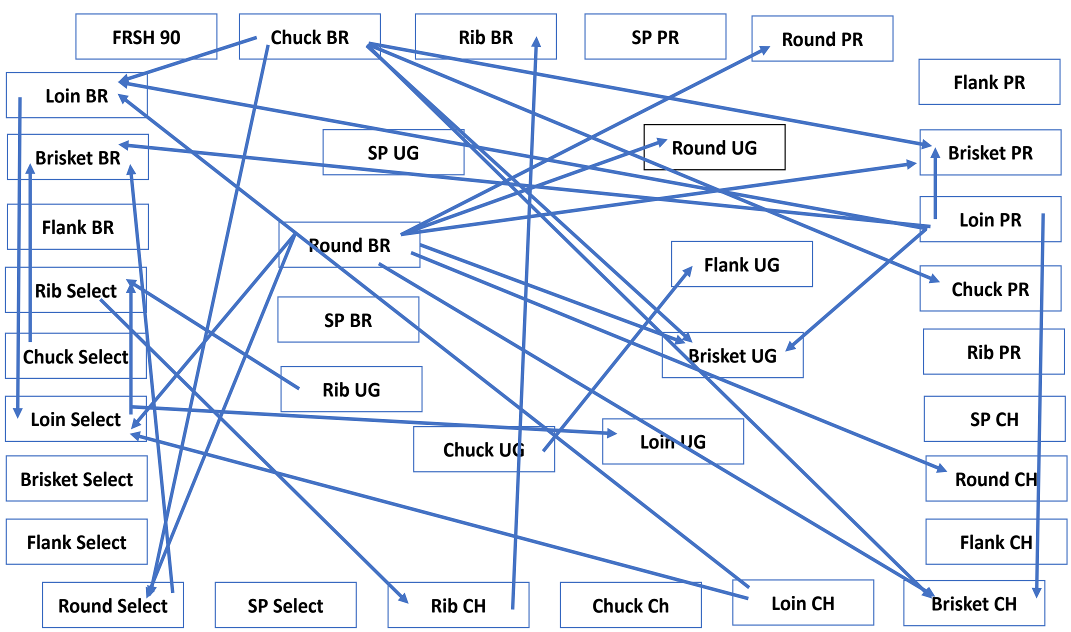

Figure 3.9 Overall Beef Price Directed Acyclic Graph Consistent Throughout the Time Periods

In period 1 there were many two-way interactions that centered around rounds (Branded, Ungraded, and Select), chucks (Branded, Ungraded, and Select), and the fresh

90 variables. This makes sense as the versatility of these primal cuts may affect other cuts in different ways (steaks, roasts, and trimmings). The single species beef model coincides with the all specie model in that these cuts have significant impact as a whole on the market. Rib and loin primals were found to interact with each other across grades, and this makes sense due to the demand for their sub-primal steaks are in the same market. The Choice loin primal did not have a two-way interaction with any cut but it was Granger caused by Prime graded loin and rib (table A.2).

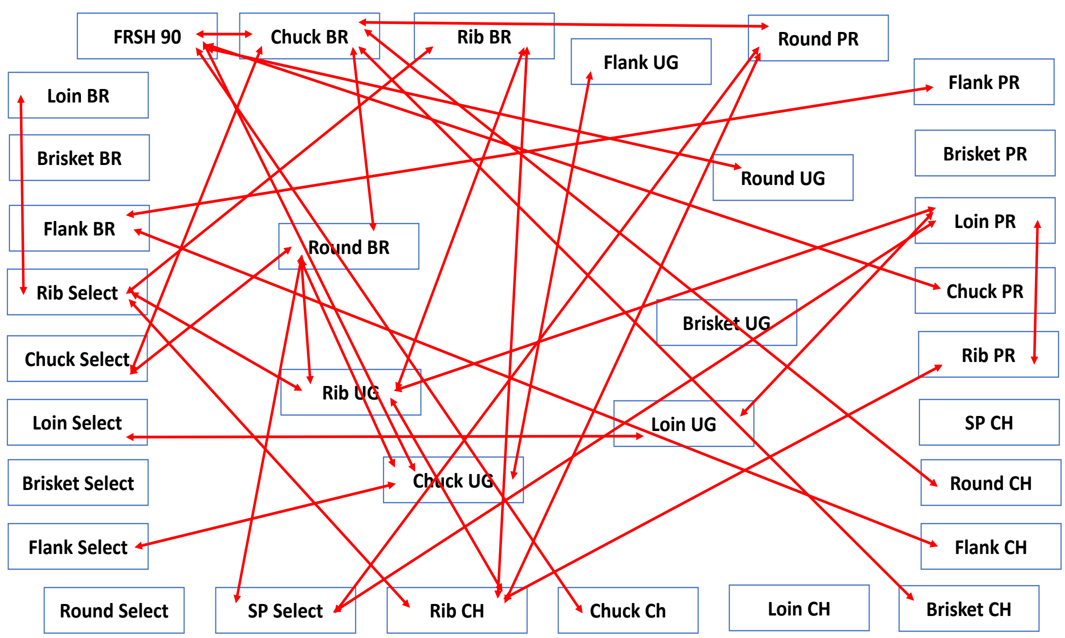

Figure 3.10 Period 1 (4/11/03-1/7/11) Beef Price Directed Acyclic Graph Representing Two-Way Relationships

Several other cuts exhibited no two-way price relationships with any other cut. Prime, Branded, and Select briskets had no two-way relationships with any other cut. Select rounds and Choice short plates also exhibited no two-way relationships.

In period 2 (1/14/11-12/27/13) (figure 3.11), there were more two-way interactions with the branded round, branded brisket, ungraded flank, and choice chuck all picking up more interactions. Fresh 90 lost its two-way interactions exhibited in period 1.

The choice loin still did not have a two-way interaction with any other cut and had fewer granger causal variables (table A.2). Choice rib lost its interaction with branded rib, and prime rib. The prime graded cuts picked up more interaction among themselves. Similar to the large all species model, briskets started to have interaction with other cuts in the market. In period 1, only the Choice brisket had two-way interaction, but Branded, Prime and Ungraded briskets gained interactions in period 2.

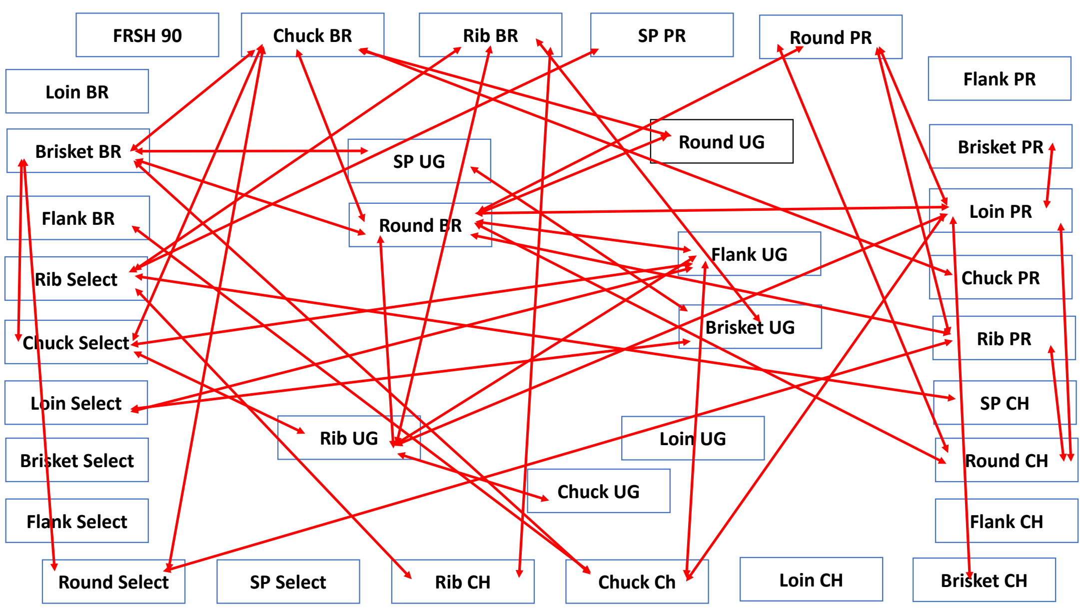

Figure 3.11 Period 2 (1/14/11-12/27/13) Beef Price Directed Acyclic Graph Representing Two-Way Relationships

The first structural break for the beef sector was found to be relatively close to the end of the Great Recession (end of 2010) with all grades of rounds, chucks, brisket, short plate, and flank. Another significant break was found in rib and loins (choice, select, branded and ungraded) at the end of 2013 and beginning of 2014. This could be partly due to the end of the recession but may also indicate when Walmart began selling Choice meat. Due to the size of Walmart as company and its market share, this choice by a large retailer could alter the market and cause the structural break in the price data.

In period 3 (1/10/14-2/8/19) (figure 3.12), fresh 90 picked back up its two-way interactions with other cuts and less branded rib interactions were found. The select round did not have any two-way interactions in period 1 but had some interactions in period 2. In period 3, the select round became a prominent variable with many two-way interactions, but none with a rib or loin primal. Briskets, as a whole, gained more two-way interactions with Select, Prime, and Choice briskets impacting ribs and loins (select, prime, and ungraded). These brisket findings are similar to the findings of briskets in the all species model. This could suggest that briskets have a growing demand which is causing a change in the brisket market. Choice and Branded ribs exhibited no two-way price relationships in period 2.

Overall in the beef sector, regardless of the grade, chucks and rounds exhibited many interactions with other cuts of beef. This makes intuitive sense due to the versatility of the primals to be fabricated into steaks, roasts or trimmings. Their impact is likely also due to their size. The chuck and the round account for 15.9% and 13.95% of a beef carcass (Drovers, 2011). Throughout all three periods, the results that Choice loins granger cause Select, and Branded loins makes sense. Most branded programs have a quality grade minimum and Choice is often the minimum, which is the case for

Certified Angus Beef. Because many branded programs are based on Choice grade, the versatility of a Choice loin being marketed in a branded program or not may be impacted by the price of Choice loins relative to the Branded loin.

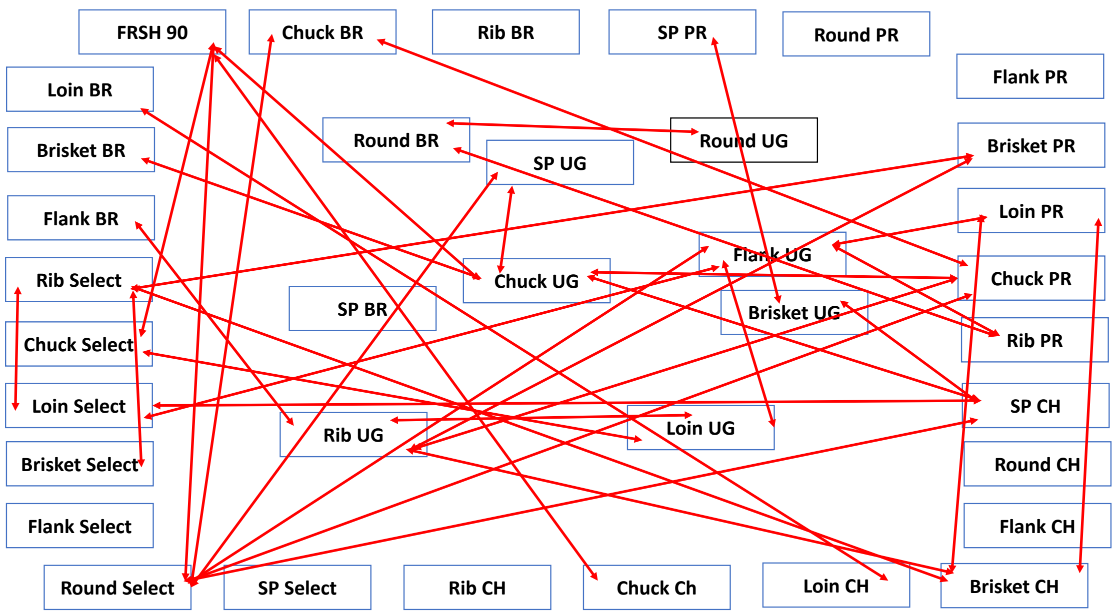

Figure 3.12 Period 3 (1/10/14-2/8/19) Beef Price Directed Acyclic Graph Representing Two-Way Relationships

The causal relationship between Branded and Choice loins might suggest more research on the relationship of upper 2/3s Choice and lower 1/3 Choice graded beef. The same line of thought can be followed on the impact of Choice loin on Select loin. Because Select is the quality grade below Choice, then a relationship of Choice impacting Select might be expected. Similar results have been found in the meat demand literature and our results agree that Choice beef impacts Select beef.

In both the beef specific model and the large all species model, briskets have gained more causal price relationships with ribs and loins, complementing the rising brisket prices discussed earlier in this chapter. Moving forward, the demand for brisket could lead to more price relationship changes in the marketplace, warranting more research in this area.

The current highest valued primal beef cut is a Prime graded rib. In period 1 the highest valued cut was a Prime graded loin. During that time the loin granger caused the prime rib. In period 2, the mean for the prime rib became larger than the prime loin and the two-way relationship disappeared but loin still granger caused the rib (table A.2). During period 3 in both the beef specific model and in the large all species model, the Prime rib was no longer caused by Prime loin prices. This shows the relationship change over time and including the recession and structural breaks the difference in price is increasing, which could signal the demand for rib is growing compared to the loin. Another aspect that could impact the Prime rib is Costco announcing that the store will sell Prime beef in its stores. Costco's announcement could impact the market similarly to Walmart selling Choice beef. The marketing of prime beef at Costco could possibly lead to a structural change in the market moving forward.

3.4.2.3. Pork

The pork results (figures 3.13- 3.16) are broken down for each period below. The pork industry had 3 structural breaks. The first structural break occurred around the end of the Great Recession. The second occurred near the end of 2015. The third break occurred in the fall of 2017.

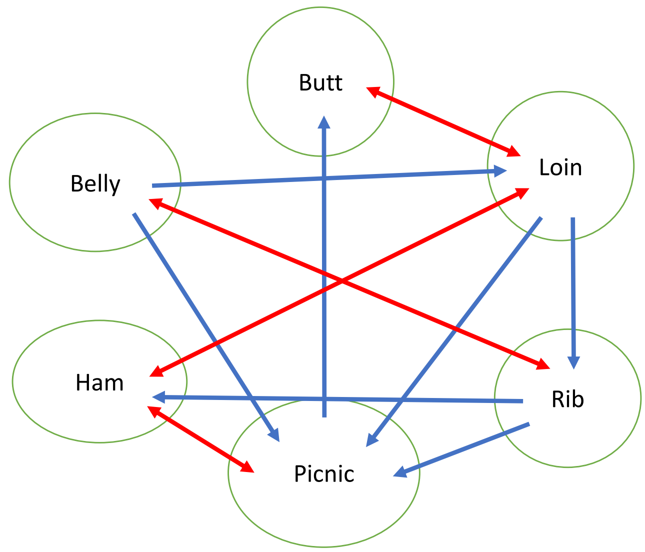

Figure 3.13 Period 1 (4/11/03-4/16/10) Pork Price Directed Acyclic Graph

In period 1 (4/11/03-4/16/10), all cuts exhibited price interactions, with the most coming from loins and picnics (figure 3.13). As discussed earlier in this chapter, in this model, the rib affected the belly but in the large all species model there were no other cuts that affected the belly. The belly and rib are the two highest valued cuts of the carcass, so uncovering their interactions in this model was not a surprise. There were no pork primals that Granger caused the rib in the large all species model during this time period. The loin was the third highest valued cut ($1.14 behind the belly) during this period, so finding that it influenced and interacted with many other cuts wasn't a surprise. The loin revealed similar interactions in the large all species model with it being Granger caused by belly, butt, and rib.

In period 2 (4/23/10-11/6/15) (figure 3.14), no cuts exhibited two-way interactions, but all primals had one-way interactions. The lag selection for this model was 3 lags. While there were no two-way interactions in this period for this model, there were some in the all species model (ham-butt, butt-rib, and loin-ham). There was still evidence of these relationships in the period 2 pork model.

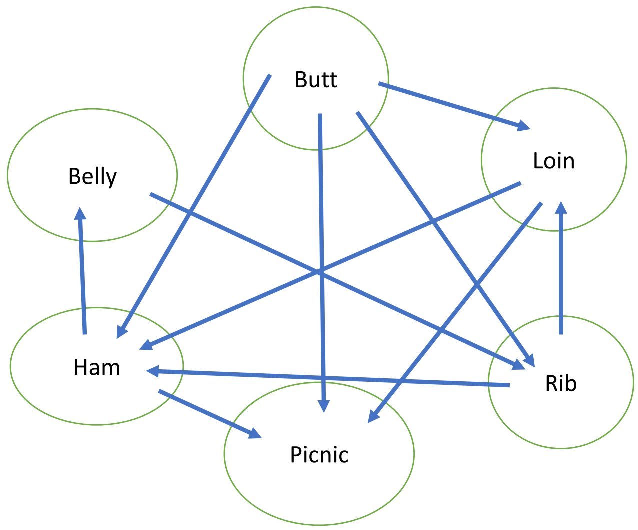

Figure 3.14 Period 2 (4/23/10-11/6/15) Pork Price Directed Acyclic Graph

During this period, all cut prices increased, but the belly exhibited the largest jump from a mean of $84.03 in period 1 to $125.35 in period 2. With the increase of $41.32 per cut in belly price, perhaps bellies Granger causing ribs (highest valued cut) makes some intuitive sense.

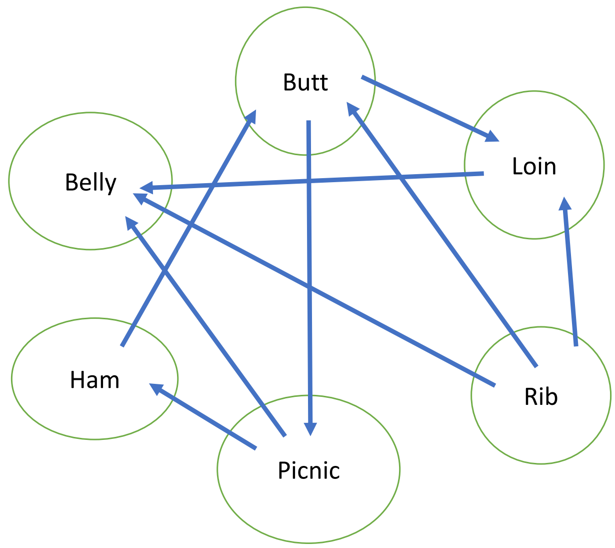

Figure 3.15 Period 3 (11/13/15-9/22/17) Pork Price Directed Acyclic Graph

In period 3 (11/13/15-9/22/17) (figure 3.15), there remained an absence of two-way interactions. The biggest difference between the two DAGs is the arrows going towards the belly. Between the large all species model and this period 3 model, the rib and the picnic Granger caused the belly. The belly was the only primal to increase in price between the two time periods. The belly only was $1.02 per cwt below the rib during this time. The rib and picnic Granger caused belly prices while the belly was the only primal to have a price increase. This result could suggest that the belly started to overall drive the pork cutout price during this time.

The pork industry experienced another structural break that gave it a fourth period. Meaning that the fourth period (figure 3.16) is a subset of the third period in the all species model. In this period, all primal cuts decreased in price, except for the butt. Although belly prices decreased the most between the periods ($9.35 per cwt), no other primal cut Granger caused belly prices. The belly had variables impact it while it increased during period three but when the price decreased, no variables impacted the belly. All other variables were impacted, and Granger caused other variables but the belly.

With the belly decreasing in price but not due another variable influencing the decrease, it still influenced the ham and the butt. Following the interaction in figure 3.16, the ham influenced the picnic and the butt influenced the loin and rib. These influences are all rooted in the belly but yet the belly wasn't influenced in its price decrease. These interactions could suggest that bellies show demand separable characteristics, but more research should be put into this question.

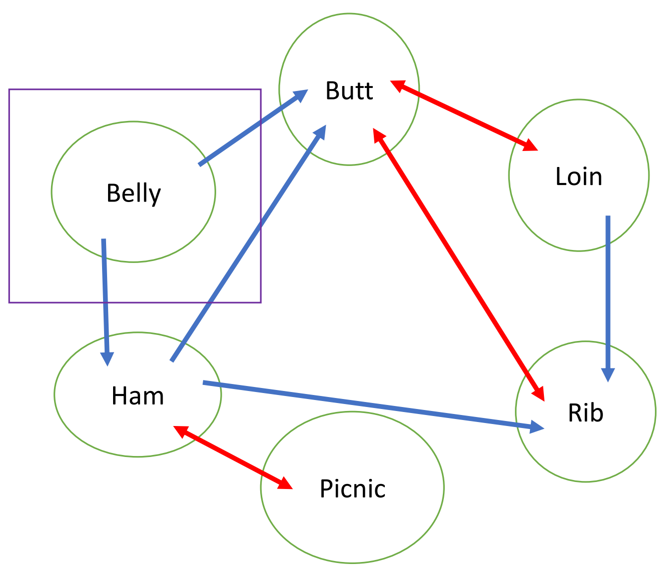

Figure 3.16 Period 4 (9/29/17-2/8/19) Pork Price Directed Acyclic Graph

In general, the pork results show that there are interactions between cuts. In period 1, there were two-way interactions and they disappeared, but the same ham-picnic and butt-loin two-way interactions reoccurred in period 4. The belly has become a prominent primal that can decrease in price and it not be due to another cut. This could be due to the “bacon” boom that has occurred in the recent years. This up-tick in demand could be driving the price change of the bellies. Since bellies have limited amount of retail cuts (minimum versatility), the supply of bellies could also be a reason for the price change.

3.4.2.4. Poultry

The poultry results are listed below (figures 3.18-3.21), and similar to the pork industry, the poultry industry had 3 structural breaks. The first break happened in 2007. This first break could possibly due to a demand change due to the lack of a supply structural change in the industry (figure 3.17). the second structural break occurred around the same time as all other meat industries, in 2011. This second change coincides with the recession ending for the industry. The third structural change occurred in 2015, and this one could be partially due to the supply change. The mean for 4/2004- 12/2014 was 892,000lbs/week and after that the mean has increased to 998,000lbs/week.

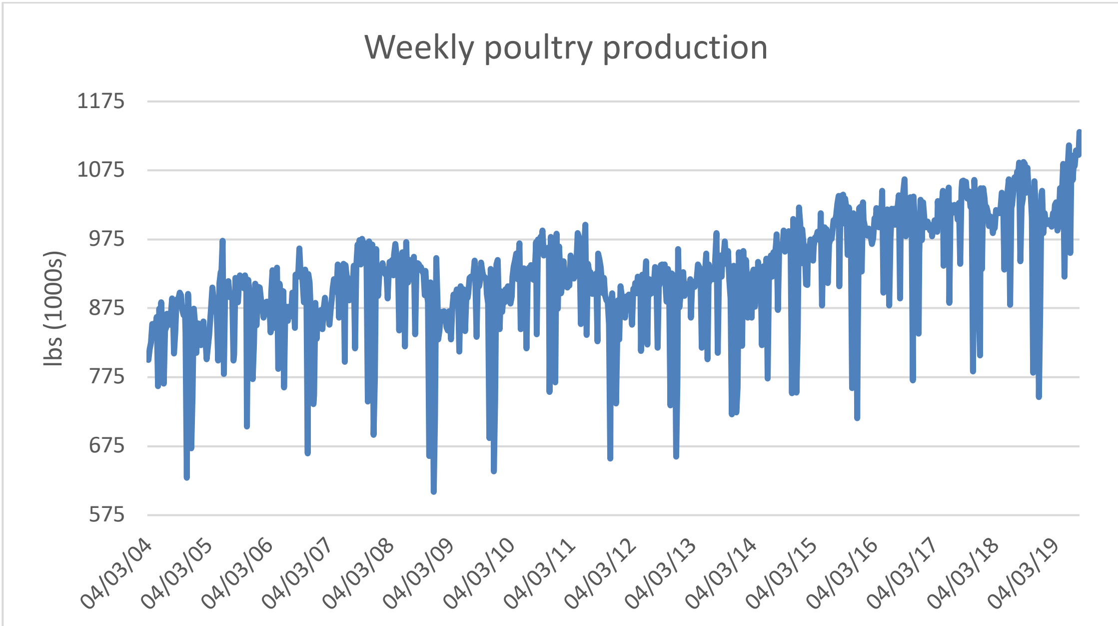

Figure 3.17 Weekly Poultry Production

In period 1 (4/11/03-2/16/07) (figure 3.18), numerous interactions amongst the cuts was exhibited. There were 3 two-way interactions (breast-legs, legs-leg quarters, and legs-thighs). The same leg-leg quarters and leg-thighs relationships were found in the all species model. These interactions are not surprising as these cuts were largely sold in choice sets to people at the food chains (Popeyes, churches, and KFC). As mentioned earlier, chicken breast was found not be granger caused by any other cuts in the large all species model, but in the period 1 chicken model only legs were found to Granger cause breast. This finding could be due to the lag change and the time frame difference. Thighs were found to be Granger caused by the breast in both the period 1 chicken model and the large all species model. The only cut that influenced wings was thighs during the period 1 model but the breast caused wings in the all species model.

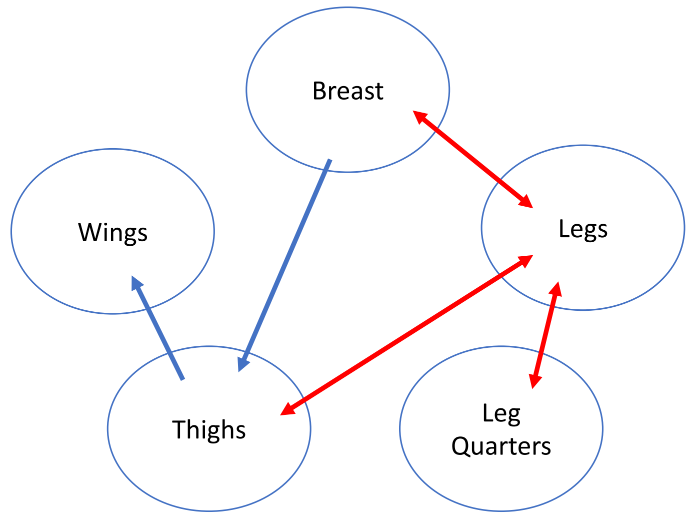

Figure 3.18 Period 1 (4/11/03-2/16/07) Chicken Price Directed Acyclic Graph

In period 2 (2/23/07-12/9/11) (figure 3.19), relationships between the cuts altered from the previous period. Legs became Granger caused by all cuts except by wings. Thighs gained another interaction with leg quarters. The same interactions that are in the period 2 chicken model was found in the large all species model.

During this period, the wings increased \$0.27/lb in mean price to \$1.22/lb. This increase closed the gap between wings and breast. Wings were \$0.51 behind breast in mean price but the gap was closed to \$0.14/lb. The price relationship between breast and whole wings was not existent in the period 2 chicken model but wings was found to granger cause the breast in the larger all species model. There were no two-way relationships in either model, which could be due to the lag difference but also this could be caused by the wings drastic price increase compared to the other cuts.

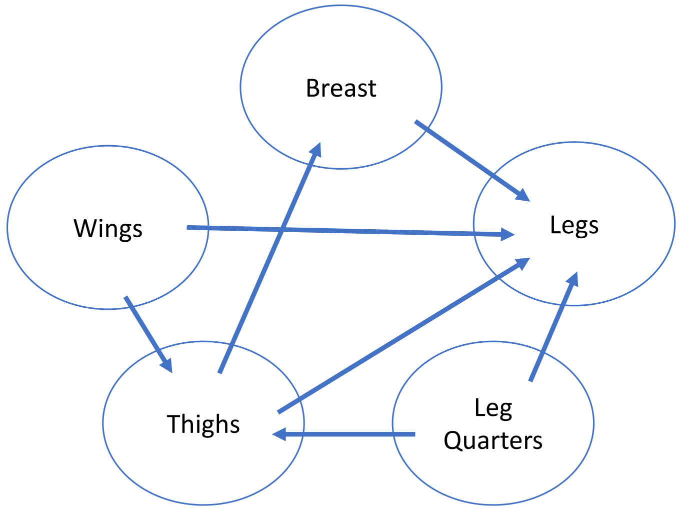

Figure 3.19 Period 2 (2/23/07-12/9/11) Chicken Price Directed Acyclic Graph

In period 3 (12/16/11-9/18/15) (figure 3.20), wings became the highest valued retail cut over the chicken breast. All the primal cuts increased in price, but the wing price increase led to relationship changes with many other cuts in both the period 3 model and the all species model. Directionally, wings flowed to the breast which then flowed to the thighs. In the third period of the large all species model wings became interactive with many of the grade beef cuts of rounds, loins briskets and fresh 90. Wings also became a variable that granger caused bellies in the 55-varaible model.

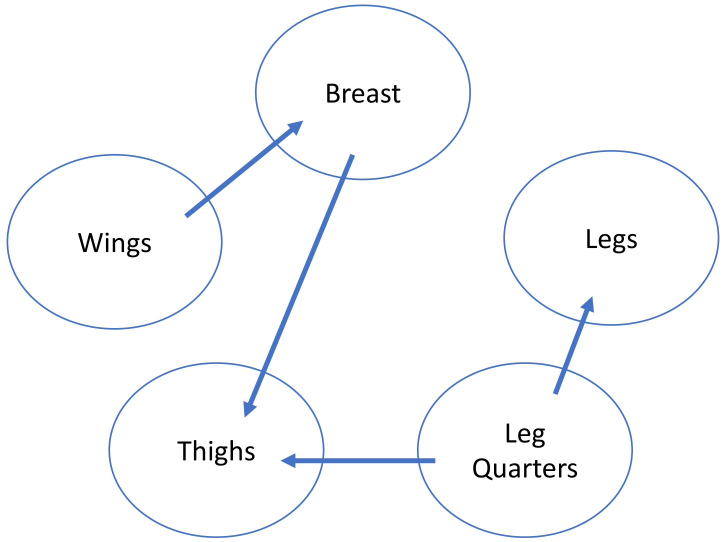

Figure 3.20 Period 3 (12/16/11-9/18/15) Chicken Price Directed Acyclic Graph

With the price increase of wings and its increased impact on the other cuts of chicken, pork and graded beef in this period, this could be due to a demand increase for wings during this time period. Wings are only produced by 2-per bird. With increased pricing, the industry would want to produce more to increase profit. This could be a reason for the supply increase that was mentioned earlier for this industry.

In period 4 (9/25/15-2/8/19) (figure 3.21), the relationships changed during this time. All the chicken primal cuts decreased in price during this time except for wings. Even though the price increased, there were two cuts that influenced the price, which were thighs and leg quarters. The same effect was found in the pork industry when bellies increased in price while other fell but they influenced bellies. This suggests that part of the increase of wings came by way of the decrease of the other two cuts. Breast became a Granger cause variable for thighs during this time. The drastic decease in the mean price of breast ($0.33/lb) could have influenced the thigh price to decrease. Legs and leg quarters regained its two-way relationship during this period.

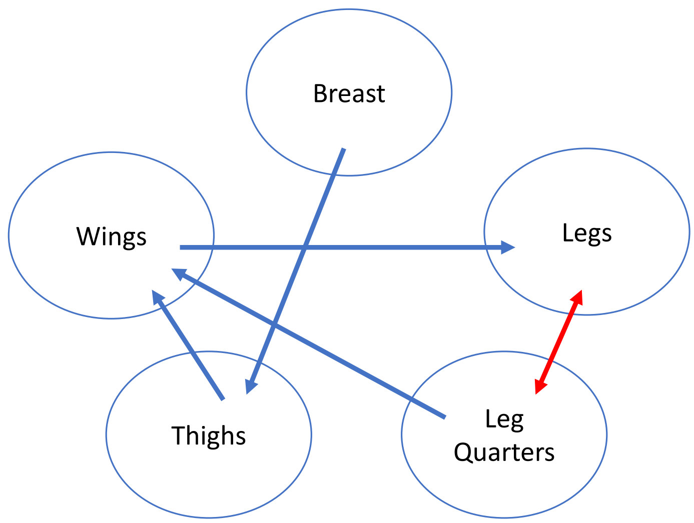

Figure 3.21 Period 4 (9/25/15-2/8/19) Chicken Price Directed Acyclic Graph

Price relationships between the cuts were found to have changed between periods. The legs-leg quarters relationship was constant, which was hypothesized. The two cuts that altered their relationships the most were the breast and the wings. The change in the relationships could be due to the price swings (demand) for wings. Wings have become a prominent meal, compliment to pizza over time and they have also had market carved out for them (Wing Stop, Wings N' More). This growth in demand is hypothesized to have altered the market for poultry and further research into the impact of wings could be beneficial for the meat demand literature.

3.5. Conclusions

This study revisited meat price relationships using wholesale level price data. The wholesale market is where all buyers interact, restaurants, grocery stores, and exporters.

Evidence has showed that in the large all species model that relationships of cuts have changed over time for all species (both between species and within species). As mentioned in the literature many times, structural changes need to be accounted for. This study utilized the beginning and ending of the recession as natural structural breaks for the all species model. This study also found structural breaks for each species, with all of them having a structural break around the time of the recession beginning ending. The poultry and pork industries had 1 more structural break post 2014.

Relationships between cuts within a species and between species have been found to change over time. There are numerous relationships that could be analyzed from table A.1. this study chose to highlight the most interesting findings in each species.

Racks in the lamb industry have become a prominent cut that has gone from a cut that was influenced by many other lamb cuts to a primal cut that influences, and Granger causes many other cuts in the lamb industry. Further research in into the impact of rack could be beneficial for the lamb industry as there is not much rack demand literature.

Graded briskets have gone from the lowest valued primal cut to the third highest behind the rib and loin. Briskets had established relationships with the lower valued cuts (short plates and flanks) but over time the demand has increased for briskets. With the demand increase, the prices increased which has led to relationships between higher valued cuts and not with the lower valued cuts.

During the time sample, ribs overtook loins as the highest valued cut of beef and with that price change the relationships have changed for the ribs in the models.

In the pork industry, the biggest change was due to the price increase of the bellies in the market. The price increase changed the dynamic of the pork cuts and their relationships. The price increase of bellies was impacted by other cuts in periods 2 and 3 but currently there are no other cuts that impact the price of belly, but the belly does impact other cuts. Further research in this area would be beneficial for the hog industry as there is not much research in belly meat demand.

In the poultry industry, legs and leg quarters were to always interact over the time sample. The biggest change has occurred between the breast and wing cuts. Breast was the highest valued cut in the first two periods. Wings became the highest valued cut in periods 3 and 4 and with that change, the relationships between the cuts changed. Wings are influenced by thighs and leg quarters in the fourth period but as their prices have decreased, the wing price continued to increase. Further research into these dynamics of these chicken cuts would be beneficial as the wing primal has developed into its own market (i.e. Wings Stop)

The price relationships within and between species is critical to understanding demand. Own price and the price of other goods are key constructs of consumer demand theory. As mentioned in the introduction, there is growing evidence of weakening demand relationships between cuts from different species. Weaker price relationships might take the form of smaller cross-price elasticities. Others have pointed to evidence of more consumer purchasing pattern changes within species than between. The relationships found from this study can aid in answering these changing relationship questions

The relationships found from this study can also be used to estimate structural demand models. An example would be briskets. Before this study, no other study had established causal relationships between the higher end cuts of beef (ribs and loins) and briskets. This study has found evidence of the relationships. With these relationships, future research should include graded ribs and loins when analyzing brisket demand. Brisket demand research should also include other cuts from other species. Bellies were found to have a relationship with briskest so in demand research, bellies should be included with brisket demand research.

This study was the first to include all 55 primal cuts from the 4 main species that produce the meat that's consumed in the U.S.. This study examines many models with identified structural price breaks. Similar results and relationships for each species were found between the large all specie and specie specific models. The results indicate that relationships have changed over time and much like structural breaks, changing relationships should be accounted for when analyzing meat demand for cuts regardless of the species.

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4. ESTIMATING PORK PRICE RELATIONSHIPS: A CLOSER LOOK AT PORK BELLIES

4.1. Introduction

Meat demand has been researched extensively. Pork demand, in particular, is a subject that's not as dense in pork research when compared to other beef research. Understanding the drivers and shifters of pork demand and supply is beneficial across the industry. Past studies have highlighted demand drivers such as advertising, new market entrants, product differentiation, and nutrition in the meat industry. Own price and the price of other goods are key constructs of consumer demand theory. Most consumer demand studies have used monthly retail price data gathered by the Bureau of Labor Statistics (BLS) at grocery stores or retail grocery store scanner price data. Few studies have used wholesale prices where purchasing occurs for all retail outlets and export markets.

Since the 1970s there has been a growing trend of consumers eating more meals away from home, known as Food-Away-From-Home (FAFH) consumption (USDA). The BLS price data commonly used in demand studies does not capture prices paid for foods purchased and consumed away from home at places such as hotels and restaurants or export sales which account for a growing share of meat sales. The United States in the 3rd largest producer of pork and ranks 2nd in world pork export shares (USDA, 2018). Because the BLS data doesn't capture the HRIs (hotels, restaurants, institutional), or export sales, the studies mentioned don't fully capture the price relationships among the pork primal cuts.

Bellies in particular, may have experienced a change in consumer demand due to growing bacon demand. Bacon originated as a salted breakfast staple but has since been transformed into a value-added gold mine. Bacon has gone from the simple seasoning of salt and smoke curing to cracked black pepper bacon, Hickory smoked cured bacon, Applewood smoked cured bacon, candied bacon, brown sugar bacon, jalapeno bacon, and has even been used for infusing whiskey. The previous examples don't include the long time uses of bacon such as, bacon bits, bacon wraps, and the bacon found on burgers. Due to the increase usage and versatility of bacon, demand has likely increased and is projected to increase in the future (Food and Focus, 2019). With this increased demand, the price of bellies has increased.

With this drastic price increase, the relationship of pork belly and other pork cuts prices have possibly changed over time. This study revisits pork price relationships using wholesale level price data. The wholesale market is where all buyers interact, restaurants, grocery stores, and exporters. This study aims to capture causal price relationships between wholesale pork cuts. This work tests the hypothesis that wholesale cut prices between the cuts have changed over time. Evidence of price relationships between species, trimming, and pork production are explored. The hypothesis that some cuts have no price relationship, i.e. are separable, to other cuts will provide some future direction for further demand analysis.

4.2. Review of Literature

Demand analysis is a subject of interest with numerous studies that have estimated demand shifters and elasticities. Demand estimation has been investigated with nontraditional and traditional demand models (Lusk and Tonsor, 2016). Consumer demand determinants have been investigated extensively for shifters that such as health, income, and advertising (Kinnucan et al.; 1997; Rickertsen, 1998; Piggott et al., 1996; Park and Capps, Jr., 2002; Piggott and Marsh, 2004; Marsh, Schroeder, and Mintert, 2004; Mazzocchi, 2006; Tonsor, Mintert and Schroeder, 2010). While some these articles do not estimate pork price relationships explicitly, these studies do arrive at price effects by analyzing demand through their selected consumer demand models. Theoretical attributes for these models can still be useful in formulating reasoning for this study and give merit to the results.

Piggott and Marsh (2004) examined pork beef and poultry demand interactions by using a Generalized Almost Ideal Demand model. The authors investigated demand for the three meats during health concern outbreaks. The price relationships that were estimated were in the form of own price and cross price elasticities. The found that price effects have a greater effect and last longer than responses to food safety concerns. The data used were aggregated monthly, thus making the data a shortcoming of the study.

Similar results were found when investigating the same issue by Marsh, Schroeder and Mintert (2004). They investigated the effects of disease outbreaks on demand using a Rotterdam mode. They also found that price effects outweigh the outbreak effects. But once again, as seen in Piggott and Marsh, the demand was estimated using monthly data.

Capps and Park (2002) estimated pork demand using a double-hurdle model. Their approach to estimating demand was different than the studies above not only because of model selection but also the data that was used. Capps and Park used survey data from the 1994-1996 Continuing Survey of Food Intakes for Individuals (CSFII) and the 1994-1996 Diet Health and Knowledge Survey (DHKS). They cite the reason for using this data was due to the short comings of aggregate time series data. Using this model and "better" data, the authors estimated pork demand estimates, beef advertisement elasticities on pork demand, and the effects of advertising, health, lifestyles, visible fat, region, urbanization, race, age, income, and seasonality on pork demand. This study is unique in that it examined the non-price relationships between pork and beef; however, it didn't incorporate poultry.

Rickertsen (1998) estimated demand for food and beverages in Norway. Using an AIDS model with differenced and lagged differenced consumption data. The model included lagged expenditures shares for each equation in the model. Due to the nature of the model, Rickertsen could examine separability between the meats. This study used data that was "directly derived from the expenditures while the prices of some representative items have to be used with the disappearance data" (Rickertsen). While the data tried to address the meat aggregation issue, the meat variable incorporated all meats (beef, chicken, pork) as one variable. Thus, the price relationships found were only between "meats" and everything else. Rickertsen also included fish in his model, but "fish" was not specified as to what products they referenced.

Tonsor, Mintert and Schroeder (2010) estimated health concern effects on U.S. meat demand using a Rotterdam model and an iterative three- stage least squares model (IT3SLS) for the time period of 1982-2007. They incorporated unique information such as a FAFH (45%), female participation in the female work force, nutrient indices (zinc, iron, and protein), and an index for the Atkins diet. This study was one of the few that acknowledged that previous consumer demand studies had not incorporated the FAFH variable. The authors found similar price interactions as previous studies, but the unique finding revolved around the FAFH variable. The authors found that while FAFH expenditures benefited pork and chicken, they could not directly explain these findings, but hypothesized that this could be due to underlying menu changes. While the data used was quarterly aggregated data, the hypotheses of menu changes by restaurants, give validity to the idea of examining the meat price relationships in the wholesale markets where restaurants purchase their meat. The data used in this study covers part of the time period that Tonsor, Mintert and Schroeder analyzed (2003-2007), but with more data points as the data is weekly and disaggregated by primal cut.

Lemieux and Wohlgenant (1989) studied the impact of a new growth hormone in the pork industry. The authors used demand and supply elasticity estimates from a complete demand system model for pork, beef, and poultry in a linear elasticity model to examine demand change at the retail level for U.S. pork. The authors used aggregated hog prices in their model and indicate that prices would fall due to the technology increasing pork supply. While this study analyzes retail demand, the authors used an aggregated price for pork and derived demand estimates. Although this study provides insight to the demand changes for consumers, the use of aggregated prices and trade quantities has some issues because the U.S. doesn't export or import all pork cuts.

Eales and Unnevehr (1993) used an inverse AIDS model to investigate endogeneity prices and quantities of the U.S. meat system for the years 1962-1989. To test endogeneity for each meat market (pork, beef, and poultry), the authors estimated each species' price and quantity separately. Price and quantity were assumed predetermined in each model, respectively. The authors find that prices cannot be taken as predetermined in models, meaning that demand systems that include prices as predetermined lead to misspecification and could provide misleading parameter estimates. Eales and Unnevehr provide a foundation that price relationships can be investigated solely without supply being included into a model. The authors also find that structural changes found through AIDS models can be misleading because of supply shocks from producers provide the same estimates as a demand shift. These two findings allow for investigation of structural changes to be identified in the wholesale prices and also allows for price relationships to be investigated for the time periods that are each side of an identified structural change.

Kinnucan et al. (1997) offered a contradiction to Eales and Unnevehr. Kinnucan et al. used a Rotterdam model to investigate the advertising of health information and trend on meat demand. They concluded that structural change in the demand for poultry, beef and pork is occurring but that supply changes are occurring, as well. They determined that the effects of advertising are uncertain because of the supply and demand structural changes and that more investigation was needed.

A key factor that is addressed by both Eales and Unneverhr and Kinnucan et al. is that structural changes must be accounted for in modeling demand. Structural changes will change price relationships in demand.

Chavas (1983) used a linear model to identify structural changes in pork demand. By identifying structural changes, Chavas showed that an elasticity calculation without thought for structural change could yield bad results. Similarly, Braschler (1983) used a single equation demand system to arrive at the same result for the same time period as Chavas.

Brester and Schroder (1995) added to the meat demand literature by investigating a classic demand shifter, advertising. The authors added a unique feature by taking beef and pork and splitting the species into branded programs and non-branded categories for each species respectively. This would allow for meat demand to be investigated for branded and non-branded beef and pork in a Rotterdam model that included poultry. The authors conclude that demand for branded and non-branded products change when advertising for the meat categories occur. They also mention that although advertising is significant, its impact is smaller than the price elasticities of the respected meat categories. Brester and Schroder show that demand for branded programs differ. Which gives foundation to this study to include branded beef in our price relationship models.

Wholesale demand estimation has been investigated for beef, pork, and poultry (Funk, Meilke and Huff, 1977; Marion and Walker, 1978; Capps et al., 1994, Lusk et al., 2001), and lamb (Bryne, Capps, and Williams, 1993).

Funk, Meilke, and Huff (1977) was one of the earliest papers to go further up the supply chain from aggregated beef demand to more specified demand analysis. The authors investigated sup-primal cuts in the Toronto, Canada market. They utilized supermarket chains data to investigate demand for sub primal cuts of beef (bottom round roast, cross rib roast, eye of round roast, point sirloin roast, point sirloin steak, prime rib roast, rump roast, short rib roast, top round roast, shoulder roast, porterhouse steak, flank steak, rib steak, sirloin steak, wing steak, brisket, and minced beef, chuck, and round), aggregated lamb, and aggregated pork demand. They used a log-log OLS model that also included advertising for each species and dummy variables that accounted for each supermarket chain location. The authors find that demand analysis by individual cuts gives more insight to the effectiveness of advertising at the supermarket and that more research need to be pointed towards individual cuts. While some of these cuts are from the same primal (wholesale cut), the data represents the recognition that all cuts are not created equal.

Capps et al. (1994) estimated wholesale level elasticities for beef (ribeye, brisket, armbone chuck, knuckle, top inside round, bottom gooseneck, strip loin, top sirloin butt, full tenderloin, flank, fresh 50% ground beef and fresh 90% ground beef), chicken and pork. The authors used a double log functional form model in which monthly USDA prices were used and a supply function was formulated by the authors. Because, weekly national supply cold is difficult to formulate from a research standpoint, the authors were the first to estimate such quantities for beef. But, due to the beef supply aggregation, the authors couldn’t break down the beef into grades (Select, Choice and Prime). Another unique contribution to the literature was inclusion of ground beef and the finding that brisket and trimmings had positive cross-products flexibilities. They suggested that further research be done because of the positive cross price flexibility results.

Parcell (2003) investigated pork wholesale cut flexibilities and elasticities. Parcell used Seemingly Unrelated Regression models to estimate flexibilities and elasticities of pork loin, pork rib, Boston butt, ham, pork belly and picnic prices. The results indicated that elasticities and flexibility estimations were different than previous aggregated research. Another result was that there was no change in wholesale price associated with a quantity demanded change. These two findings led Parcell to suggest that future research should be done for each individual cut.

Using a dynamic model, Hahn and Green (2000) showed that retail and wholesale meat costs are jointly together. Meaning if costs increase or decrease in either sector of the supply chain, then the opposing sector does the same. They used Choice beef price, pork cutout, and a whole fryer price (chicken) in their model. Lagged prices were included in the time series model with the results that only lagged wholesale prices were significant. All species were modeled together, and the authors found that different lag lengths for each species. They recommended more research in the area of understanding the relationships of the wholesale market should be done.

Gardner (1975) examined the price transmission (farm-retail spread) for a competitive food market. While he includes other industries such as sweet potatoes, the basis of his model and study is that when using demand and supply for each market, elasticities can be generated for the demand at the retail level for each good (i.e. beef, pork, and chicken). By understanding price transmission, retailers, packers and producers can better adjust/plan for price swings. Gardner acknowledges and warns that while the theory is correct, aggregation of prices can be an issue for estimating elasticities. The same warning coincides with derived demand using scanner data pointed out by Taylor and Tonsor (2013) and Lensing and Purcell (2006).

When investigating demand, many of the above studies mentioned the need to incorporate structural changes. Moschini and Meilke (1989) used a traditional AIDS model to estimate structural change in U.S. meat demand. Boetel and Liu (2010) investigated structural breaks for the U.S. pork and beef prices. Using unit root tests and cointegration tests, the authors found evidence for 4 structural breaks for cattle (November 1975, July 1981, May 1993, and April 2001) and 3 structural breaks for hogs (October 1978, September 1987, and October 1997).

Similarly, Adachi and Liu (2009) used unit root tests to investigate structural breaks in the Japanese pork industry for the years (1967 to 2008) and identified four structural breaks. Additionally, Adachi and Liu used the time periods to conduct VAR models to forecast and simulate short run dynamics in the Japanese market.

Although demand literature is rich with the theory-based models, cointegration and causality of the proteins is relatively unexplored. Bessler and Akleman (1998) showed that cointegration can help explain causality between beef and pork markets via Directed Acyclic Graphs (DAGSs). They used time series techniques to analyze retail price spreads for pork and beef prices. Their model also included income, wage, gasoline, and CPI. They found that price variation in both meat markets are affected by farm level innovation. Although Bessler and Akleman didn't apply their study to the cuts of meat and aggregation could be a flaw in the price data, cointegration can still help explain directional impacts on cuts of meat prices at the wholesale level.

Tiffin and Dawson (2000) showed how cointegration can help explain links in the United Kingdom lamb industry. The authors used time series techniques to analyze causality of retail and farm level pricing for the UK lamb industry. They found that retail pricing Granger causes farm pricing, thus retail price drives farm pricing variability.

Investigation with cointegration could also reinvestigate separability (Eales and Unnevehr, 1988; Moschini, Moro, and Green 1994; Mutando and Henneberry, 2007) of the wholesale cuts.

The past meat demand studies mentioned in the literature review section have used traditional models (AIDS, Rotterdam, Hedonic, Price transmission) to estimate elasticities of proteins. The data that was used has been known to have aggregation flaws. This study can add to the meat demand literature, in particularly the wholesale meat demand literature, by taking a different approach. This study will utilize time series techniques in order to investigate relationships of pork primal cuts, trimmings and pork production.

Investigation with cointegration could also reinvestigate separability (Eales and Unnevehr, 1988; Moschini, Moro, and Green 1994; Mutando and Henneberry, 2007) of the pork primals.

In order to arrive at the DAGs this study will utilize Vector Autoregression (VAR) models that were popularized by Sims (1980). The advantage that Sims points out about VAR models, is that is “theory is not normalized” by the models. Accounting autocorrelation is crucial for estimating VAR models.

Past studies have used a times series models known as Vector Autoregression (VAR) models that were popularized by Sims (1980). A feature or added attribute to a VAR model is when structure is applied, known as a Structural VAR model (SVAR). These models have been used in analysis of finance, energy, and macro questions (Orden and Flackler,1989; Kim and Roubini, 2000; Cover, Enders, and Hueng, 2006; Cologni and Manera, 2008). These studies utilized the framework based on Sims and Zha (1995). Sims and Zha suggested a SVAR model to analyze the price puzzle in monetary policy. A key question of the price puzzle was the relationship of interest rates and the supply and demand of money. Previous research up to that point used VAR modeling to analyze the question. Sims and Zha showed that by including money supply and with contemporaneous restrictions that one could distinguish between supply shocks and demand shocks. Following the same logic, the models in this study will include a supply variable to tease out supply shocks and demand shocks. In all the above mentioned SVAR studies, ordering or identifying which variable has the highest causality is crucial for the first explanatory variable. This study will model pork production as the first explanatory variable, due to the supply of the primal cuts is strictly due to the amount of pork production each week.

This study utilizes Granger causality tests which is based on Granger (1969). The Granger tests is defined as follows; a variable x is said to “Granger cause” another variable y, if past lagged variables of x aid in the prediction of variable y. The Granger tests utilizes the null hypothesis that the summation of the estimated coefficients of lagged variable *x* are jointly zero. Through this test, relationships between variables can be estimated. Granger generalized in his study the difficulty in deciding direction of causality between two variables. He presented testable definitions on how variables can feed each other information (causality). His definitions allow for instantaneous causality to be rejected when using time series data. By using Granger causality tests, the results can provide a better understanding on how the pork cuts "feed" each other and provide analysis of the effect of supply on the primals.

4.3. Data & Methodology

The data consists of weekly prices and production from 2003-2019 from the Livestock Marketing Information Center (LMIC) and USDA. Each cut's percentage of the carcass weight is contained in figure 4.1 - Boston butt, picnic shoulder, loin, rib, belly, ham, production and trimmings.

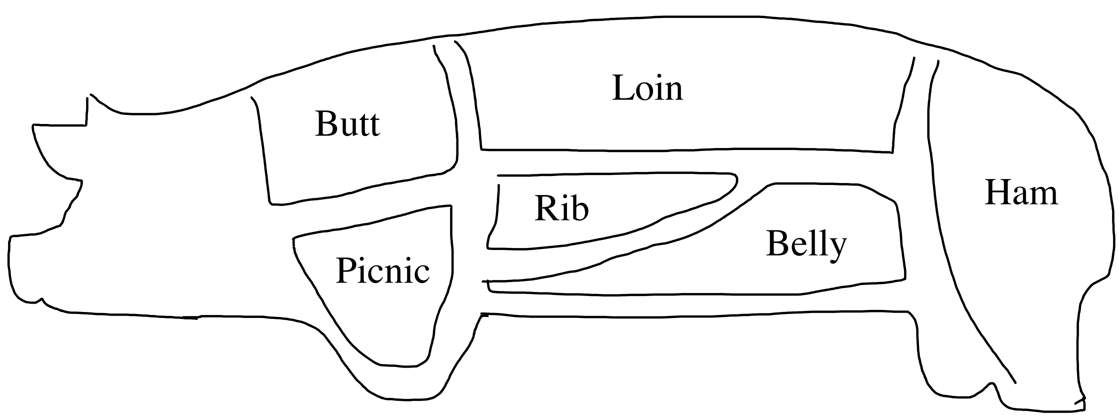

Figure 4.1 Pork Wholesale Cut Diagram

This study utilizes a Supremum Wald test in order to identify structural breaks in the time series data. Quandt (1960) proposed this test originally and it was applied and generalized by numerous studies (Andrews, 1993; Bai, 1993, Andrews and Ploberger, 1994; Vogelsang, 1997). The Supremum Wald tests for an unknown break date for estimates using symmetric trimming of 15% of the data series. Each supremum statistic is the maximum value obtained from a series of Wald tests that accounts for multiple breaks possibility points. The null hypothesis of no structural change in k coefficients is given by the following equation:

$$Supremum\ S_T = \sup_{b_1 \leq b \leq b_2} S_T(b) \tag{4.1}$$

where b denotes a possible break data in the range $[b_1, b_2]$ for a sample of size *T*. $S_T(b)$ is the Wald test statistic that's being evaluated at potentially date b (STATA, 2013). Once a break was detected, that data was then trimmed to that that period break. The process is continued until there is no structural break detected by the Supremum Wald test in the remining data set. Table 4.1 contains the structural breaks that were identified. When deciding which structural break dates to use for the pork models, all cuts except for the loin wholesale cut had a structural break in 2010. The loin cut had a structural break at the end of 2015 thus the study followed similar methodology of Bessler and Akleman and split the breaks into two time periods to cover both breaks.

Table 4.1 Identified Structural Breaks and Pork Time Periods

Period	Date	Date
1	4/11/03	4/16/10
2	4/23/10	11/6/15
3	11/13/15	9/22/17
4	9/29/17	2/8/19

Table 4.2 Descriptive Statistics for Each Pork Primal Cut by Time Period

Variable	Obs	Mean	Std. Dev.	Min	Max
Period 1 (4/11/03-4/16/10)					
Loin	366	82.62	10.06	64.43	115.97
Butt	366	67.71	10.50	44.12	102.91
Picnic	366	44.85	8.67	28.01	74.34
Rib	366	114.59	17.05	78.55	177.16
Ham	366	55.79	11.43	32.85	89.46
Belly	366	84.03	12.53	53.34	122.46
Production (millions of pounds)	366	408.23	49.08	288.90	502.80
Period 2 (4/23/10-11/6/15)					
Variable	Obs	Mean	Std. Dev.	Min	Max
Loin	289	100.00	13.54	79.90	146.32
Butt	289	97.77	18.04	73.73	151.75
Picnic	289	66.75	15.01	39.04	111.02
Rib	289	141.21	16.76	109.95	197.26
Ham	289	76.81	17.29	40.60	141.49
Belly	289	125.35	26.79	63.85	199.72
Production (millions of pounds)	289	440.05	33.67	348.00	500.10
Period 3 (11/13/15-9/22/17)					
Variable	Obs	Mean	Std. Dev.	Min	Max
Loin	97	80.72	7.32	65.52	96.10
Butt	97	89.58	11.27	71.34	110.60
Picnic	97	53.16	7.54	36.80	69.97
Rib	97	128.88	14.50	103.83	158.42
Ham	97	64.41	8.06	49.46	80.39
Belly	97	127.86	30.68	82.62	214.69
Production (millions of pounds)	97	476.05	32.77	360.10	539.60
Period 4 (9/29/17-2/8/19)					
Variable	Obs	Mean	Std. Dev.	Min	Max
Loin	72	73.06	5.09	62.63	84.84
Butt	72	90.35	8.25	70.45	113.29
Picnic	72	51.48	7.92	37.40	70.59
Rib	72	124.97	7.77	114.80	149.29
Ham	72	56.72	6.16	45.24	70.86
Belly	72	118.51	21.90	75.39	171.52
Production (millions of pounds)	72	507.42	36.26	407.90	583.60
Trimmings	72	60.0	10.21774	41.6	88.5

Table 4.2 contains the summary statistics for the variables for each identified time period. Price reporting for pork trimmings limits the amount of data points for these models, but this study did include pork trimmings as a variable in the fourth period

model. To exclude it altogether could lead to a biased estimate, as trimmings are an important ingredient for pork sausage and can come from any of the other cuts.

Once the structural breaks were identified, the necessary lag length estimation for the specified SVAR model for each period were identified.

To estimate the lag, *p,* for the SVAR models this study will use the same technique shown in Hamilton (1994)

$$\mathrm{LL} = \left(\frac{T}{2}\right)\left\{\ln\left(\left|\widehat{\Sigma^{-1}}\right|\right) - K\ln(2\pi) - K\right\} \tag{4.2}$$

where T is the number of observations, K is the number of equations, and $\hat{\Sigma}$ is the maximum likelihood estimate of $E\,[u_t u_t']$, where u_t is the K x 1 vector of disturbances. Since

$$\ln\left(\left|\widehat{\Sigma^{-1}}\right|\right) = -\ln\left(\left|\hat{\Sigma}\right|\right) \tag{4.3}$$

then the likelihood equation can be written as

$$\mathrm{LL} = \left(\frac{T}{2}\right)\left\{\ln\left(\left|\hat{\Sigma}\right|\right) + K\ln(2\pi) + K\right\} \tag{4.4}$$

which yields

$$\mathrm{LR}(j) = 2\{\mathrm{LL}(j) - \mathrm{LL}(j-1)\} \tag{4.5}$$

and allows LL(j) to be the value of the log likelihood with j lags and yields the LR statistic order j. Once LR stat is reached the lag estimation for that value is chosen, which is p or lag length needed for SVAR estimation. Table 4.3 contains the estimated lag length for the 4 periods.

Table 4.3 Pork Time Period Lag Estimations

Period	Lag Estimation
1	3
2	3
3	2
4	2

Results for the LR statistic also give information selection criteria stats (AIC, SBIC, HQIC). Lütkepohl (2005) showed the following information criterion equations are used for selection:

$$\text{AIC} = \ln(|\Sigma_u|) + \frac{2pK^2}{T} \tag{4.6}$$

$$\text{SBIC} = \ln(|\Sigma_u|) + \frac{\ln(T)}{T} pK^2 \tag{4.7}$$

$$\text{HQIC} = \ln(|\Sigma_u|) + \frac{2\ln\{\ln(T)\}}{T} pK^2 \tag{4.8}$$

This study follows Bessler and Akleman's information selection criterion. They used SBIC and HQIC as their selection criterions and if the tests differ in result, this study will choose parsimoniousness with the fewest suggested lagged prices.

The SVAR model follows the following equation:

$$A\left(I_K - A_1 - A_2L^2 - \cdots A_pL^p\right)y_t = A\epsilon_t = Be_t \tag{4.9}$$

where L is the selected lag estimation, A, B and $A_1, \ldots, A_p$ are K x K matrices are the parameters, ϵ_t is a K x 1 vector innovations with $\epsilon_t \sim N(0,\Sigma)$ and $E[e_t e_s'] = O_K$ for all s≠t, and e_t is an orthogonal K x 1 vector of innovations. Sims (1980) and Sims and Kha (1995) showed that a Cholesky matrix is needed in order to identify the casual relationships. Below is the SVAR model with an imposed Cholesky matrix.

$$\tilde{A}\left(I_K - A_1 - A_2L^2 - \cdots A_pL^p\right)y_t = \tilde{B}e_t \tag{4.10}$$

where $\tilde{A}$ is a lower triangular matrix with ones diagonally and $\tilde{B}$ is a diagonal matrix. P is a matrix and because $P_{sr} = \tilde{A}^{-1}\tilde{B}$, the estimate of $\hat{P}_{sr}$, which is obtained by plugging in estimates of $\tilde{A}$ and $\tilde{B}$, should equal the Cholesky decomposition of $\hat{\Sigma}$ (STATA, 2013). The Cholesky restrictions are

$$A = \begin{bmatrix} 1 & 0 & 0 \\ . & 1 & 0 \\ . & . & 1 \end{bmatrix} \; and \; B = \begin{bmatrix} . & 0 & 0 \\ 0 & . & 0 \\ 0 & 0 & . \end{bmatrix} \tag{4.11}$$

The A and B matrix in equation 4.11 has three variables. In this studies models, the restrictions will have 7 diagonals for the 7 variables of periods 1-3 and 8 diagonals for the 8 variables for the 4th period model. As mentioned earlier the ordering of the variables is crucial for the SVAR model, thus supply is first variable, as pork supply is divided into primal cuts. Trimmings are last in the order as trimmings are the excess product of the primal cuts or is the alternate of the primal cuts. The production data is reported weekly and is lagged for the time of slaughter to presentation for retail sale. Wright et al. (2005) showed that there was a two-week lag between harvest and wholesale transaction of the product between retailers and packers. This study lags production by two weeks.

4.4. Results

The results are presented as Directed Acyclic Graphs (DAG) in figures 4.2- 4.5. The Granger causal relationships are presented in two forms, one-way and two-way. One way is presented with a blue arrow going from one variable to another. This represents the one-way Granger causality in the DAGs. If two variable feed each other, then a red arrow (double headed) represents that two-way relationship in the DAG.

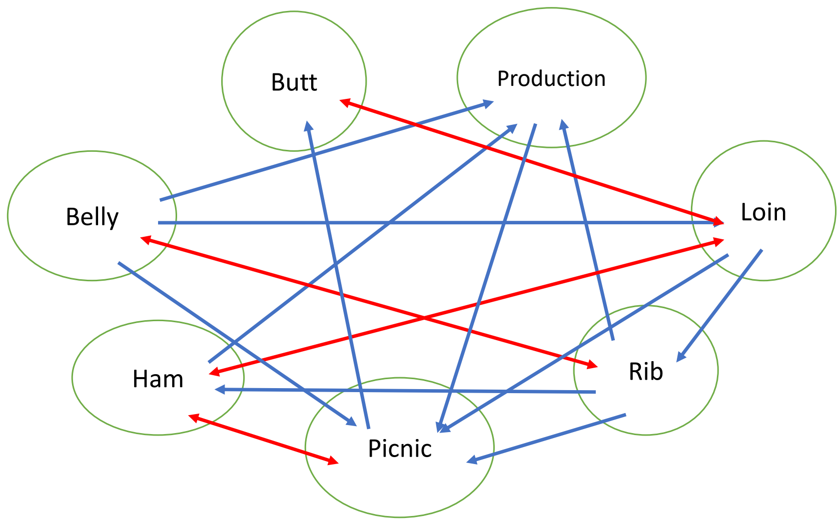

Figure 4.2 Period 1 (4/11/03-4/16/10), DAG Price Relationships between Primal Cuts

In period 1 (4/11/03-4/16/10) (figure 4.2) there were a lot of interactions between all cuts. Pork belly, picnic, and rib prices exhibited a Granger caused relationship with production. The two highest valued cuts (rib and belly prices) fed each other in a two-way relationship, implying that their prices affect each other. The loin had a two-way relationship with butt and ham. The ham also had a two-way relationship with the picnic. The butt primal cut price only had two interactions, while the other cuts had 4 or more interactions. The results imply a large amount of price interactions and, perhaps, substitutability between cuts.

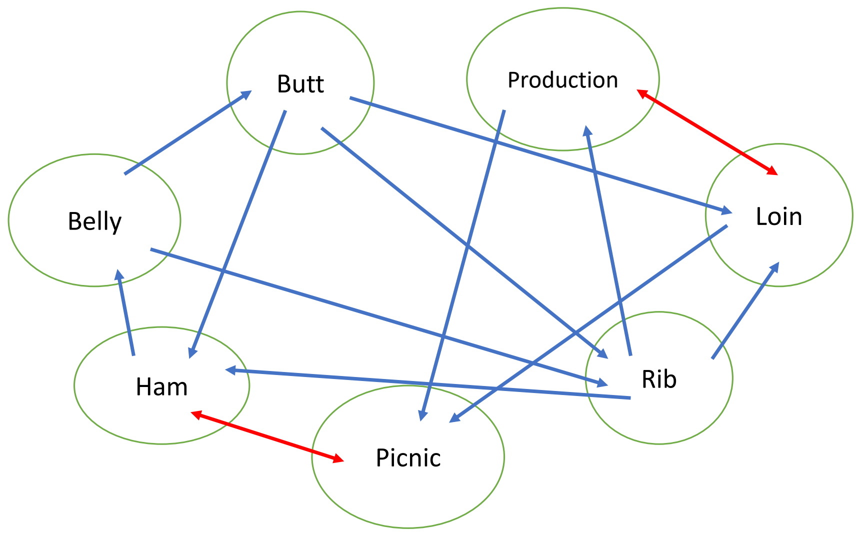

Figure 4.3 Period 2 (4/23/10-11/6/15), DAG Price Relationships between Primal Cuts

In period 2 (4/23/10-11/6/15) (figure 4.3) the amount of price interactions between cuts declined. Pork production increased during this time, but pork prices increased from the previous period. Pork production had no relationship with belly and ham prices. It maintained a price relationship with ribs and picnics and gained a two-way relationship with the loin. The butt primal picked up more price interactions. The two-way relationship between the ham and picnic remained. During this period the average price (table 4.2) of the rib increased by $0.26/lb., while the belly increased by $0.41/lb. Price increases could explain price interaction changes between cuts during this period. This time period included the Great Recession. Production was not found to Granger cause rib or belly price even though pork supply was higher during this time period. With supplies increasing and having no effect on bellies and ribs, the price increase shows strong indication of a demand change for these cuts. The increase of all prices for the pork industry could indicate that the effects of the demand increase was greater than the effects of supply production.

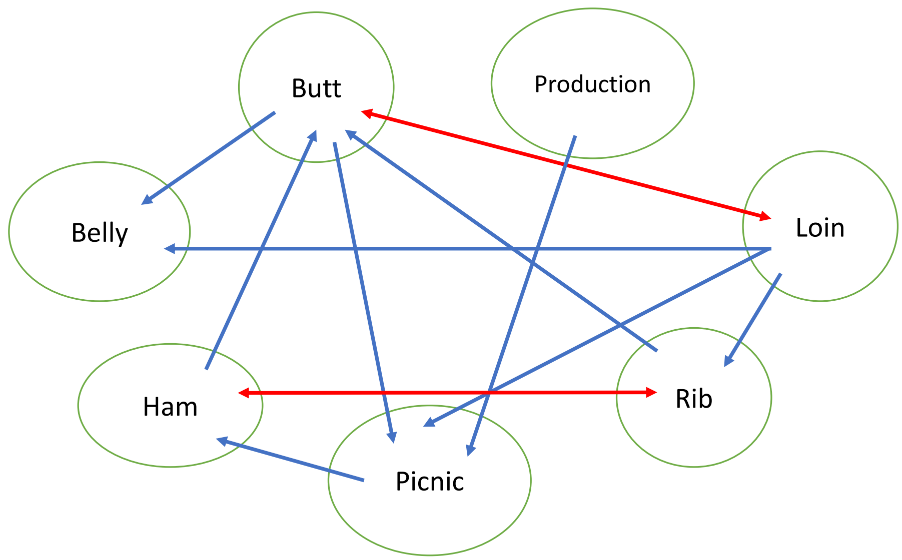

Figure 4.4 Period 3 (11/13/15-9/22/17), DAG Price Relationships between Primal Cuts

In period 3 (11/13/15-9/22/17) (figure 4.4) there were relatively the same amount of interactions, but in different ways. Weekly pork production (table 4.2) increased on average from 440.05 million pounds to 476.05 million pounds. Production also was found to have 1 interaction, with picnic prices. The supply increase would suggest that pork price should decrease. All the primal cut prices decreased except bellies. The average price increased by $.02/lb and belly prices were found to be Granger caused by the butt and loin. The increase brought the belly to just $.01/lb under the highest valued cut, the rib. This result could be evidence that demand for the belly kept holding strong and even increased between period 2 and 3. With the other cut's prices decreasing, ribs and hams picked up a two-way relationship, as well as the loin and butt.

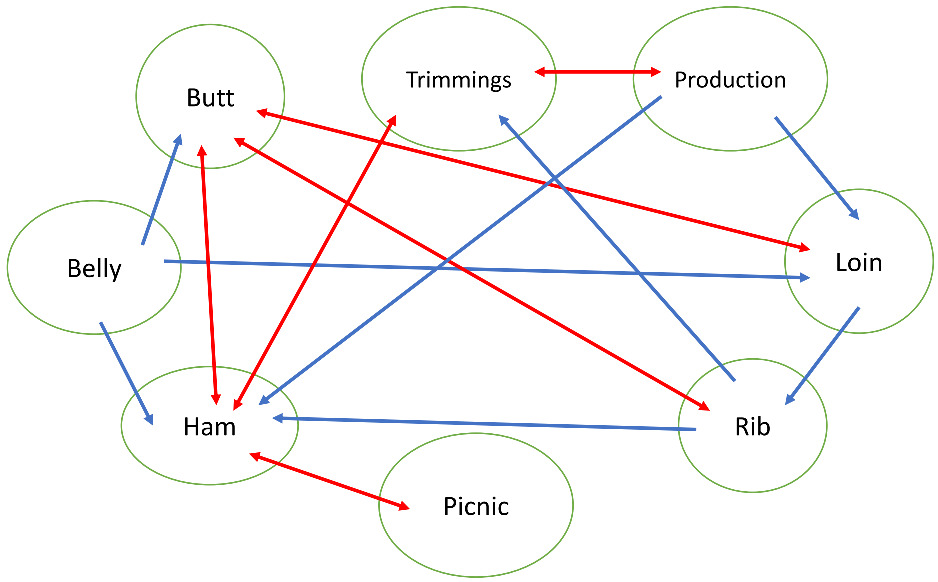

Figure 4.5 Period 4 (9/29/17-2/8/19), DAG Price Relationships between Primal Cuts

In period 4 (9/29/17-2/8/19) (figure 4.5), pork production continued to increase on a weekly average and gained a two-way relationship with the newly added trimmings variable. Trimmings were found to have a two-way relationship with ham prices. In this period, there more two-way relationships than any other period. This could indicate that with trimmings being added to the equation, relationships become stronger between two cuts that feed each other. During this time all the cuts besides the but decreased in price.

The butt increased by $0.007/lb., which isn't much of an increase. Between period 3 and 4, the butt price was the only cut that increased. But, the Boston butt went from few price interactions in period 1, to a cut that has 3 two-way relationships in period 4. There are some cuts that had constant price interactions over the four periods: picnic-ham, rib-loin, butt-ham, butt-loin, and butt-rib. In period 4, belly prices became a cut that wasn't Granger caused by any other cut. Supply was found to have no effect on belly prices, but the average belly price decreased over the period. meaning that the supply increase wasn't one of the causal reasons for the decrease.

4.5. Conclusions

This study found 3 structural breaks in the pork primal cuts since 2004, breaking the data set into four periods. Over the four periods the results indicate that there are interactions between cuts, but these interactions have changed over time. There are price relationships that have stayed in constant interaction over the four periods: picnic-ham, rib-loin, butt-ham, butt-loin, and butt-rib. In past literature, there have been very few studies that have identified structural breaks in pork prices, but there are even fewer studies that have identified structural breaks for the primal cuts during this time frame. By including the lagged pork production variable into our SVAR model, the study was able to examine the interaction of supply and the prices of the primal cuts. In periods 1-3, pork production was found to impact cut prices, and Granger cause the picnic, but that relationship disappeared, and a new price relationship emerged between production and the loin and trimmings in period 4.

Adding trimmings prices teased out stronger two-way relationships in period 4. The impact of trimmings was not surprising, as most lingering pieces of meat and excess product from the primal cuts after fabrication are marketed as trimmings through sausage production.

The relationships of bellies with other cuts was also found to have changed throughout the 4 periods. The belly has become a prominent primal cut on its own. This could be due to the “bacon” boom that has occurred in recent years. Since bellies have limited amount of retail cuts (minimum versatility), the supply of bellies could also theoretically, be a reason for the price change. Through the SVAR model and the inclusion of production, supplies were not found to directly Granger cause price changes. Prices increased in period 3 while production increased, and other prices decreased. This indicates that belly price increase was a result of growing demand. The introduction highlighted the increasing selection of value-added products from bacon. The increase of the value-added products brings more demand for bacon in all forms. This result means that the demand for bacon is driving the changes in belly prices at the wholesale level. Currently there are no other cuts that impact the price of belly, but the belly does impact other cuts. Further research in this area would be beneficial for the hog industry as there is not much research in belly meat demand.

The price relationships for the pork industry is critical to understanding demand. As mentioned in the introduction, there is growing evidence of weakening demand relationships between cuts. Weaker price relationships might take the form of smaller cross-price elasticities. Others have pointed to evidence of more consumer purchasing pattern changes as a factor for the changes. Our results coincide with this, especially for bacon as it is not Granger caused by supply, thus leaving demand as a driving factor. The results indicate that pork relationships have changed over time and much like structural breaks, changing relationships should be accounted for when analyzing meat demand for cuts. The relationships found from this study can aid in answering these changing relationship questions in future research.

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5. CONCLUSIONS

These essays covered multiple sectors of the livestock industry. The first essay established that weather, and average beginning weight of feeder cattle can affect shrink of cattle being shipped. The study also found that 44.7% of shrink variability of cattle can be explained by random events that occur on a given trip, such as a bad driver, traffic stops, construction, or breakdowns. Understanding these factors can aid both buyers and sellers of feeder cattle in estimating costs associated with transportation.

The second essay used primal cut prices for graded beef, pork, lamb, and poultry to establish relationships between cuts. The study identified structural breaks inside the whole sale meat market for each cut. Utilizing time periods that were established with the identified structural breaks, the study estimated Vector Autoregression (VAR) models that included all primal cuts for graded beef, pork, lamb, and poultry.

The study also estimated specie specific VAR models with identified structural breaks for beef, pork, lamb, and poultry.

By estimating larger and specie specific VAR models, the study could identify price relationship changes. Price relationships were found to have changed between cuts between periods. Four price relationship changes (foreshanks, prime flanks, pork bellies, and chicken breasts) from the large VAR models were discussed in the study. The specie specific models identified lamb rack, brisket, wing and belly prices to have some of the most changing of relationships.

Relationships identified in this study could be applied to structural models in future research.

By disaggregating each specie cutout value into primal cut prices, this study identified changing relationships and structural breaks for the study period. This study was the first to estimate relationships that included all 55 primal cuts from the 4 main species. Similar results and relationships for each species were found between the large all specie and specie specific models. The results indicate that relationships have changed over time and much like structural breaks, changing relationships should be accounted for when analyzing meat demand for cuts regardless of the species.

The third essay investigated the relationship of belly prices and other prices of primal cuts of pork, trimmings, and pork production. Utilizing a Structural Vector Autoregression model (SVAR) for identified structural breaks, the study showed that belly price relationships have changed over time with the other variables. Belly price had variables affect its price in a causal way in the early periods. In the last period, bellies were found to not have a casual effect from another variable. This suggests that bacon demand is carrying the belly price.

The results from these essays present findings that could be beneficial for stakeholders in their respective part of the supply chain in their industry. Understanding the factors and relationships discussed can aid in making better economic decisions for retailers, wholesalers, consultants, economists, and producers.

APPENDIX A

Table A.1 Granger Cause Variables

Wholesale Cut	Granger Cause Variable Period 1	p-value	Period 2	p-value	Period 3	p-value
ALegTrotterOff	Belly	0.088	Belly	0.063	Belly	0
	Butt	0.079	LegQuarters	0.036	Breast	0
	Ham	0	LoinTrimmed4x4	0.019	BreastBS	0.073
	Legs	0.019	Picnic	0.062	EFlankUntrimmed	0.03
	Loin	0.015	PrimalBrisketBR	0.063	FRSH90	0
	LoinTrimmed4x4	0.029	PrimalChuckPR	0.045	LegQuarters	0
	PrimalBrisketBR	0.001	PrimalChuckselect	0.001	LoinTrimmed4x4	0.045
	PrimalBrisketse~t	0.001	PrimalChuckUG	0.034	Neck	0.08
	PrimalFlankselect	0.097	PrimalFlankBR	0.093	Picnic	0.009
	PrimalLoinPR	0.031	PrimalLoinBR	0.085	PrimalBrisketUG	0.069
	PrimalRibBR	0.026	PrimalRibBR	0.004	PrimalChuckBR	0.029
	PrimalRibselect	0.005	PrimalRibCH	0.017	PrimalChuckselect	0.008
	PrimalRibUG	0.023	PrimalRoundBR	0.031	PrimalFlankUG	0.095
	Rack8RibMedium	0.014	PrimalShortPla~PR	0.033	PrimalLoinBR	0.037
	Rib	0.035	Rack8RibMedium	0.001	PrimalLoinCH	0.032
	ShouldersSquare~t	0.047	Thighs	0.064	PrimalLoinPR	0
	WingsWhole	0.001	WingsWhole	0.002	PrimalLoinselect	0.06
					PrimalLoinUG	0.089
					PrimalRibCH	0.069
					PrimalRibPR	0.089
					PrimalRibselect	0.043
					PrimalRibUG	0.003
					PrimalRoundBR	0.012
					PrimalRoundCH	0.051
					PrimalRoundUG	0.025
					PrimalShortPla~BR	0.017
					Rib	0.038
					ShouldersSquare~t	0.098
					Thighs	0.009
					WingsWhole	0.002
Wholesale Cut	Granger Cause Variable Period 1	p-value	Period 2	p-value	Period 3	p-value
Belly	FRSH90	0.064	PrimalShortPlat~H	0	EFlankUntrimmed	0
	LoinTrimmed4x4	0.063	PrimalChuckCH	0.001	Foreshank	0.094
	PrimalFlankPR	0.059	PrimalBrisketCH	0.002	Ham	0.078
	PrimalRoundselect	0.011	PrimalBrisketPR	0.002	LegQuarters	0.089
	Rack8RibMedium	0.059	PrimalShortPla~PR	0.009	Legs	0.025
			PrimalFlankUG	0.015	LoinTrimmed4x4	0
			PrimalLoinselect	0.018	Neck	0.087

Table A.1 Continued

Wholesale Cut	Granger Cause Variable Period 1	p-value	Period 2	p-value	Period 3	p-value
			PrimalChuckselect	0.019	Picnic	0.075
			PrimalFlankselect	0.025	PrimalBrisketBR	0
			PrimalChuckPR	0.045	PrimalBrisketse~t	0
			BreastBS	0.058	PrimalBrisketUG	0
			PrimalRoundPR	0.092	PrimalChuckBR	0.018
			PrimalRibCH	0.1	PrimalFlankBR	0.074
					PrimalFlankUG	0.018
					PrimalLoinPR	0.003
					PrimalRibCH	0.054
					PrimalRibPR	0.066
					PrimalRibselect	0.067
					Rack8RibMedium	0.091
					Rib	0.01
					ShouldersSquare~t	0.031
					WingsWhole	0.087

Wholesale Cut	Granger Cause Variable Period 1	p-value	Period 2	p-value	Period 3	p-value
Breast	PrimalLoinselect	0	Rack8RibMedium	0	Rack8RibMedium	0
	BreastBS	0	PrimalShortPlat~G	0	Belly	0
	ALegTrotterOff	0.005	Belly	0	PrimalRoundCH	0.004
	WingsWhole	0.007	FRSH90	0.001	PrimalChuckUG	0.006
	PrimalFlankBR	0.01	Butt	0.001	PrimalShortPla~PR	0.009
	PrimalRibPR	0.011	PrimalFlankBR	0.002	Loin	0.009
	PrimalLoinUG	0.015	Rib	0.003	PrimalShortPlat~G	0.011
	FRSH90	0.017	PrimalRibPR	0.007	PrimalLoinPR	0.016
	PrimalChuckBR	0.025	PrimalChuckselect	0.012	PrimalRibBR	0.017
	LegQuarters	0.034	Thighs	0.018	PrimalLoinUG	0.017
	Foreshank	0.067	PrimalFlankUG	0.039	Neck	0.02
	PrimalBrisketPR	0.072	ALegTrotterOff	0.041	ALegTrotterOff	0.024
	PrimalBrisketCH	0.074	PrimalFlankPR	0.043	Foreshank	0.037
	ShouldersSquare~t	0.093	LegQuarters	0.045	Butt	0.06
	Foreshank	0.012	EFlankUntrimmed	0.047	PrimalRibUG	0.061
	FRSH90	0.052	PrimalFlankCH	0.047	PrimalFlankBR	0.089
	LegQuarters	0.006	WingsWhole	0.073		
	Legs	0.026	PrimalBrisketBR	0.097		
	PrimalBrisketCH	0.003				
	PrimalBrisketPR	0.003				
	PrimalBrisketse~t	0.023				
	PrimalChuckBR	0.001				
	PrimalChuckCH	0.005				

Table A.1 Continued

Wholesale Cut	Granger Cause Variable Period 1	p-value	Period 2	p-value	Period 3	p-value
	PrimalChuckPR	0.005				
	PrimalRibPR	0.068				
	PrimalRibselect	0.076				
	PrimalRoundBR	0.078				
	PrimalRoundCH	0.049				
	PrimalRoundPR	0.037				
	PrimalRoundselect	0.016				
	PrimalRoundUG	0.06				
	Rib	0.012				
	WingsWhole	0.025				
Wholesale Cut	Granger Cause Variable Period 1	p-value	Period 2	p-value	Period 3	p-value
BreastBS	*	*	Rib	0.001	Butt	0.037
	*	*	PrimalRoundUG	0.002	EFlankUntrimmed	0.075
	*	*	PrimalLoinselect	0.003	Loin	0.084
	*	*	ShouldersSquare~t	0.032	PrimalBrisketCH	0.09
	*	*	LoinTrimmed4x4	0.032	PrimalBrisketse~t	0.001
	*	*	PrimalRoundselect	0.032	PrimalChuckUG	0.064
	*	*	Thighs	0.042	PrimalLoinUG	0.01
	*	*	ALegTrotterOff	0.053	PrimalRibCH	0.025
	*	*	Picnic	0.055	PrimalRoundUG	0.006
	*	*	PrimalFlankselect	0.086	ShouldersSquare~t	0.036
			PrimalRoundPR	0.093		
Wholesale Cut	Granger Cause Variable Period 1	p-value	Period 2	p-value	Period 3	p-value
Butt	ALegTrotterOff	0.071	PrimalLoinBR	0	Belly	0
	Breast	0.006	FRSH90	0.001	Breast	0.004
	EFlankUntrimmed	0.086	PrimalRibselect	0.001	BreastBS	0.011
	Loin	0.001	LegQuarters	0.001	Foreshank	0.002
	Picnic	0.003	PrimalChuckselect	0.003	Ham	0.006
	PrimalBrisketBR	0.004	Thighs	0.003	Loin	0.001
	PrimalBrisketse~t	0.014	PrimalLoinUG	0.005	Neck	0.088
	PrimalBrisketUG	0.001	BreastBS	0.009	PrimalBrisketse~t	0.002
	PrimalChuckCH	0.065	PrimalLoinPR	0.013	PrimalChuckBR	0.025
	PrimalChuckPR	0.063	LoinTrimmed4x4	0.018	PrimalLoinBR	0.099
	PrimalChuckselect	0.002	PrimalLoinselect	0.02	PrimalRibPR	0.001
	PrimalChuckUG	0.004	Ham	0.02	PrimalRibselect	0.026
	PrimalFlankCH	0.011	PrimalShortPlat~t	0.021	PrimalRoundBR	0.008
	PrimalFlankPR	0.005	Breast	0.026	PrimalRoundCH	0.053
	PrimalFlankUG	0.023	PrimalBrisketUG	0.032	PrimalRoundPR	0.017

Table A.1 Continued

Wholesale Cut	Granger Cause Variable Period 1	p-value	Period 2	p-value	Period 3	p-value
	PrimalLoinselect	0.035	Neck	0.04	PrimalRoundUG	0.048
	PrimalRibPR	0.054	ALegTrotterOff	0.044	Rib	0.006
	PrimalRibUG	0.084	PrimalRibUG	0.059	WingsWhole	0.002
	PrimalRoundCH	0.034	PrimalRoundUG	0.062		
	PrimalRoundPR	0.029	Rib	0.067		
	Rack8RibMedium	0.093	PrimalChuckBR	0.073		
	Thighs	0.001				
	WingsWhole	0.004				
Wholesale Cut	Granger Cause Variable Period 1	p-value	Period 2	p-value	Period 3	p-value
EFlankUntrimmed	PrimalRibCH	0.002	Breast	0	ALegTrotterOff	0
	Rack8RibMedium	0.006	PrimalBrisketUG	0.023	PrimalLoinUG	0
	PrimalRibPR	0.006	Belly	0.037	Belly	0
	PrimalLoinselect	0.021	Thighs	0.053	PrimalLoinselect	0.001
	ALegTrotterOff	0.023	PrimalRibCH	0.064	PrimalLoinBR	0.001
	PrimalRoundselect	0.026	PrimalLoinUG	0.068	BreastBS	0.001
	Foreshank	0.035	PrimalBrisketBR	0.076	WingsWhole	0.001
	PrimalChuckUG	0.06	ALegTrotterOff	0.08	Neck	0.002
	PrimalRoundCH	0.068	Rib	0.086	Rib	0.006
	Breast	0.069	PrimalLoinselect	0.09	Foreshank	0.008
	PrimalRoundPR	0.069	LoinTrimmed4x4	0.092	PrimalRibselect	0.009
	PrimalBrisketse~t	0.084	Picnic	0.095	ShouldersSquare~t	0.011
			PrimalFlankPR	0.1	Breast	0.018
					PrimalRoundselect	0.024
					PrimalRoundCH	0.026
					PrimalLoinCH	0.029
					PrimalShortPla~PR	0.046
					PrimalShortPlat~G	0.046
					Legs	0.059
Wholesale Cut	Granger Cause Variable Period 1	p-value	Period 2	p-value	Period 3	p-value
Foreshank	Ham	0.002	ALegTrotterOff	0	Belly	0.009
	PrimalRibPR	0.005	PrimalRoundselect	0	LoinTrimmed4x4	0.017
	PrimalBrisketCH	0.013	WingsWhole	0	PrimalBrisketUG	0.034
	PrimalBrisketPR	0.013	ShouldersSquare~t	0.001	PrimalChuckUG	0.035
	Legs	0.017	Rack8RibMedium	0.002	PrimalRoundPR	0.087
	Belly	0.025	PrimalRibBR	0.002		
	PrimalLoinPR	0.034	BreastBS	0.002		

Table A.1 Continued

Wholesale Cut	Granger Cause Variable Period 1	p-value	Period 2	p-value	Period 3	p-value
	Neck	0.05	Thighs	0.002		
	PrimalLoinUG	0.063	LegQuarters	0.003		
	PrimalChuckCH	0.079	PrimalChuckUG	0.004		
	PrimalRibUG	0.086	Breast	0.012		
	PrimalChuckPR	0.088	EFlankUntrimmed	0.012		
			PrimalRoundCH	0.014		
			PrimalRibCH	0.015		
			PrimalRoundPR	0.02		
			PrimalShortPlat~H	0.021		
			PrimalChuckselect	0.026		
			PrimalRoundBR	0.03		
			Legs	0.055		
			Picnic	0.072		
			PrimalLoinUG	0.079		
			PrimalBrisketse~t	0.08		
			PrimalShortPla~PR	0.093		

Wholesale Cut	Granger Cause Variable Period 1	p-value	Period 2	p-value	Period 3	p-value
FRSH90	PrimalChuckUG	0.002	PrimalRoundselect	0.002	PrimalLoinPR	0
	Loin	0.002	Neck	0.006	PrimalRibCH	0.001
	Picnic	0.002	PrimalChuckBR	0.012	Thighs	0.001
	Thighs	0.002	WingsWhole	0.013	Picnic	0.003
	Butt	0.015	Butt	0.025	Rib	0.003
	Foreshank	0.017	PrimalShortPlat~G	0.038	PrimalRoundBR	0.006
	PrimalRibUG	0.018	PrimalRibUG	0.042	PrimalFlankBR	0.011
	ShouldersSquare~t	0.021	PrimalRoundUG	0.043	ALegTrotterOff	0.015
	WingsWhole	0.026	Rib	0.046	Foreshank	0.016
	PrimalChuckBR	0.041	PrimalShortPlat~H	0.08	PrimalRibPR	0.018
	Legs	0.045	PrimalLoinBR	0.082	PrimalLoinBR	0.019
	LegQuarters	0.05	EFlankUntrimmed	0.095	Belly	0.019
	PrimalFlankCH	0.064			PrimalRoundUG	0.039
	EFlankUntrimmed	0.066			PrimalRibUG	0.046
	PrimalRoundUG	0.066			EFlankUntrimmed	0.05
	PrimalFlankBR	0.08			LoinTrimmed4x4	0.067
	PrimalFlankUG	0.083			WingsWhole	0.067
					Legs	0.07
					PrimalChuckselect	0.088
					PrimalLoinUG	0.093
					PrimalFlankPR	0.094

Table A.1 Continued

Wholesale Cut	Granger Cause Variable Period 1	p-value	Period 2	p-value	Period 3	p-value
Ham	Belly	0.039	PrimalFlankselect	0	Breast	0
	Breast	0.002	PrimalRibUG	0	LegQuarters	0
	Butt	0.076	PrimalLoinUG	0	Picnic	0.076
	Foreshank	0.025	PrimalFlankUG	0	PrimalBrisketBR	0.077
	LegQuarters	0.096	PrimalChuckPR	0.001	PrimalBrisketCH	0.045
	Loin	0	LegQuarters	0.001	PrimalBrisketPR	0.071
	LoinTrimmed4x4	0.01	PrimalRibselect	0.002	PrimalFlankBR	0.081
	Picnic	0.002	PrimalLoinPR	0.003	PrimalFlankCH	0.015
	PrimalBrisketse~t	0.01	Belly	0.007	PrimalFlankPR	0.002
	PrimalChuckUG	0.027	PrimalRibPR	0.008	PrimalLoinBR	0.05
	PrimalFlankBR	0.016	Loin	0.012	PrimalLoinCH	0.013
	PrimalFlankselect	0.058	EFlankUntrimmed	0.017	PrimalRoundPR	0.053
	PrimalLoinPR	0.025	PrimalRoundUG	0.017	PrimalRoundselect	0.005
	PrimalRibPR	0.02	PrimalFlankPR	0.021	WingsWhole	0.004
	PrimalRibUG	0.065	Legs	0.022		
	PrimalRoundselect	0.005	PrimalChuckUG	0.024		
	PrimalRoundUG	0.082	PrimalShortPla~PR	0.032		
	Rack8RibMedium	0.021	PrimalShortPlat~H	0.04		
	Rib	0.008	PrimalFlankCH	0.044		
	ShouldersSquare~t	0.099	PrimalBrisketUG	0.045		
	WingsWhole	0.064	PrimalRoundBR	0.048		
			ShouldersSquare~t	0.085		
			LoinTrimmed4x4	0.088		
			Thighs	0.091		
			Neck	0.094		

Wholesale Cut	Granger Cause Variable Period 1	p-value	Period 2	p-value	Period 3	p-value
LegQuarters	BreastBS	0.01	Legs	0	Belly	0.004
	EFlankUntrimmed	0.011	PrimalChuckPR	0.001	EFlankUntrimmed	0.047
	Ham	0.077	Thighs	0.004	LoinTrimmed4x4	0.055
	Legs	0	ShouldersSquare~t	0.009	Neck	0.099
	PrimalChuckBR	0	Picnic	0.026	PrimalBrisketse~t	0.038
	PrimalChuckselect	0.01	PrimalShortPla~PR	0.043	PrimalChuckCH	0.067
	PrimalChuckUG	0.097	PrimalLoinUG	0.056	PrimalChuckPR	0.027
	PrimalFlankBR	0	PrimalShortPlat~t	0.079	PrimalLoinBR	0.011
	PrimalFlankCH	0.044			PrimalLoinCH	0.001
	PrimalFlankPR	0.055			PrimalLoinselect	0.002
	PrimalLoinBR	0.058			PrimalRibCH	0.012
	PrimalLoinselect	0.07			PrimalRibselect	0.001

Table A.1 Continued

Wholesale Cut	Granger Cause Variable Period 1	p-value	Period 2	p-value	Period 3	p-value
	PrimalLoinUG	0.029			PrimalRoundCH	0
	PrimalRoundBR	0.062			PrimalRoundPR	0
	PrimalRoundCH	0.014			PrimalRoundselect	0.028
	PrimalRoundPR	0.013			PrimalShortPla~BR	0.008
	Thighs	0.005			WingsWhole	0
Wholesale Cut	Granger Cause Variable Period 1	p-value	Period 2	p-value	Period 3	p-value
Legs	Belly	0.056	Belly	0	ALegTrotterOff	0.001
	Ham	0.047	LegQuarters	0	Belly	0.012
	LegQuarters	0	PrimalBrisketse~t	0.001	Foreshank	0.029
	LoinTrimmed4x4	0.073	PrimalShortPla~PR	0.002	FRSH90	0.011
	Neck	0.055	LoinTrimmed4x4	0.005	LegQuarters	0
	PrimalBrisketse~t	0.1	PrimalChuckPR	0.006	PrimalBrisketse~t	0
	PrimalChuckselect	0.075	Rack8RibMedium	0.007	PrimalChuckBR	0.008
	PrimalFlankBR	0.007	Thighs	0.011	PrimalChuckselect	0.068
	PrimalFlankselect	0.087	PrimalFlankUG	0.023	PrimalChuckUG	0.027
	PrimalFlankUG	0.083	Foreshank	0.025	PrimalFlankUG	0.018
	PrimalRoundUG	0.062	PrimalChuckBR	0.033	PrimalLoinBR	0.044
			PrimalShortPlat~t	0.035	PrimalLoinCH	0.043
			WingsWhole	0.035	PrimalRibBR	0.096
			PrimalLoinselect	0.037	Thighs	0.04
			PrimalChuckCH	0.041	WingsWhole	0.047
			PrimalShortPlat~H	0.072		
			PrimalLoinUG	0.092		
			PrimalChuckselect	0.093		
Wholesale Cut	Granger Cause Variable Period 1	p-value	Period 2	p-value	Period 3	p-value
Loin	Belly	0	Neck	0	Belly	0.004
	Breast	0.077	PrimalFlankBR	0.002	BreastBS	0.057
	BreastBS	0.091	FRSH90	0.003	Foreshank	0.002
	Butt	0.092	PrimalRoundUG	0.007	Ham	0.03
	PrimalBrisketUG	0.012	PrimalChuckselect	0.012	Legs	0.001
	PrimalChuckCH	0.072	PrimalFlankPR	0.017	PrimalBrisketBR	0.078
	PrimalChuckPR	0.067	PrimalFlankCH	0.02	PrimalBrisketse~t	0.012
	PrimalFlankBR	0.009	Ham	0.024	PrimalChuckBR	0.093
	PrimalFlankCH	0.008	PrimalLoinPR	0.026	PrimalChuckselect	0.039
	PrimalFlankPR	0.019	PrimalFlankUG	0.026	PrimalFlankUG	0.09
	PrimalFlankselect	0.039	Thighs	0.026	PrimalLoinBR	0.037

Table A.1 Continued

Wholesale Cut	Granger Cause Variable Period 1	p-value	Period 2	p-value	Period 3	p-value
	PrimalRibPR	0.049	PrimalChuckCH	0.049	PrimalRibBR	0.03
	PrimalRoundCH	0.02	PrimalRoundselect	0.066	PrimalRibCH	0.015
	PrimalRoundPR	0.016	PrimalBrisketse~t	0.075	PrimalRibPR	0.092
	PrimalRoundselect	0.034	PrimalLoinCH	0.075	PrimalRibUG	0.081
	Rib	0.014	PrimalLoinBR	0.08	PrimalRoundBR	0
			Belly	0.086	PrimalRoundselect	0
			PrimalShortPlat~t	0.09	PrimalShortPla~PR	0.004
					PrimalShortPlat~G	0.002
					ShouldersSquare~t	0.009
					WingsWhole	0

Wholesale Cut	Granger Cause Variable Period 1	p-value	Period 2	p-value	Period 3	p-value
LoinTrimmed4x4	PrimalRibselect	0	PrimalRibPR	0	PrimalRibCH	0
	Rib	0	PrimalLoinPR	0	PrimalFlankCH	0
	PrimalFlankCH	0.003	LegQuarters	0.001	PrimalFlankPR	0
	PrimalFlankPR	0.006	Butt	0.004	PrimalRibBR	0
	Loin	0.01	PrimalRoundCH	0.009	WingsWhole	0
	FRSH90	0.015	PrimalRibselect	0.01	BreastBS	0.002
	LegQuarters	0.02	PrimalLoinCH	0.011	Rack8RibMedium	0.004
	PrimalRibUG	0.021	PrimalRoundPR	0.012	EFlankUntrimmed	0.004
	ShouldersSquare~t	0.023	Rack8RibMedium	0.016	ALegTrotterOff	0.004
	Rack8RibMedium	0.031	Legs	0.018	Picnic	0.005
	PrimalLoinBR	0.037	PrimalFlankUG	0.033	Belly	0.005
	Breast	0.046	PrimalFlankCH	0.04	PrimalRoundUG	0.008
	PrimalRoundBR	0.048	PrimalFlankPR	0.067	PrimalBrisketCH	0.015
	Neck	0.083	PrimalChuckBR	0.079	Thighs	0.016
			Thighs	0.093	PrimalBrisketPR	0.031
					PrimalRoundCH	0.043
					PrimalChuckselect	0.062

Wholesale Cut	Granger Cause Variable Period 1	p-value	Period 2	p-value	Period 3	p-value
Neck	EFlankUntrimmed	0.001	PrimalChuckBR	0.008	PrimalFlankselect	0.001
	PrimalRoundselect	0.002	PrimalBrisketPR	0.009	PrimalRibselect	0.006
	PrimalLoinCH	0.007	PrimalFlankUG	0.009	Rack8RibMedium	0.009
	Breast	0.013	EFlankUntrimmed	0.013	ALegTrotterOff	0.011
	PrimalLoinBR	0.014	PrimalBrisketCH	0.014	PrimalChuckBR	0.017
	PrimalChuckBR	0.017	Breast	0.031	PrimalRoundCH	0.023
	PrimalRoundUG	0.035	PrimalLoinselect	0.033	Rib	0.025

Table A.1 Continued

Wholesale Cut	Granger Cause Variable Period 1	p-value	Period 2	p-value	Period 3	p-value
	WingsWhole	0.041	PrimalBrisketUG	0.043	Foreshank	0.053
	PrimalRibCH	0.05	ShouldersSquare~t	0.057	Breast	0.054
	PrimalBrisketUG	0.054	LoinTrimmed4x4	0.057	ShouldersSquare~t	0.056
	PrimalChuckselect	0.062	PrimalRoundBR	0.099	PrimalRoundPR	0.062
	PrimalFlankBR	0.065			PrimalBrisketUG	0.064
	PrimalBrisketBR	0.07			PrimalLoinUG	0.07
	Legs	0.098			PrimalLoinselect	0.071
					EFlankUntrimmed	0.087
Wholesale Cut	Granger Cause Variable Period 1	p-value	Period 2	p-value	Period 3	p-value
Picnic	Belly	0.001	Ham	0	EFlankUntrimmed	0.06
	Breast	0.07	PrimalFlankselect	0.011	Foreshank	0.019
	Ham	0.001	ALegTrotterOff	0.015	Legs	0.006
	Legs	0.07	Belly	0.017	Loin	0.001
	Loin	0.068	PrimalRibPR	0.03	PrimalBrisketUG	0.004
	Neck	0.005	PrimalFlankUG	0.036	PrimalChuckBR	0.001
	PrimalBrisketCH	0.009	Breast	0.05	PrimalFlankUG	0.051
	PrimalBrisketPR	0.009	Loin	0.052	PrimalLoinBR	0.027
	PrimalBrisketUG	0.082	PrimalFlankPR	0.066	PrimalLoinselect	0.009
	PrimalChuckCH	0.003	PrimalBrisketUG	0.078	PrimalRibCH	0.049
	PrimalChuckPR	0.003	PrimalRoundBR	0.088	PrimalRibselect	0.001
	PrimalChuckUG	0.014	PrimalChuckselect	0.09	PrimalRibUG	0.072
	PrimalFlankBR	0.021	Thighs	0.098	PrimalRoundBR	0.002
	PrimalFlankCH	0.054			PrimalRoundPR	0.076
	PrimalFlankPR	0.016			PrimalShortPla~BR	0.005
	PrimalLoinBR	0.091			ShouldersSquare~t	0.018
	PrimalLoinselect	0.069			WingsWhole	0
	PrimalLoinUG	0.075				
	PrimalRibCH	0.01				
	PrimalRibPR	0.007				
	PrimalShortPlat~H	0.011				
	PrimalShortPlat~t	0.011				
	Rack8RibMedium	0.005				
	Rib	0.025				
Wholesale Cut	Granger Cause Variable Period 1	p-value	Period 2	p-value	Period 3	p-value
PrimalBrisketBR	Breast	0.096	PrimalChuckCH	0	Belly	0.017
	BreastBS	0.005	PrimalChuckPR	0	Breast	0.009

Table A.1 Continued

Wholesale Cut	Granger Cause Variable Period 1	p-value	Period 2	p-value	Period 3	p-value
	Foreshank	0	PrimalLoinBR	0	BreastBS	0.012
	FRSH90	0.008	PrimalBrisketCH	0.002	Foreshank	0.014
	Ham	0.044	Butt	0.002	Legs	0.037
	LoinTrimmed4x4	0	PrimalBrisketPR	0.003	Loin	0.004
	Picnic	0	Rib	0.004	LoinTrimmed4x4	0.021
	PrimalBrisketse~t	0.02	PrimalChuckselect	0.007	Picnic	0.014
	PrimalChuckBR	0.003	FRSH90	0.01	PrimalBrisketUG	0
	PrimalChuckCH	0.019	PrimalRibselect	0.015	PrimalChuckCH	0.042
	PrimalChuckPR	0.018	PrimalBrisketUG	0.021	PrimalChuckPR	0.01
	PrimalChuckselect	0.018	PrimalRibUG	0.046	PrimalChuckselect	0.035
	PrimalChuckUG	0	Breast	0.048	PrimalFlankBR	0.015
	PrimalFlankselect	0.078	ALegTrotterOff	0.051	PrimalLoinCH	0.041
	PrimalLoinBR	0.099	PrimalChuckBR	0.061	PrimalLoinPR	0
	PrimalLoinCH	0.006	PrimalShortPlat~G	0.074	PrimalLoinUG	0.008
	PrimalLoinPR	0.001			PrimalRibCH	0.091
	PrimalLoinUG	0.072			PrimalRibUG	0.06
	PrimalRibPR	0			PrimalRoundBR	0.001
	PrimalRoundCH	0.089			Rack8RibMedium	0.055
	PrimalRoundPR	0.1			WingsWhole	0.056
	PrimalRoundUG	0.044				
	Rack8RibMedium	0.019				
	WingsWhole	0.023				

Wholesale Cut	Granger Cause Variable Period 1	p-value	Period 2	p-value	Period 3	p-value
PrimalBrisketCH	PrimalFlankselect	0.001	WingsWhole	0.001	FRSH90	0
	PrimalRoundUG	0.001	PrimalChuckCH	0.002	PrimalLoinPR	0
	PrimalLoinPR	0.003	PrimalBrisketBR	0.002	PrimalRoundBR	0
	PrimalBrisketse~t	0.004	PrimalChuckPR	0.006	PrimalBrisketBR	0
	PrimalRoundBR	0.005	ALegTrotterOff	0.016	PrimalRibUG	0
	PrimalChuckPR	0.007	PrimalLoinBR	0.017	Belly	0
	PrimalChuckCH	0.008	PrimalChuckselect	0.03	Neck	0.001
	Ham	0.01	BreastBS	0.031	BreastBS	0.001
	Picnic	0.015	PrimalLoinselect	0.033	PrimalBrisketUG	0.008
	Breast	0.016	PrimalRibPR	0.034	Picnic	0.008
	PrimalChuckBR	0.017	PrimalShortPlat~t	0.038	EFlankUntrimmed	0.013
	PrimalLoinCH	0.019	PrimalRibUG	0.04	PrimalRoundselect	0.019
	PrimalChuckUG	0.028	FRSH90	0.046	WingsWhole	0.024
	PrimalBrisketPR	0.033	PrimalRoundCH	0.055	PrimalLoinselect	0.027
	PrimalRibPR	0.036	PrimalRibBR	0.056	PrimalChuckBR	0.041

Table A.1 Continued

Wholesale Cut	Granger Cause Variable Period 1	p-value	Period 2	p-value	Period 3	p-value
	PrimalLoinBR	0.038	PrimalBrisketUG	0.058	PrimalFlankBR	0.046
	ALegTrotterOff	0.047	Rack8RibMedium	0.077	PrimalChuckCH	0.052
	Neck	0.05	Breast	0.087	PrimalChuckUG	0.052
					PrimalLoinUG	0.064
					PrimalChuckselect	0.071
					Butt	0.072

Wholesale Cut	Granger Cause Variable Period 1	p-value	Period 2	p-value	Period 3	p-value
PrimalBrisketPR	ALegTrotterOff	0.048	PrimalBrisketCH	0	Belly	0
	Breast	0.017	PrimalBrisketCH	0	BreastBS	0.002
	Ham	0.009	PrimalChuckCH	0.002	Butt	0.065
	Neck	0.051	WingsWhole	0.002	EFlankUntrimmed	0.014
	Picnic	0.016	PrimalChuckCH	0.002	FRSH90	0
	PrimalBrisketCH	0.032	WingsWhole	0.002	Neck	0.001
	PrimalBrisketse~t	0.004	PrimalBrisketBR	0.003	Picnic	0.005
	PrimalChuckBR	0.019	PrimalBrisketBR	0.003	PrimalBrisketBR	0
	PrimalChuckCH	0.007	ALegTrotterOff	0.016	PrimalBrisketUG	0.008
	PrimalChuckPR	0.006	ALegTrotterOff	0.016	PrimalChuckBR	0.036
	PrimalChuckUG	0.027	PrimalLoinBR	0.02	PrimalChuckCH	0.05
	PrimalFlankselect	0.001	PrimalLoinBR	0.02	PrimalChuckselect	0.054
	PrimalLoinBR	0.031	PrimalChuckPR	0.028	PrimalChuckUG	0.049
	PrimalLoinCH	0.015	PrimalChuckPR	0.028	PrimalFlankBR	0.044
	PrimalLoinPR	0.003	PrimalChuckselect	0.036	PrimalLoinPR	0
	PrimalRibPR	0.037	PrimalChuckselect	0.036	PrimalLoinselect	0.039
	PrimalRoundBR	0.005	PrimalLoinselect	0.039	PrimalLoinUG	0.051
	PrimalRoundUG	0.001	PrimalLoinselect	0.039	PrimalRibBR	0.058
			PrimalShortPlat~t	0.04	PrimalRibUG	0
			PrimalShortPlat~t	0.04	PrimalRoundBR	0
			FRSH90	0.041	PrimalRoundselect	0.016
			FRSH90	0.041	ShouldersSquare~t	0
			PrimalRibUG	0.042	WingsWhole	0.019
			PrimalRibUG	0.042		
			PrimalRibPR	0.044		
			PrimalRibPR	0.044		
			PrimalRoundCH	0.046		
			PrimalRibBR	0.046		
			PrimalRoundCH	0.046		
			PrimalRibBR	0.046		
			BreastBS	0.047		

Table A.1 Continued

Wholesale Cut	Granger Cause Variable Period 1	p-value	Period 2	p-value	Period 3	p-value
			BreastBS	0.047		
			PrimalBrisketUG	0.057		
			PrimalBrisketUG	0.057		
			Breast	0.064		
			Breast	0.064		
			Rack8RibMedium	0.097		
Wholesale Cut	Granger Cause Variable Period 1	p-value	Period 2	p-value	Period 3	p-value
PrimalBrisketse~t	PrimalFlankselect	0	ALegTrotterOff	0	Neck	0
	Picnic	0	PrimalChuckCH	0	PrimalLoinCH	0
	PrimalChuckUG	0.001	PrimalBrisketCH	0	PrimalBrisketUG	0.002
	PrimalChuckCH	0.002	PrimalChuckPR	0	FRSH90	0.004
	PrimalChuckPR	0.002	PrimalBrisketUG	0	PrimalRibPR	0.004
	PrimalRoundBR	0.005	PrimalShortPlat~H	0.001	PrimalLoinBR	0.006
	PrimalChuckselect	0.006	PrimalBrisketPR	0.001	PrimalFlankUG	0.006
	PrimalLoinPR	0.006	Butt	0.001	PrimalLoinselect	0.024
	Foreshank	0.007	FRSH90	0.002	ALegTrotterOff	0.031
	PrimalRibPR	0.008	PrimalChuckselect	0.004	PrimalRibUG	0.055
	Ham	0.008	Rib	0.004	Rib	0.068
	PrimalBrisketPR	0.009	Rack8RibMedium	0.013	PrimalLoinUG	0.069
	PrimalBrisketCH	0.01	Neck	0.015	PrimalShortPla~BR	0.079
	PrimalChuckBR	0.014	PrimalBrisketBR	0.02	Rack8RibMedium	0.084
	PrimalRoundCH	0.03	WingsWhole	0.033	Foreshank	0.089
	PrimalRibBR	0.03	BreastBS	0.038		
	PrimalRoundPR	0.041	PrimalRibPR	0.045		
	PrimalLoinCH	0.043	PrimalLoinBR	0.057		
	PrimalLoinBR	0.047	PrimalShortPla~PR	0.088		
	PrimalLoinUG	0.05	PrimalLoinCH	0.092		
	PrimalRoundUG	0.053				
	ALegTrotterOff	0.057				
	Thighs	0.057				
	Breast	0.072				
Wholesale Cut	Granger Cause Variable Period 1	p-value	Period 2	p-value	Period 3	p-value
PrimalBrisketUG	Foreshank	0.012	PrimalShortPlat~H	0	ALegTrotterOff	0.043
	Ham	0.066	PrimalBrisketBR	0	Belly	0
	LegQuarters	0.04	Neck	0.011	Breast	0.017
	Picnic	0.054	Foreshank	0.036	BreastBS	0

Table A.1 Continued

Wholesale Cut	Granger Cause Variable Period 1	p-value	Period 2	p-value	Period 3	p-value
	PrimalBrisketse~t	0.002	Breast	0.038	EFlankUntrimmed	0.073
	PrimalChuckBR	0.034	PrimalLoinselect	0.04	FRSH90	0
	PrimalChuckCH	0.01	Butt	0.045	Picnic	0.004
	PrimalChuckPR	0.011	FRSH90	0.064	PrimalBrisketBR	0
	PrimalChuckselect	0.027	Belly	0.072	PrimalChuckCH	0.015
	PrimalChuckUG	0.08	EFlankUntrimmed	0.084	PrimalChuckPR	0.006
	PrimalFlankselect	0.013	PrimalLoinCH	0.091	PrimalFlankBR	0.088
	PrimalLoinCH	0.029	PrimalShortPla~PR	0.091	PrimalFlankselect	0.04
	PrimalLoinPR	0.005	PrimalChuckselect	0.098	PrimalFlankUG	0.001
	PrimalLoinselect	0.056			PrimalLoinPR	0
	PrimalLoinUG	0.084			PrimalLoinUG	0.076
	PrimalRibPR	0.012			PrimalRibselect	0.072
	PrimalRoundBR	0.02			PrimalRibUG	0.001
	PrimalRoundUG	0.004			PrimalRoundBR	0.008
					PrimalRoundselect	0.025
					Rib	0.011
					ShouldersSquare~t	0.013

Wholesale Cut	Granger Cause Variable Period 1	p-value	Period 2	p-value	Period 3	p-value
PrimalChuckBR	Belly	0.015	FRSH90	0	Belly	0.002
	BreastBS	0.005	PrimalChuckselect	0.005	Breast	0.025
	Ham	0.035	PrimalRoundBR	0.031	BreastBS	0.004
	Loin	0.019	PrimalRibselect	0.039	Foreshank	0
	Picnic	0	Rib	0.053	FRSH90	0.006
	PrimalBrisketCH	0.014	PrimalRibUG	0.071	LoinTrimmed4x4	0.021
	PrimalBrisketPR	0.014	LegQuarters	0.072	Picnic	0.001
	PrimalChuckCH	0.029	PrimalBrisketUG	0.086	PrimalBrisketCH	0.031
	PrimalChuckPR	0.027			PrimalBrisketPR	0.043
	PrimalChuckUG	0			PrimalChuckUG	0
	PrimalFlankselect	0.001			PrimalFlankBR	0.024
	PrimalLoinPR	0.001			PrimalFlankCH	0.038
	PrimalRoundBR	0.046			PrimalFlankPR	0.018
	PrimalRoundCH	0.074			PrimalFlankselect	0.011
	PrimalRoundPR	0.084			PrimalFlankUG	0
	Rack8RibMedium	0.018			PrimalLoinBR	0.073
	houldersSquare~t	0.005			PrimalLoinCH	0.052
					PrimalLoinPR	0.002
					PrimalLoinselect	0
					PrimalRibCH	0.003

Table A.1 Continued

Wholesale Cut	Granger Cause Variable Period 1	p-value	Period 2	p-value	Period 3	p-value
					PrimalShortPla~BR	0.078
					PrimalShortPla~PR	0.087
					Rack8RibMedium	0.031

Wholesale Cut	Granger Cause Variable Period 1	p-value	Period 2	p-value	Period 3	p-value
PrimalChuckCH	PrimalLoinPR	0	FRSH90	0	FRSH90	0
	PrimalChuckUG	0	PrimalChuckBR	0	PrimalLoinselect	0
	Picnic	0.001	PrimalChuckselect	0.003	BreastBS	0
	ShouldersSquare~t	0.002	PrimalRoundBR	0.013	Foreshank	0.001
	Ham	0.008	Rib	0.049	PrimalFlankUG	0.001
	BreastBS	0.009	PrimalFlankUG	0.053	Belly	0.002
	PrimalFlankselect	0.011	LegQuarters	0.054	Picnic	0.004
	Rib	0.011	PrimalRibCH	0.067	PrimalChuckUG	0.006
	PrimalLoinCH	0.012	PrimalChuckUG	0.092	PrimalRibUG	0.019
	Rack8RibMedium	0.014	Thighs	0.096	PrimalLoinBR	0.023
	PrimalFlankBR	0.027	PrimalBrisketBR	0.097	PrimalRibCH	0.024
	PrimalRoundBR	0.031			PrimalLoinPR	0.033
	Loin	0.034			Rack8RibMedium	0.07
	PrimalChuckPR	0.044			PrimalBrisketPR	0.07
	PrimalLoinUG	0.068			PrimalBrisketCH	0.076
	PrimalChuckselect	0.076			PrimalFlankPR	0.081
					PrimalLoinCH	0.085
					PrimalFlankselect	0.097

Wholesale Cut	Granger Cause Variable Period 1	p-value	Period 2	p-value	Period 3	p-value
PrimalChuckPR	BreastBS	0.011	PrimalChuckBR	0	PrimalLoinselect	0
	Ham	0.008	FRSH90	0.001	BreastBS	0
	Loin	0.046	PrimalFlankBR	0.019	FRSH90	0.001
	Picnic	0.001	PrimalChuckselect	0.022	PrimalChuckUG	0.001
	PrimalChuckCH	0.037	Breast	0.032	PrimalFlankUG	0.001
	PrimalChuckselect	0.064	PrimalRibCH	0.041	Picnic	0.001
	PrimalChuckUG	0	PrimalRoundBR	0.046	Belly	0.001
	PrimalFlankBR	0.033	Rib	0.05	Foreshank	0.002
	PrimalFlankselect	0.014	PrimalRibUG	0.052	PrimalRibUG	0.031
	PrimalLoinCH	0.012	PrimalFlankUG	0.052	PrimalRibCH	0.035
	PrimalLoinPR	0	PrimalChuckUG	0.053	Rack8RibMedium	0.041
	PrimalLoinUG	0.086	EFlankUntrimmed	0.054	PrimalLoinPR	0.046
	PrimalRoundBR	0.032	PrimalLoinCH	0.065	PrimalBrisketCH	0.058

Table A.1 Continued

Wholesale Cut	Granger Cause Variable Period 1	p-value	Period 2	p-value	Period 3	p-value
	Rack8RibMedium	0.017	WingsWhole	0.066	PrimalBrisketPR	0.068
	Rib	0.007	PrimalBrisketBR	0.092	PrimalLoinCH	0.089
	shouldersSquare~t	0.002			PrimalLoinBR	0.091
					PrimalFlankPR	0.093
Wholesale Cut	Granger Cause Variable Period 1	p-value	Period 2	p-value	Period 3	p-value
PrimalChuckselect	ShouldersSquare~t	0	FRSH90	0	FRSH90	0
	PrimalLoinCH	0	PrimalRoundBR	0.01	PrimalLoinselect	0
	PrimalLoinPR	0	Rib	0.018	PrimalRibCH	0
	PrimalChuckUG	0	PrimalChuckBR	0.036	PrimalLoinPR	0
	Picnic	0.001	PrimalRibCH	0.043	PrimalChuckUG	0
	BreastBS	0.001	Thighs	0.053	PrimalFlankUG	0
	PrimalFlankselect	0.002	EFlankUntrimmed	0.057	Belly	0
	Rack8RibMedium	0.008	PrimalRoundselect	0.057	BreastBS	0
	PrimalChuckCH	0.01	PrimalRibUG	0.065	Foreshank	0.001
	PrimalChuckPR	0.01	PrimalBrisketCH	0.068	PrimalBrisketCH	0.001
	Loin	0.013	Breast	0.078	PrimalBrisketPR	0.001
	Ham	0.014	PrimalBrisketPR	0.085	PrimalFlankPR	0.001
	PrimalRoundBR	0.02			Picnic	0.003
	PrimalFlankBR	0.023			Neck	0.007
	PrimalBrisketPR	0.042			PrimalFlankselect	0.013
	PrimalBrisketCH	0.043			PrimalFlankCH	0.013
	PrimalLoinBR	0.057			PrimalLoinBR	0.017
	PrimalLoinUG	0.062			PrimalLoinCH	0.023
	PrimalChuckBR	0.082			PrimalRibselect	0.034
					PrimalShortPla~BR	0.034
					LoinTrimmed4x4	0.047
					PrimalRibPR	0.047
					PrimalBrisketUG	0.048
					ALegTrotterOff	0.052
					PrimalLoinUG	0.055
					PrimalRibUG	0.059
					PrimalFlankBR	0.066
					ShouldersSquare~t	0.072
					PrimalChuckCH	0.093
Wholesale Cut	Granger Cause Variable Period 1	p-value	Period 2	p-value	Period 3	p-value
PrimalChuckUG	Breast	0.086	PrimalChuckselect	0	ALegTrotterOff	0.048

Table A.1 Continued

Wholesale Cut	Granger Cause Variable Period 1	p-value	Period 2	p-value	Period 3	p-value
	BreastBS	0.005	FRSH90	0.001	Belly	0.008
	Butt	0.054	PrimalRibselect	0.015	Breast	0.013
	Foreshank	0.065	PrimalRibUG	0.016	BreastBS	0.002
	Ham	0.006	Thighs	0.042	Foreshank	0.002
	Loin	0.071	PrimalRoundBR	0.047	FRSH90	0
	Picnic	0.004	PrimalBrisketBR	0.048	LoinTrimmed4x4	0.007
	PrimalChuckBR	0.042	PrimalRibCH	0.072	Picnic	0.001
	PrimalChuckCH	0.038	EFlankUntrimmed	0.076	PrimalBrisketCH	0.002
	PrimalChuckPR	0.037	PrimalRoundselect	0.096	PrimalBrisketPR	0.004
	PrimalFlankBR	0.094	PrimalShortPla~PR	0.099	PrimalBrisketUG	0.044
	PrimalFlankselect	0.006			PrimalChuckCH	0.056
	PrimalLoinBR	0.046			PrimalChuckselect	0.069
	PrimalLoinCH	0			PrimalFlankselect	0.008
	PrimalLoinPR	0			PrimalFlankUG	0
	PrimalRoundBR	0.005			PrimalLoinCH	0.046
	Rack8RibMedium	0.009			PrimalLoinPR	0
	ShouldersSquare~t	0			PrimalLoinselect	0
					PrimalLoinUG	0.007
					PrimalRibCH	0
					PrimalRibPR	0.002
					PrimalShortPla~BR	0.075

Wholesale Cut	Granger Cause Variable Period 1	p-value	Period 2	p-value	Period 3	p-value
PrimalFlankBR	ALegTrotterOff	0.003	PrimalFlankselect	0.004	ALegTrotterOff	0.049
	Ham	0.025	Belly	0.063	Breast	0.057
	Legs	0.084	PrimalLoinselect	0.067	Foreshank	0.017
	PrimalBrisketCH	0.008	Rib	0.085	Ham	0.093
	PrimalBrisketPR	0.008			Loin	0.054
	PrimalChuckCH	0.052			LoinTrimmed4x4	0.079
	PrimalChuckPR	0.054			Neck	0.017
	PrimalChuckselect	0.057			PrimalFlankUG	0.007
	PrimalFlankCH	0.019			PrimalLoinCH	0.002
	PrimalFlankPR	0.001			PrimalLoinPR	0.001
	PrimalFlankselect	0.033			PrimalRibBR	0.044
	PrimalRoundBR	0.002			PrimalRoundBR	0.003
	PrimalRoundselect	0.041				
	PrimalRoundUG	0.023				
	Rack8RibMedium	0.067				
	ShouldersSquare~t	0.01				

Table A.1 Continued

Wholesale Cut	Granger Cause Variable Period 1	p-value	Period 2	p-value	Period 3	p-value
	Thighs	0.01				

Wholesale Cut	Granger Cause Variable Period 1	p-value	Period 2	p-value	Period 3	p-value
PrimalFlankCH	EFlankUntrimmed	0.051	PrimalFlankselect	0.001	PrimalLoinCH	0.001
	Ham	0.019	PrimalChuckselect	0.006	Loin	0.005
	PrimalBrisketBR	0.059	PrimalFlankBR	0.006	PrimalFlankUG	0.006
	PrimalFlankBR	0.017	LoinTrimmed4x4	0.014	PrimalRoundBR	0.008
	PrimalFlankPR	0.001	Thighs	0.019	PrimalLoinPR	0.009
	PrimalFlankUG	0.073	Rack8RibMedium	0.02	ALegTrotterOff	0.016
	PrimalLoinCH	0.051	PrimalChuckCH	0.039	PrimalRibBR	0.023
	PrimalLoinPR	0.033	Butt	0.042	Ham	0.051
	PrimalRoundBR	0.056	PrimalBrisketse~t	0.044	Neck	0.058
	Belly	0.068	PrimalChuckBR	0.047	Breast	0.07
	EFlankUntrimmed	0.06	PrimalBrisketUG	0.047	LoinTrimmed4x4	0.074
	Ham	0.024	ALegTrotterOff	0.052	PrimalShortPla~BR	0.074
	PrimalBrisketBR	0.065	ShouldersSquare~t	0.072	Foreshank	0.076
	PrimalChuckUG	0.096	PrimalRoundUG	0.086	ALegTrotterOff	0.022
	PrimalFlankBR	0.013				
	PrimalFlankCH	0.02				
	PrimalFlankUG	0.09				
	PrimalLoinCH	0.052				
	PrimalLoinPR	0.026				
	PrimalRoundBR	0.061				

Wholesale Cut	Granger Cause Variable Period 1	p-value	Period 2	p-value	Period 3	p-value
PrimalFlankPR	*	*	PrimalFlankselect	0.001	Breast	0.072
	*	*	PrimalChuckselect	0.005	Foreshank	0.068
	*	*	PrimalFlankBR	0.005	Ham	0.029
	*	*	Thighs	0.013	Loin	0.007
	*	*	Rack8RibMedium	0.021	LoinTrimmed4x4	0.039
	*	*	LoinTrimmed4x4	0.023	Neck	0.044
	*	*	PrimalBrisketUG	0.039	PrimalFlankUG	0.003
	*	*	ALegTrotterOff	0.045	PrimalLoinCH	0
	*	*	Butt	0.048	PrimalLoinPR	0.006
	*	*	PrimalBrisketse~t	0.05	PrimalRibBR	0.02
	*	*	PrimalChuckCH	0.051	PrimalRoundBR	0.002
	*	*	ShouldersSquare~t	0.093	PrimalShortPla~BR	0.078
	*	*	PrimalBrisketBR	0.095		

Table A.1 Continued

Wholesale Cut	Granger Cause Variable Period 1	p-value	Period 2	p-value	Period 3	p-value
			PrimalRoundUG	0.1		
Wholesale Cut	Granger Cause Variable Period 1	p-value	Period 2	p-value	Period 3	p-value
PrimalFlankselect	PrimalChuckUG	0.008	ShouldersSquare~t	0.015	PrimalShortPla~BR	0
	PrimalRoundBR	0.011	PrimalChuckselect	0.03	Breast	0.001
	PrimalChuckselect	0.03	PrimalRoundBR	0.033	Ham	0.001
	PrimalLoinPR	0.035	Rack8RibMedium	0.087	PrimalShortPla~PR	0.002
	PrimalLoinCH	0.041	Belly	0.088	PrimalLoinCH	0.007
	PrimalRoundUG	0.044			PrimalFlankUG	0.008
	ShouldersSquare~t	0.058			Foreshank	0.013
	PrimalChuckCH	0.075			FRSH90	0.013
	PrimalChuckPR	0.077			BreastBS	0.016
					PrimalLoinPR	0.018
					PrimalRibBR	0.023
					PrimalShortPlat~G	0.024
					Loin	0.033
					PrimalLoinUG	0.04
					PrimalRibselect	0.044
					PrimalChuckUG	0.051
					ALegTrotterOff	0.099
Wholesale Cut	Granger Cause Variable Period 1	p-value	Period 2	p-value	Period 3	p-value
PrimalFlankUG	ALegTrotterOff	0.078	PrimalFlankselect	0	ALegTrotterOff	0.06
	Picnic	0.098	ALegTrotterOff	0.003	Breast	0.017
	PrimalChuckCH	0.072	PrimalRibBR	0.007	BreastBS	0.07
	PrimalChuckPR	0.075	PrimalRoundBR	0.016	Foreshank	0.004
	PrimalChuckselect	0.049	PrimalFlankBR	0.022	FRSH90	0.005
	PrimalChuckUG	0.003	Rack8RibMedium	0.027	Ham	0.064
	PrimalFlankCH	0.069	PrimalLoinPR	0.027	Loin	0.06
	PrimalFlankPR	0.047	Belly	0.03	LoinTrimmed4x4	0.026
	PrimalFlankselect	0	PrimalChuckselect	0.035	Neck	0.052
	PrimalLoinPR	0.028	FRSH90	0.048	PrimalFlankselect	0.015
	PrimalRoundBR	0.016	ShouldersSquare~t	0.062	PrimalLoinCH	0.001
	PrimalRoundselect	0.021	Neck	0.067	PrimalLoinPR	0
			PrimalRoundUG	0.068	PrimalRibBR	0.065
					PrimalRoundBR	0.005
					PrimalRoundselect	0.057
					PrimalShortPla~PR	0.056

Table A.1 Continued

Wholesale Cut	Granger Cause Variable Period 1	p-value	Period 2	p-value	Period 3	p-value
					Rack8RibMedium	0.075

Wholesale Cut	Granger Cause Variable Period 1	p-value	Period 2	p-value	Period 3	p-value
PrimalLoinBR	ALegTrotterOff	0	PrimalLoinselect	0	BreastBS	0.003
	Belly	0.058	PrimalBrisketse~t	0.001	Butt	0.053
	BreastBS	0.008	PrimalBrisketCH	0.001	EFlankUntrimmed	0.01
	Foreshank	0.026	PrimalRoundBR	0.001	Foreshank	0.017
	Loin	0.007	PrimalBrisketPR	0.002	FRSH90	0.04
	PrimalChuckCH	0	Belly	0.002	LoinTrimmed4x4	0.019
	PrimalChuckPR	0	PrimalLoinUG	0.004	Picnic	0
	PrimalChuckselect	0.076	WingsWhole	0.004	PrimalBrisketBR	0.02
	PrimalChuckUG	0.021	Ham	0.006	PrimalChuckCH	0.03
	PrimalLoinCH	0	Butt	0.009	PrimalChuckPR	0.001
	PrimalLoinPR	0.068	PrimalFlankCH	0.03	PrimalChuckselect	0.007
	PrimalLoinselect	0.039	Rib	0.033	PrimalFlankBR	0.013
	PrimalRibselect	0.027	Rack8RibMedium	0.035	PrimalFlankCH	0.069
	PrimalRoundCH	0.003	FRSH90	0.039	PrimalFlankPR	0.017
	PrimalRoundPR	0.003	PrimalFlankPR	0.049	PrimalLoinCH	0
	PrimalRoundselect	0.01	PrimalChuckselect	0.064	PrimalLoinPR	0.01
	ShouldersSquare~t	0.018	PrimalRibselect	0.079	PrimalRoundBR	0.057
	WingsWhole	0.07	Picnic	0.087	PrimalRoundselect	0.002
			PrimalFlankselect	0.089	Rib	0.017
			PrimalShortPlat~t	0.092	WingsWhole	0.002

Wholesale Cut	Granger Cause Variable Period 1	p-value	Period 2	p-value	Period 3	p-value
PrimalLoinCH	ALegTrotterOff	0	ALegTrotterOff	0	PrimalLoinPR	0.001
	PrimalLoinselect	0	PrimalLoinselect	0	WingsWhole	0.001
	PrimalLoinBR	0	PrimalRibCH	0	Loin	0.002
	PrimalBrisketBR	0	PrimalLoinBR	0	Picnic	0.009
	PrimalLoinUG	0.002	Thighs	0	PrimalFlankBR	0.013
	PrimalFlankselect	0.003	PrimalRibBR	0.003	PrimalLoinUG	0.017
	PrimalChuckUG	0.008	Foreshank	0.005	PrimalChuckPR	0.025
	Ham	0.009	PrimalRibUG	0.008	PrimalFlankPR	0.039
	WingsWhole	0.009	Legs	0.011	Rib	0.049
	Loin	0.01	Rack8RibMedium	0.014	EFlankUntrimmed	0.061
	BreastBS	0.01	PrimalChuckUG	0.021	PrimalRoundselect	0.063
	PrimalRibselect	0.014	PrimalBrisketse~t	0.04	PrimalBrisketBR	0.073
	PrimalFlankPR	0.016			PrimalFlankselect	0.082

Table A.1 Continued

Wholesale Cut	Granger Cause Variable Period 1	p-value	Period 2	p-value	Period 3	p-value
	Butt	0.018			PrimalRoundUG	0.086
	PrimalFlankBR	0.021				
	PrimalFlankCH	0.022				
	LoinTrimmed4x4	0.024				
	PrimalRoundBR	0.026				
	Belly	0.026				
	PrimalRoundselect	0.045				
	ShouldersSquare~t	0.065				
	PrimalRoundPR	0.065				
	PrimalRoundCH	0.066				

Wholesale Cut	Granger Cause Variable Period 1	p-value	Period 2	p-value	Period 3	p-value
PrimalLoinPR	Butt	0.1	PrimalRibUG	0	ALegTrotterOff	0.031
	FRSH90	0.003	ShouldersSquare~t	0.001	Breast	0.023
	Loin	0.064	LoinTrimmed4x4	0.002	Butt	0.001
	PrimalChuckBR	0.1	PrimalLoinselect	0.004	EFlankUntrimmed	0.085
	PrimalChuckUG	0	PrimalRoundBR	0.005	Foreshank	0.027
	PrimalLoinBR	0.001	PrimalRibPR	0.011	FRSH90	0.072
	PrimalLoinCH	0.019	PrimalRoundPR	0.02	PrimalBrisketBR	0.004
	PrimalRibCH	0.001	PrimalLoinBR	0.025	PrimalBrisketse~t	0.07
	PrimalRibPR	0.054	PrimalRibselect	0.029	PrimalBrisketUG	0.021
	PrimalRoundBR	0.015	PrimalRoundCH	0.031	PrimalChuckUG	0.028
	PrimalRoundCH	0.066	WingsWhole	0.031	PrimalFlankBR	0.036
	PrimalRoundPR	0.062	PrimalChuckselect	0.069	PrimalLoinBR	0.046
			LegQuarters	0.082	PrimalLoinselect	0.051
			PrimalShortPlat~G	0.09	PrimalRibCH	0.082
			PrimalLoinCH	0.098	PrimalRibselect	0.041
					PrimalRibUG	0.045
					PrimalRoundBR	0.022
					PrimalRoundUG	0.041
					PrimalShortPla~PR	0.078
					PrimalShortPlat~G	0.082
					Rib	0.048
					ShouldersSquare~t	0.021
					Thighs	0.011
					WingsWhole	0.003

Wholesale Cut	Granger Cause Variable Period 1	p-value	Period 2	p-value	Period 3	p-value

Table A.1 Continued

Wholesale Cut	Granger Cause Variable Period 1	p-value	Period 2	p-value	Period 3	p-value
PrimalLoinselect	PrimalLoinCH	0	PrimalLoinBR	0	PrimalLoinCH	0
	PrimalChuckUG	0	PrimalFlankBR	0	PrimalLoinPR	0
	PrimalLoinUG	0.002	PrimalBrisketse~t	0.002	PrimalLoinUG	0
	PrimalLoinBR	0.004	PrimalLoinUG	0.003	Belly	0.001
	ShouldersSquare~t	0.006	PrimalRoundBR	0.007	PrimalBrisketCH	0.003
	PrimalRoundBR	0.007	PrimalFlankCH	0.01	PrimalBrisketPR	0.004
	BreastBS	0.018	Loin	0.019	PrimalRibPR	0.006
	PrimalChuckPR	0.021	PrimalFlankUG	0.021	PrimalRibCH	0.007
	PrimalFlankBR	0.022	Neck	0.023	FRSH90	0.009
	PrimalChuckCH	0.025	Belly	0.033	PrimalChuckBR	0.027
	PrimalFlankselect	0.037	PrimalChuckselect	0.037	LegQuarters	0.027
	Ham	0.044	PrimalBrisketUG	0.038	PrimalFlankUG	0.03
	PrimalBrisketUG	0.051	WingsWhole	0.045	Thighs	0.035
	Breast	0.063	PrimalFlankPR	0.053	EFlankUntrimmed	0.038
	LegQuarters	0.063	LegQuarters	0.059	BreastBS	0.042
	EFlankUntrimmed	0.064	PrimalFlankselect	0.06	Picnic	0.047
	PrimalLoinPR	0.098	Picnic	0.066	PrimalRibselect	0.064
	PrimalChuckselect	0.099	LoinTrimmed4x4	0.098		
	PrimalRoundselect	0.1				
	ALegTrotterOff	0				
Wholesale Cut	Granger Cause Variable Period 1	p-value	Period 2	p-value	Period 3	p-value
PrimalLoinUG	Belly	0.044	WingsWhole	0	ALegTrotterOff	0.026
	Breast	0.006	PrimalLoinselect	0.002	EFlankUntrimmed	0.041
	EFlankUntrimmed	0.011	PrimalRibUG	0.003	FRSH90	0.055
	Loin	0.021	PrimalFlankCH	0.005	PrimalBrisketBR	0.015
	PrimalBrisketUG	0.024	Rack8RibMedium	0.006	PrimalBrisketse~t	0.098
	PrimalChuckCH	0.021	Foreshank	0.007	PrimalChuckCH	0.009
	PrimalChuckPR	0.021	Butt	0.007	PrimalChuckPR	0.012
	PrimalChuckUG	0.049	PrimalRoundCH	0.009	PrimalFlankUG	0.004
	PrimalFlankBR	0.005	PrimalFlankPR	0.011	PrimalLoinCH	0.009
	PrimalFlankselect	0.008	PrimalRoundPR	0.013	PrimalLoinPR	0.038
	PrimalLoinBR	0.075	Breast	0.014	PrimalLoinselect	0.086
	PrimalLoinCH	0.011	PrimalShortPla~PR	0.03	PrimalRibBR	0.067
	PrimalLoinPR	0.002	PrimalShortPlat~G	0.043	PrimalRibCH	0
	PrimalLoinselect	0.001	PrimalFlankBR	0.049	PrimalRoundBR	0.001
	PrimalRibPR	0.033	Belly	0.057	PrimalRoundPR	0.07
	PrimalRoundBR	0.004	PrimalBrisketUG	0.064	PrimalRoundselect	0.016
	PrimalRoundCH	0.073	PrimalChuckselect	0.086	Rib	0.014

Table A.1 Continued

Wholesale Cut	Granger Cause Variable Period 1	p-value	Period 2	p-value	Period 3	p-value
	PrimalRoundPR	0.083	PrimalChuckBR	0.09	WingsWhole	0.007
	ShouldersSquare~t	0.005	PrimalLoinPR	0.096		
	WingsWhole	0.02				

Wholesale Cut	Granger Cause Variable Period 1	p-value	Period 2	p-value	Period 3	p-value
PrimalRibBR	Belly	0.063	Rack8RibMedium	0	ALegTrotterOff	0
	Loin	0	PrimalRibselect	0	Belly	0.019
	PrimalChuckUG	0.064	LoinTrimmed4x4	0.003	PrimalBrisketUG	0.027
	PrimalLoinBR	0.03	Butt	0.004	PrimalChuckCH	0.034
	PrimalLoinPR	0.077	Breast	0.007	PrimalChuckPR	0.044
	PrimalLoinselect	0.042	PrimalRibCH	0.009	PrimalFlankselect	0.003
	PrimalLoinUG	0.073	PrimalRibUG	0.013	PrimalLoinPR	0.09
	PrimalRibCH	0.002	PrimalLoinselect	0.014	PrimalRibCH	0
	PrimalRoundBR	0.023	PrimalLoinCH	0.017	PrimalRibselect	0.023
	PrimalRoundCH	0.073	PrimalBrisketCH	0.02	PrimalRoundselect	0.014
	PrimalRoundPR	0.074	PrimalFlankBR	0.02	Thighs	0
	ShouldersSquare~t	0.065	PrimalLoinUG	0.025		
	Thighs	0.078	PrimalBrisketPR	0.026		
			ALegTrotterOff	0.031		
			Rib	0.04		
			BreastBS	0.041		
			PrimalChuckPR	0.052		
			EFlankUntrimmed	0.058		

Wholesale Cut	Granger Cause Variable Period 1	p-value	Period 2	p-value	Period 3	p-value
PrimalRibCH	PrimalRibBR	0	PrimalRibBR	0	ALegTrotterOff	0
	PrimalChuckUG	0.001	Breast	0.001	PrimalFlankselect	0
	Loin	0.001	PrimalBrisketCH	0.001	PrimalLoinCH	0
	PrimalLoinPR	0.015	PrimalBrisketPR	0.001	WingsWhole	0.001
	Belly	0.019	PrimalLoinselect	0.003	PrimalChuckBR	0.008
	PrimalRoundBR	0.033	Rib	0.004	PrimalRibselect	0.009
	PrimalFlankselect	0.056	PrimalFlankBR	0.005	Rib	0.009
	PrimalBrisketse~t	0.074	Thighs	0.007	Ham	0.009
	WingsWhole	0.075	PrimalLoinUG	0.01	PrimalBrisketBR	0.014
			Foreshank	0.02	PrimalRoundBR	0.026
			BreastBS	0.021	PrimalRoundselect	0.028
			PrimalRibUG	0.029	PrimalChuckCH	0.033
			PrimalRibselect	0.03	PrimalChuckPR	0.056

Table A.1 Continued

Wholesale Cut	Granger Cause Variable Period 1	p-value	Period 2	p-value	Period 3	p-value
			Loin	0.032	PrimalBrisketUG	0.066
			Rack8RibMedium	0.033	PrimalRibBR	0.068
			PrimalBrisketUG	0.033	PrimalRoundUG	0.071
			PrimalChuckUG	0.035	PrimalLoinselect	0.073
			PrimalBrisketse~t	0.043	Belly	0.086
			Butt	0.054	Legs	0.1
			FRSH90	0.057		
			LegQuarters	0.07		
			PrimalFlankPR	0.095		

Wholesale Cut	Granger Cause Variable Period 1	p-value	Period 2	p-value	Period 3	p-value
PrimalRibPR	Legs	0.037	PrimalLoinPR	0	Butt	0
	Loin	0.096	PrimalLoinUG	0.001	Belly	0
	LoinTrimmed4x4	0.005	PrimalRoundBR	0.003	Loin	0.003
	Neck	0.062	Thighs	0.013	WingsWhole	0.004
	PrimalChuckselect	0.001	PrimalChuckUG	0.018	PrimalRibselect	0.007
	PrimalChuckUG	0.002	PrimalChuckBR	0.022	Thighs	0.011
	PrimalFlankUG	0.044	FRSH90	0.026	ALegTrotterOff	0.018
	PrimalLoinselect	0.054	ShouldersSquare~t	0.034	BreastBS	0.019
	PrimalRibCH	0.035	PrimalFlankBR	0.044	Legs	0.021
	PrimalRoundselect	0.015	BreastBS	0.046	EFlankUntrimmed	0.027
	PrimalRoundUG	0.073	LegQuarters	0.053	PrimalBrisketCH	0.031
	PrimalShortPlat~H	0.011	Belly	0.055	PrimalRoundBR	0.043
	PrimalShortPlat~t	0.011	Loin	0.061	PrimalRibBR	0.05
	ShouldersSquare~t	0.001	PrimalRoundselect	0.063	PrimalLoinselect	0.051
	Thighs	0.038	PrimalRibBR	0.063	Picnic	0.057
			Neck	0.083	PrimalBrisketPR	0.058
					Rib	0.069

Wholesale Cut	Granger Cause Variable Period 1	p-value	Period 2	p-value	Period 3	p-value
PrimalRibselect	ShouldersSquare~t	0	Rib	0	Picnic	0
	PrimalFlankselect	0	Belly	0.001	Legs	0
	PrimalChuckUG	0	PrimalFlankBR	0.002	ShouldersSquare~t	0.001
	PrimalShortPlat~t	0.001	PrimalChuckselect	0.011	PrimalChuckCH	0.001
	PrimalShortPlat~H	0.001	Thighs	0.02	PrimalChuckPR	0.001
	PrimalFlankUG	0.001	Butt	0.021	PrimalLoinCH	0.006
	Ham	0.009	PrimalRoundselect	0.028	LegQuarters	0.006
	PrimalRoundCH	0.01	WingsWhole	0.031	PrimalRibBR	0.007

Table A.1 Continued

Wholesale Cut	Granger Cause Variable Period 1	p-value	Period 2	p-value	Period 3	p-value
	PrimalLoinselect	0.012	PrimalRoundBR	0.042	PrimalLoinUG	0.007
	PrimalRoundPR	0.013	Foreshank	0.056	PrimalRoundselect	0.009
	LoinTrimmed4x4	0.018	LoinTrimmed4x4	0.073	PrimalFlankBR	0.009
	PrimalChuckselect	0.022	Loin	0.078	PrimalLoinPR	0.014
	PrimalRibUG	0.027	PrimalLoinselect	0.083	ALegTrotterOff	0.017
	Loin	0.027	PrimalChuckBR	0.09	Rack8RibMedium	0.019
	LegQuarters	0.033			PrimalBrisketUG	0.019
	FRSH90	0.04			PrimalBrisketCH	0.038
	PrimalChuckPR	0.041			PrimalRibPR	0.039
	PrimalChuckCH	0.048			Foreshank	0.045
	Foreshank	0.051			Thighs	0.055
	Thighs	0.062			PrimalFlankselect	0.057
	PrimalRoundBR	0.066			Butt	0.063
					PrimalBrisketPR	0.066
					PrimalBrisketse~t	0.081
					Belly	0.092
					PrimalFlankPR	0.096

Wholesale Cut	Granger Cause Variable Period 1	p-value	Period 2	p-value	Period 3	p-value
PrimalRibUG	Foreshank	0.018	PrimalRibselect	0	ALegTrotterOff	0.007
	Ham	0.001	PrimalLoinCH	0	Foreshank	0.074
	Loin	0.028	Butt	0	FRSH90	0.002
	LoinTrimmed4x4	0.049	Rack8RibMedium	0.001	Loin	0.001
	PrimalChuckUG	0.003	PrimalRoundselect	0.002	LoinTrimmed4x4	0.07
	PrimalFlankBR	0.034	LegQuarters	0.003	Picnic	0.005
	PrimalFlankselect	0	PrimalRoundCH	0.004	PrimalBrisketCH	0
	PrimalFlankUG	0.024	PrimalRoundPR	0.004	PrimalBrisketPR	0.001
	PrimalLoinCH	0.005	Rib	0.005	PrimalChuckBR	0.028
	PrimalLoinUG	0.008	Picnic	0.008	PrimalFlankBR	0.021
	PrimalRibBR	0.092	Thighs	0.011	PrimalFlankUG	0.049
	PrimalRibCH	0.059	PrimalRoundBR	0.017	PrimalLoinBR	0.001
	PrimalRoundBR	0.005	ALegTrotterOff	0.02	PrimalLoinCH	0.015
	PrimalRoundCH	0.039	Belly	0.025	PrimalLoinPR	0.043
	PrimalRoundPR	0.042	PrimalLoinPR	0.041	PrimalLoinselect	0.027
	ShouldersSquare~t	0.004	PrimalChuckselect	0.046	PrimalLoinUG	0.001
			LoinTrimmed4x4	0.058	PrimalRibBR	0.043
			Breast	0.071	PrimalRoundBR	0.035
			PrimalLoinUG	0.079	PrimalRoundselect	0.081
			PrimalShortPla~PR	0.081	Rib	0.003

Table A.1 Continued

Wholesale Cut	Granger Cause Variable Period 1	p-value	Period 2	p-value	Period 3	p-value
			Legs	0.09	ShouldersSquare~t	0.004
					Thighs	0.022

Wholesale Cut	Granger Cause Variable Period 1	p-value	Period 2	p-value	Period 3	p-value
PrimalRoundBR	BreastBS	0	FRSH90	0	Belly	0.007
	Ham	0.001	PrimalShortPlat~H	0.004	Breast	0.068
	Loin	0.026	LegQuarters	0.009	BreastBS	0.057
	Picnic	0.004	PrimalRoundselect	0.012	Foreshank	0
	PrimalBrisketBR	0.045	PrimalShortPla~PR	0.017	FRSH90	0.048
	PrimalBrisketCH	0.044	Thighs	0.059	Picnic	0.001
	PrimalBrisketPR	0.044	Legs	0.069	PrimalBrisketCH	0.006
	PrimalChuckBR	0.083	PrimalLoinCH	0.078	PrimalBrisketPR	0.009
	PrimalChuckCH	0.004			PrimalChuckselect	0.003
	PrimalChuckPR	0.004			PrimalChuckUG	0.001
	PrimalChuckselect	0.081			PrimalFlankCH	0.051
	PrimalChuckUG	0.001			PrimalFlankPR	0.01
	PrimalFlankBR	0.014			PrimalFlankselect	0
	PrimalFlankselect	0.005			PrimalFlankUG	0
	PrimalLoinPR	0.001			PrimalLoinPR	0.005
	PrimalLoinUG	0.011			PrimalLoinselect	0.004
	PPrimalRibPR	0.096			PrimalRibCH	0.003
	PrimalShortPlat~H	0.051			PrimalRibPR	0.018
	PrimalShortPlat~t	0.052				
	Rack8RibMedium	0.082				
	Rib	0.047				
	ShouldersSquare~t	0				

Wholesale Cut	Granger Cause Variable Period 1	p-value	Period 2	p-value	Period 3	p-value
PrimalRoundCH	ShouldersSquare~t	0	FRSH90	0	PrimalChuckUG	0
	PrimalLoinPR	0	PrimalRoundselect	0.019	PrimalFlankUG	0
	BreastBS	0	LegQuarters	0.054	Foreshank	0.001
	PrimalChuckCH	0.001	Thighs	0.055	PrimalChuckselect	0.001
	PrimalChuckPR	0.001	Rib	0.072	PrimalRibCH	0.001
	Ham	0.001	ShouldersSquare~t	0.082	PrimalLoinPR	0.001
	PrimalFlankselect	0.002	PrimalShortPla~PR	0.094	PrimalFlankselect	0.003
	PrimalChuckUG	0.002	PrimalRibCH	0.097	Belly	0.003
	PrimalFlankBR	0.004			FRSH90	0.006
	Picnic	0.004			PrimalLoinselect	0.006

Table A.1 Continued

Wholesale Cut	Granger Cause Variable Period 1	p-value	Period 2	p-value	Period 3	p-value
	Loin	0.014			PrimalBrisketCH	0.009
	PrimalBrisketBR	0.019			PrimalBrisketPR	0.011
	PrimalLoinCH	0.028			BreastBS	0.017
	PrimalChuckBR	0.03			PrimalRibPR	0.018
	PrimalRibUG	0.039			PrimalFlankPR	0.031
	PrimalBrisketCH	0.045			Picnic	0.033
	PrimalBrisketPR	0.045			PrimalRoundBR	0.042
	Breast	0.064			PrimalRibUG	0.052
	PrimalRoundBR	0.074				
	PrimalLoinUG	0.077				
	PrimalFlankPR	0.088				
	PrimalChuckselect	0.096				
Wholesale Cut	**Granger Cause Variable Period 1**	**p-value**	**Period 2**	**p-value**	**Period 3**	**p-value**
PrimalRoundPR	Breast	0.066	FRSH90	0	Foreshank	0.001
	BreastBS	0	PrimalRoundselect	0.018	PrimalChuckselect	0.001
	Ham	0.001	LegQuarters	0.054	PrimalFlankselect	0.001
	Loin	0.021	Thighs	0.055	PrimalRibCH	0.001
	Picnic	0.005	Rib	0.066	PrimalLoinselect	0.002
	PrimalBrisketBR	0.019	ShouldersSquare~t	0.082	FRSH90	0.004
	PrimalBrisketCH	0.042	PrimalRibCH	0.093	Belly	0.007
	PrimalBrisketPR	0.042	PrimalShortPla~PR	0.094	BreastBS	0.03
	PrimalChuckBR	0.036			Picnic	0.015
	PrimalChuckCH	0.001			PrimalBrisketCH	0.006
	PrimalChuckPR	0.001			PrimalBrisketPR	0.009
	PrimalChuckselect	0.079			PrimalChuckUG	0
	PrimalChuckUG	0.002			PrimalFlankCH	0.09
	PrimalFlankBR	0.005			PrimalFlankPR	0.022
	PrimalFlankPR	0.098			PrimalFlankUG	0
	PrimalFlankselect	0.003			PrimalLoinPR	0.004
	PrimalLoinCH	0.025			PrimalRibPR	0.024
	PrimalLoinPR	0			PrimalRibUG	0.097
	PrimalLoinUG	0.09			PrimalRoundBR	0.041
	PrimalRibUG	0.034				
	PrimalRoundBR	0.075				
	ShouldersSquare~t	0				
Wholesale Cut	**Granger Cause Variable Period 1**	**p-value**	**Period 2**	**p-value**	**Period 3**	**p-value**

Table A.1 Continued

Wholesale Cut	Granger Cause Variable Period 1	p-value	Period 2	p-value	Period 3	p-value
PrimalRoundselect	PrimalFlankselect	0	FRSH90	0	PrimalChuckUG	0
	Ham	0	PrimalShortPlat~H	0.001	PrimalFlankUG	0
	ShouldersSquare~t	0.001	PrimalShortPla~PR	0.003	Foreshank	0.001
	PrimalLoinPR	0.001	Thighs	0.013	PrimalChuckselect	0.001
	BreastBS	0.002	LegQuarters	0.046	PrimalFlankselect	0.001
	PrimalFlankBR	0.004	PrimalLoinCH	0.054	PrimalRibCH	0.001
	Loin	0.004	PrimalRibPR	0.066	PrimalLoinPR	0.001
	PrimalRoundBR	0.006	PrimalChuckselect	0.07	PrimalBrisketCH	0.002
	Picnic	0.009	Rib	0.084	PrimalBrisketPR	0.003
	PrimalChuckPR	0.016			PrimalLoinselect	0.005
	PrimalChuckCH	0.017			FRSH90	0.006
	PrimalChuckBR	0.024			PrimalRibPR	0.009
	PrimalLoinUG	0.028			Picnic	0.009
	PrimalChuckUG	0.038			PrimalFlankPR	0.011
	PrimalRoundUG	0.071			PrimalRoundBR	0.033
	Belly	0.086			BreastBS	0.045
	PrimalFlankPR	0.089			PrimalLoinBR	0.058
	PrimalLoinCH	0.091			Belly	0.07
	PrimalRibUG	0.093			PrimalFlankCH	0.077

Wholesale Cut	Granger Cause Variable Period 1	p-value	Period 2	p-value	Period 3	p-value
PrimalRoundUG	BreastBS	0.004	FRSH90	0	Breast	0.045
	Ham	0.001	PrimalRoundselect	0.003	BreastBS	0.057
	Loin	0.022	PrimalShortPlat~H	0.004	Foreshank	0
	Picnic	0.024	PrimalShortPla~PR	0.005	FRSH90	0.003
	PrimalChuckBR	0.028	Thighs	0.01	Picnic	0.002
	PrimalChuckCH	0.046	PrimalLoinBR	0.019	PrimalBrisketCH	0.001
	PrimalChuckPR	0.041	PrimalChuckselect	0.02	PrimalBrisketPR	0.001
	PrimalChuckUG	0.004	WingsWhole	0.047	PrimalChuckselect	0.005
	PrimalFlankBR	0.012	PrimalRibCH	0.051	PrimalChuckUG	0.002
	PrimalFlankselect	0.001	Neck	0.084	PrimalFlankPR	0.027
	PrimalLoinCH	0.008	LegQuarters	0.084	PrimalFlankUG	0.003
	PrimalLoinPR	0.001	Rib	0.089	PrimalLoinBR	0.002
	PrimalLoinUG	0.032	PrimalLoinCH	0.094	PrimalLoinCH	0.002
	PrimalRibPR	0.059	PrimalBrisketse~t	0.1	PrimalLoinPR	0
	PrimalRoundBR	0.005			PrimalLoinselect	0.006
	PrimalRoundCH	0.092			PrimalRibCH	0
	PrimalRoundPR	0.078			PrimalRibPR	0.007
	Rack8RibMedium	0.03			PrimalRibUG	0.044

Table A.1 Continued

Wholesale Cut	Granger Cause Variable Period 1	p-value	Period 2	p-value	Period 3	p-value
	ShouldersSquare~t	0			ShouldersSquare~t	0.04

Wholesale Cut	Granger Cause Variable Period 1	p-value	Period 2	p-value	Period 3	p-value
PrimalShortPla~BR	*	*	*	*	ALegTrotterOff	0.025
	*	*	*	*	Belly	0.033
	*	*	*	*	BreastBS	0.018
	*	*	*	*	Foreshank	0.002
	*	*	*	*	FRSH90	0
	*	*	*	*	Ham	0.025
	*	*	*	*	Loin	0.012
	*	*	*	*	LoinTrimmed4x4	0.096
	*	*	*	*	Neck	0.038
	*	*	*	*	PrimalChuckCH	0.097
	*	*	*	*	PrimalChuckPR	0.086
	*	*	*	*	PrimalFlankUG	0.094
	*	*	*	*	PrimalLoinCH	0
	*	*	*	*	PrimalLoinPR	0
	*	*	*	*	PrimalLoinselect	0.052
	*	*	*	*	PrimalRibBR	0.009
	*	*	*	*	PrimalRoundselect	0.014
	*	*	*	*	PrimalRoundUG	0.008
	*	*	*	*	Rack8RibMedium	0.003

Wholesale Cut	Granger Cause Variable Period 1	p-value	Period 2	p-value	Period 3	p-value
PrimalShortPla~PR	*	*	ShouldersSquare~t	0.001	ALegTrotterOff	0.028
	*	*	PrimalBrisketUG	0.002	Belly	0.037
	*	*	Neck	0.003	BreastBS	0.017
	*	*	Foreshank	0.008	Foreshank	0.001
	*	*	PrimalShortPlat~t	0.022	FRSH90	0
	*	*	Legs	0.075	Ham	0.025
	*	*			Loin	0.011
	*	*			LoinTrimmed4x4	0.097
	*	*			Neck	0.036
	*	*			PrimalChuckCH	0.099
	*	*			PrimalChuckPR	0.088
	*	*			PrimalFlankUG	0.087
	*	*			PrimalShortPla~PR	0
					PrimalLoinCH	
	*	*			PrimalLoinPR	0

Table A.1 Continued

Wholesale Cut	Granger Cause Variable Period 1	p-value	Period 2	p-value	Period 3	p-value
	*	*			PrimalLoinselect	0.056
	*	*			PrimalRibBR	0.01
	*	*			PrimalRoundselect	0.015
	*	*			PrimalRoundUG	0.008
	*	*			Rack8RibMedium	0.003
Wholesale Cut	Granger Cause Variable Period 1	p-value	Period 2	p-value	Period 3	p-value
PrimalShortPlat~G	*	*	ShouldersSquare~t	0.001	ALegTrotterOff	0.028
	*	*	PrimalBrisketUG	0.002	Belly	0.037
	*	*	Neck	0.003	BreastBS	0.017
	*	*	Foreshank	0.008	Foreshank	0.001
	*	*	PrimalShortPlat~t	0.022	FRSH90	0
	*	*	Legs	0.077	Ham	0.024
	*	*			Loin	0.011
	*	*			LoinTrimmed4x4	0.096
	*	*			Neck	0.036
	*	*			PrimalChuckCH	0.099
	*	*			PrimalChuckPR	0.088
	*	*			PrimalFlankUG	0.087
	*	*			PrimalLoinCH	0
	*	*			PrimalLoinPR	0
	*	*			PrimalLoinselect	0.056
	*	*			PrimalRibBR	0.01
	*	*			PrimalRoundselect	0.015
	*	*			PrimalRoundUG	0.008
	*	*			Rack8RibMedium	0.003
Wholesale Cut	Granger Cause Variable Period 1	p-value	Period 2	p-value	Period 3	p-value
PrimalShortPlat~H	PrimalChuckUG	0	ShouldersSquare~t	0.001	*	*
	PrimalLoinPR	0.001	PrimalBrisketUG	0.002	*	*
	Picnic	0.005	Neck	0.003	*	*
	ShouldersSquare~t	0.027	Foreshank	0.008	*	*
	PrimalRibBR	0.054	PrimalShortPlat~t	0.021	*	*
	PrimalChuckPR	0.067	Legs	0.075	*	*
	PrimalChuckCH	0.07			*	*
	PrimalRoundUG	0.071			*	*
	Ham	0.071			*	*
	PrimalLoinUG	0.077			*	*

Table A.1 Continued

Wholesale Cut	Granger Cause Variable Period 1	p-value	Period 2	p-value	Period 3	p-value
	PrimalRoundselect	0.08			*	*
	PrimalRoundBR	0.08			*	*
	PrimalChuckselect	0.084			*	*
	PrimalRibCH	0.09			*	*
	Thighs	0.091			*	*

Wholesale Cut	Granger Cause Variable Period 1	p-value	Period 2	p-value	Period 3	p-value
PrimalShortPlat~t	PrimalChuckUG	0	ShouldersSquare~t	0.001	*	*
	PrimalLoinPR	0.001	PrimalBrisketUG	0.002	*	*
	Picnic	0.005	Neck	0.003	*	*
	ShouldersSquare~t	0.028	Foreshank	0.008	*	*
	PrimalRibBR	0.053	Legs	0.076	*	*
	PrimalChuckPR	0.068			*	*
	PrimalRoundUG	0.07			*	*
	PrimalChuckCH	0.072			*	*
	Ham	0.072			*	*
	PrimalLoinUG	0.075			*	*
	PrimalRoundBR	0.077			*	*
	PrimalRoundselect	0.08			*	*
	PrimalChuckselect	0.088			*	*
	PrimalRibCH	0.088			*	*
	Thighs	0.092			*	*

Wholesale Cut	Granger Cause Variable Period 1	p-value	Period 2	p-value	Period 3	p-value
Rack8RibMedium	PrimalChuckselect	0.004	WingsWhole	0	Butt	0
	PrimalChuckUG	0.012	Breast	0.01	PrimalBrisketCH	0.001
	ALegTrotterOff	0.022	Thighs	0.04	PrimalRibUG	0.002
	PrimalBrisketCH	0.022	PrimalLoinCH	0.069	Loin	0.003
	PrimalBrisketPR	0.023	Ham	0.083	BreastBS	0.003
	LegQuarters	0.027			PrimalChuckBR	0.004
	PrimalRibPR	0.057			PrimalBrisketPR	0.005
	PrimalBrisketBR	0.063			PrimalFlankPR	0.005
	WingsWhole	0.065			PrimalFlankCH	0.006
	Thighs	0.069			PrimalLoinPR	0.008
	Foreshank	0.084			FRSH90	0.019
	Legs	0.087			PrimalBrisketUG	0.023
	PrimalFlankBR	0.088			PrimalChuckPR	0.033
	Rib	0.09			Picnic	0.033

Table A.1 Continued

Wholesale Cut	Granger Cause Variable Period 1	p-value	Period 2	p-value	Period 3	p-value
					PrimalLoinCH	0.042
					PrimalChuckUG	0.063
					PrimalBrisketBR	0.069
					WingsWhole	0.07
					PrimalFlankUG	0.084
					Neck	0.085
					PrimalRoundBR	0.088
Wholesale Cut	Granger Cause Variable Period 1	p-value	Period 2	p-value	Period 3	p-value
Rib	ALegTrotterOff	0.089	Neck	0	ALegTrotterOff	0
	Breast	0	PrimalBrisketUG	0.001	Belly	0.074
	BreastBS	0.01	LegQuarters	0.001	Breast	0
	LoinTrimmed4x4	0.002	Ham	0.002	Butt	0.036
	PrimalBrisketBR	0.051	BreastBS	0.003	Loin	0.036
	PrimalBrisketse~t	0.053	Legs	0.005	Neck	0.03
	PrimalLoinCH	0.049	Butt	0.006	PrimalBrisketCH	0.005
	PrimalRibUG	0.059	PrimalLoinPR	0.007	PrimalBrisketPR	0.01
	PrimalRoundCH	0.038	PrimalRibPR	0.014	PrimalBrisketUG	0.004
	PrimalRoundPR	0.041	ALegTrotterOff	0.016	PrimalFlankBR	0.005
	PrimalRoundselect	0.058	PrimalRoundUG	0.029	PrimalFlankselect	0.034
			PrimalLoinUG	0.035	PrimalFlankUG	0.044
					PrimalLoinselect	0.036
					PrimalLoinUG	0.055
					PrimalRibselect	0.006
					PrimalRoundBR	0.019
					PrimalRoundselect	0.005
					PrimalRoundUG	0.015
					ShouldersSquare~t	0.003
					Thighs	0.001
					WingsWhole	0.004
Wholesale Cut	Granger Cause Variable Period 1	p-value	Period 2	p-value	Period 3	p-value
ShouldersSquare~t	Foreshank	0	Ham	0.002	WingsWhole	0
	ALegTrotterOff	0	Thighs	0.004	FRSH90	0.001
	PrimalFlankBR	0	BreastBS	0.011	PrimalFlankCH	0.001
	PrimalLoinPR	0.001	PrimalRoundselect	0.013	PrimalRibBR	0.001
	Breast	0.002	Rack8RibMedium	0.017	Rib	0.002
	PrimalLoinUG	0.014	PrimalBrisketPR	0.049	BreastBS	0.002

Table A.1 Continued

Wholesale Cut	Granger Cause Variable Period 1	p-value	Period 2	p-value	Period 3	p-value
	PrimalShortPlat~t	0.015	PrimalBrisketCH	0.062	PrimalFlankBR	0.01
	Rack8RibMedium	0.016	PrimalBrisketse~t	0.082	PrimalRoundUG	0.015
	PrimalShortPlat~H	0.02	LoinTrimmed4x4	0.084	PrimalFlankPR	0.017
	PrimalBrisketBR	0.02	Legs	0.094	Breast	0.031
	Ham	0.02	PrimalChuckselect	0.095	Butt	0.042
	PrimalLoinselect	0.039	PrimalLoinUG	0.095	PrimalRoundCH	0.044
	PrimalRoundBR	0.04			PrimalLoinCH	0.064
	PrimalRoundUG	0.048			PrimalBrisketCH	0.073
	WingsWhole	0.071			Legs	0.076
					LegQuarters	0.08
					LoinTrimmed4x4	0.087
					PrimalBrisketPR	0.091

Wholesale Cut	Granger Cause Variable Period 1	p-value	Period 2	p-value	Period 3	p-value
Thighs	BreastBS	0.001	Neck	0	ALegTrotterOff	0.071
	Foreshank	0.052	PrimalShortPlat~H	0	Belly	0.049
	FRSH90	0.005	Belly	0	Foreshank	0
	Ham	0.077	EFlankUntrimmed	0.001	LoinTrimmed4x4	0.097
	LegQuarters	0	PrimalLoinCH	0.001	Picnic	0.056
	Legs	0	WingsWhole	0.005	PrimalChuckPR	0.096
	Loin	0.011	PrimalShortPla~PR	0.006	PrimalFlankCH	0.054
	PrimalBrisketCH	0.013	PrimalRibBR	0.023	PrimalFlankPR	0.087
	PrimalBrisketPR	0.013	Rib	0.024	PrimalFlankUG	0.013
	PrimalBrisketUG	0.058	PrimalLoinPR	0.027	PrimalLoinBR	0.04
	PrimalChuckCH	0.03	PrimalRibCH	0.033	PrimalLoinCH	0.042
	PrimalChuckPR	0.033	PrimalFlankBR	0.045	Rack8RibMedium	0.064
	PrimalFlankBR	0.041	PrimalLoinUG	0.047	WingsWhole	0.059
	PrimalFlankCH	0.097	PrimalChuckselect	0.056		
	PrimalFlankselect	0.079	PrimalRibUG	0.059		
	PrimalLoinselect	0.064	PrimalLoinselect	0.069		
	PrimalRibBR	0.09				
	PrimalRoundselect	0.064				
	PrimalRoundUG	0.098				
	WingsWhole	0.042				

Wholesale Cut	Granger Cause Variable Period 1	p-value	Period 2	p-value	Period 3	p-value
WingsWhole	Belly	0	PrimalRibPR	0.008	Belly	0.029
	BreastBS	0	Foreshank	0.053	Breast	0.002

Table A.1 Continued

Wholesale Cut	Granger Cause Variable Period 1	p-value	Period 2	p-value	Period 3	p-value
	Butt	0.029	PrimalChuckCH	0.062	BreastBS	0.006
	EFlankUntrimmed	0.037	PrimalRoundBR	0.073	Foreshank	0.002
	FRSH90	0.047	PrimalFlankselect	0.079	Ham	0.088
	LegQuarters	0.06	PrimalChuckBR	0.079	PrimalBrisketBR	0.032
	Loin	0.001	PrimalFlankPR	0.088	PrimalBrisketUG	0.045
	PrimalRibUG	0			PrimalChuckCH	0.001
	PrimalRoundCH	0.04			PrimalChuckPR	0
	PrimalRoundPR	0.037			PrimalChuckUG	0.048
	PrimalRoundselect	0.08			PrimalFlankCH	0.083
	Rack8RibMedium	0.089			PrimalFlankPR	0.07
	Thighs	0.037			PrimalLoinPR	0.089
					PrimalRibBR	0.005
					PrimalRibCH	0.001
					PrimalRibPR	0.023
					PrimalRibselect	0.01
					ShouldersSquare~t	0.006
					Thighs	0.004

Table A.2 All Beef Variables and Granger Results

Variable	Granger Variable	Period 1 p-value	Period 2 p-value	Period 3 p-value
FRSH90	PrimalRibselect	0.533	0.499	0.654
FRSH90	PrimalChuckselect	0.244	0.581	0.006
FRSH90	PrimalRoundselect	0.513	0.765	0.094
FRSH90	PrimalLoinselect	0.101	0.155	0.051
FRSH90	PrimalBrisketse~t	0.355	0.21	0.514
FRSH90	PrimalShortPlat~t	0.841	0.317	-
FRSH90	PrimalFlankselect	0.029	0.064	0.335
FRSH90	PrimalRibCH	0.278	0.539	0.14
FRSH90	PrimalChuckCH	0.057	0.421	0.029
FRSH90	PrimalRoundCH	0.504	0.64	0.956
FRSH90	PrimalLoinCH	0.485	0.063	0.381
FRSH90	PrimalBrisketCH	0.94	0.363	0.637
FRSH90	PrimalShortPlat~H	0.841	0.564	0.463
FRSH90	PrimalFlankCH	0.106	0.079	0.838
FRSH90	PrimalRibPR	0.988	0.43	0
FRSH90	PrimalChuckPR	0.04	0.143	0.127
FRSH90	PrimalRoundPR	0.541	0.678	0.861
FRSH90	PrimalLoinPR	0.14	0.552	0.006
FRSH90	PrimalBrisketPR	0.937	0.367	0.697
FRSH90	PrimalShortPla~PR		0.31	0.051
FRSH90	PrimalFlankPR	0.104	0.058	0.903
FRSH90	PrimalRibBR	0.419	0.791	0.187
FRSH90	PrimalChuckBR	0.04	0.486	0.463
FRSH90	PrimalRoundBR	0.243	0.067	0.283

Table A.2 Continued

Variable	Granger Variable	Period 1 p-value	Period 2 p-value	Period 3 p-value
FRSH90	PrimalLoinBR	0.29	0.227	0.578
FRSH90	PrimalBrisketBR	0.092	0.618	0.16
FRSH90	PrimalShortPla~BR			0.525
FRSH90	PrimalFlankBR	0.819	0.613	0.476
FRSH90	PrimalRibUG	0.088	0.263	0.473
FRSH90	PrimalChuckUG	0.04	0.159	0
FRSH90	PrimalRoundUG	0.096	0.156	0.28
FRSH90	PrimalLoinUG	0.703	0.501	0.488
FRSH90	PrimalBrisketUG	0.66	0.221	0.723
FRSH90	PrimalShortPlat~G		0.289	0.054
FRSH90	PrimalFlankUG	0.059	0.346	0.278
FRSH90	ALL	0.025	0	0
PrimalRibselect	FRSH90	0.136	0.449	0.146
PrimalRibselect	PrimalChuckselect	0	0	0.224
PrimalRibselect	PrimalRoundselect	0.494	0.519	0.023
PrimalRibselect	PrimalLoinselect	0.005	0.024	0.033
PrimalRibselect	PrimalBrisketse~t	0.095	0.583	0.018
PrimalRibselect	PrimalShortPlat~t	0.098	0.299	
PrimalRibselect	PrimalFlankselect	0.01	0.607	0.27
PrimalRibselect	PrimalRibCH	0.009	0.018	0.548
PrimalRibselect	PrimalChuckCH	0.641	0.271	0.227
PrimalRibselect	PrimalRoundCH	0.497	0.997	0.357
PrimalRibselect	PrimalLoinCH	0.714	0.278	0.112
PrimalRibselect	PrimalBrisketCH	0.786	0.364	0.01
PrimalRibselect	PrimalShortPlat~H	0.096	0.054	0.746
PrimalRibselect	PrimalFlankCH	0.153	0.788	0.796
PrimalRibselect	PrimalRibPR	0.185	0.253	0.014
PrimalRibselect	PrimalChuckPR	0.889	0.961	0.308
PrimalRibselect	PrimalRoundPR	0.416	0.931	0.947
PrimalRibselect	PrimalLoinPR	0.166	0.032	0.978
PrimalRibselect	PrimalBrisketPR	0.793	0.369	0.013
PrimalRibselect	PrimalShortPla~PR		0.012	0.946
PrimalRibselect	PrimalFlankPR	0.161	0.687	0.42
PrimalRibselect	PrimalRibBR	0	0.032	0.794
PrimalRibselect	PrimalChuckBR	0.689	0.481	0.105
PrimalRibselect	PrimalRoundBR	0.009	0	0.786
PrimalRibselect	PrimalLoinBR	0.743	0.454	0.017
PrimalRibselect	PrimalBrisketBR	0.362	0.439	0.957
PrimalRibselect	PrimalShortPla~BR			0.176
PrimalRibselect	PrimalFlankBR	0.822	0.043	0.374
PrimalRibselect	**PrimalRibUG**	0.004	0	0.054
PrimalRibselect	PrimalChuckUG	0.141	0.122	0.343
PrimalRibselect	PrimalRoundUG	0.826	0.03	0.481
PrimalRibselect	PrimalLoinUG	0.017	0.962	0.773
PrimalRibselect	PrimalBrisketUG	0.399	0.618	0.222
PrimalRibselect	PrimalShortPlat~G		0.696	0.863
PrimalRibselect	PrimalFlankUG	0.004	0.038	0.388
PrimalRibselect	ALL	0	0	0

Table A.2 Continued

Variable	Granger Variable	Period 1 p-value	Period 2 p-value	Period 3 p-value
PrimalChuckselect	FRSH90	0.008	0.741	0.046
PrimalChuckselect	PrimalRibselect	0.462	0.396	0.013
PrimalChuckselect	PrimalRoundselect	0.688	0.228	0.396
PrimalChuckselect	PrimalLoinselect	0.366	0.299	0.421
PrimalChuckselect	PrimalBrisketse~t	0.198	0.188	0.723
PrimalChuckselect	PrimalShortPlat~t	0.173	0.478	
PrimalChuckselect	PrimalFlankselect	0.232	0.819	0.41
PrimalChuckselect	PrimalRibCH	0.173	0.499	0.547
PrimalChuckselect	PrimalChuckCH	0.756	0.338	0.091
PrimalChuckselect	PrimalRoundCH	0.21	0.165	0.445
PrimalChuckselect	PrimalLoinCH	0.693	0.827	0.707
PrimalChuckselect	PrimalBrisketCH	0.413	0.319	0.443
PrimalChuckselect	PrimalShortPlat~H	0.169	0.316	0.005
PrimalChuckselect	PrimalFlankCH	0.222	0.132	0.46
PrimalChuckselect	PrimalRibPR	0.861	0.007	0.497
PrimalChuckselect	PrimalChuckPR	0.5	0.547	0.004
PrimalChuckselect	PrimalRoundPR	0.279	0.134	0.486
PrimalChuckselect	PrimalLoinPR	0.286	0.007	0.751
PrimalChuckselect	PrimalBrisketPR	0.42	0.308	0.529
PrimalChuckselect	PrimalShortPla~PR		0.186	0.081
PrimalChuckselect	PrimalFlankPR	0.127	0.124	0.403
PrimalChuckselect	PrimalRibBR	0.411	0.356	0.09
PrimalChuckselect	PrimalChuckBR	0.012	0.033	0.336
PrimalChuckselect	PrimalRoundBR	0	0	0.34
PrimalChuckselect	PrimalLoinBR	0.761	0.572	0.795
PrimalChuckselect	PrimalBrisketBR	0.447	0.012	0.132
PrimalChuckselect	PrimalShortPla~BR			0.467
PrimalChuckselect	PrimalFlankBR	0.061	0.257	0.532
PrimalChuckselect	PrimalRibUG	0.191	0.014	0.453
PrimalChuckselect	PrimalChuckUG	0	0.342	0
PrimalChuckselect	PrimalRoundUG	0.948	0.337	0.729
PrimalChuckselect	PrimalLoinUG	0.595	0.115	0.057
PrimalChuckselect	PrimalBrisketUG	0.976	0.737	0.4
PrimalChuckselect	PrimalShortPlat~G		0.275	0
PrimalChuckselect	PrimalFlankUG	0.301	0.01	0.12
PrimalChuckselect	ALL	0	0	0
PrimalRoundselect	FRSH90	0.002	0.573	0.001
PrimalRoundselect	PrimalRibselect	0.607	0.185	0.935
PrimalRoundselect	PrimalChuckselect	0.052	0.244	0.563
PrimalRoundselect	PrimalLoinselect	0.47	0.789	0.642
PrimalRoundselect	PrimalBrisketse~t	0.853	0.286	0.41
PrimalRoundselect	PrimalShortPlat~t	0.106	0.804	
PrimalRoundselect	PrimalFlankselect	0.474	0.366	0.356
PrimalRoundselect	PrimalRibCH	0.198	0.966	0.503
PrimalRoundselect	PrimalChuckCH	0.786	0.127	0.65
PrimalRoundselect	PrimalRoundCH	0.826	0.196	0.658
PrimalRoundselect	PrimalLoinCH	0.863	0.734	0.779
PrimalRoundselect	PrimalBrisketCH	0.863	0.19	0.612

Table A.2 Continued

Variable	Granger Variable	Period 1 p-value	Period 2 p-value	Period 3 p-value
PrimalRoundselect	PrimalShortPlat~H	0.102	0.387	0
PrimalRoundselect	PrimalFlankCH	0.393	0.876	0.51
PrimalRoundselect	PrimalRibPR	0.626	0.018	0.106
PrimalRoundselect	PrimalChuckPR	0.676	0.965	0.004
PrimalRoundselect	PrimalRoundPR	0.968	0.16	0.278
PrimalRoundselect	PrimalLoinPR	0.997	0.011	0.875
PrimalRoundselect	PrimalBrisketPR	0.86	0.186	0.58
PrimalRoundselect	PrimalShortPla~PR		0.281	0.614
PrimalRoundselect	PrimalFlankPR	0.319	0.909	0.6
PrimalRoundselect	PrimalRibBR	0.425	0.601	0.241
PrimalRoundselect	PrimalChuckBR	0.004	0.065	0.081
PrimalRoundselect	PrimalRoundBR	0	0	0
PrimalRoundselect	PrimalLoinBR	0.427	0.922	0.647
PrimalRoundselect	PrimalBrisketBR	0.366	0.07	0.864
PrimalRoundselect	PrimalShortPla~BR			0.699
PrimalRoundselect	PrimalFlankBR	0.414	0.778	0.167
PrimalRoundselect	PrimalRibUG	0.112	0.042	0.86
PrimalRoundselect	PrimalChuckUG	0.023	0.559	0
PrimalRoundselect	PrimalRoundUG	0.084	0.164	0.085
PrimalRoundselect	PrimalLoinUG	0.449	0.681	0.031
PrimalRoundselect	PrimalBrisketUG	0.343	0.501	0.702
PrimalRoundselect	PrimalShortPlat~G		0.59	0
PrimalRoundselect	PrimalFlankUG	0.7	0.022	0.092
PrimalRoundselect	ALL	0	0	0
PrimalLoinselect	FRSH90	0.501	0.009	0.263
PrimalLoinselect	PrimalRibselect	0.544	0.204	0.007
PrimalLoinselect	PrimalChuckselect	0.293	0.13	0.534
PrimalLoinselect	PrimalRoundselect	0.069	0.554	0.062
PrimalLoinselect	PrimalBrisketse~t	0.519	0.136	0.16
PrimalLoinselect	PrimalShortPlat~t	0.807	0.841	
PrimalLoinselect	PrimalFlankselect	0.383	0.653	0.313
PrimalLoinselect	PrimalRibCH	0.651	0.228	0.047
PrimalLoinselect	PrimalChuckCH	0.688	0.733	0.133
PrimalLoinselect	PrimalRoundCH	0.459	0.72	0.11
PrimalLoinselect	**PrimalLoinCH**	0.024	0.02	0
PrimalLoinselect	PrimalBrisketCH	0.271	0.214	0.001
PrimalLoinselect	PrimalShortPlat~H	0.803	0.82	0.093
PrimalLoinselect	PrimalFlankCH	0.329	0.863	0.193
PrimalLoinselect	PrimalRibPR	0.004	0.451	0.001
PrimalLoinselect	PrimalChuckPR	0.676	0.818	0
PrimalLoinselect	PrimalRoundPR	0.557	0.647	0.168
PrimalLoinselect	PrimalLoinPR	0	0.172	0
PrimalLoinselect	PrimalBrisketPR	0.275	0.215	0.002
PrimalLoinselect	PrimalShortPla~PR		0.732	0.922
PrimalLoinselect	PrimalFlankPR	0.395	0.933	0.116
PrimalLoinselect	PrimalRibBR	0.154	0.304	0.866
PrimalLoinselect	PrimalChuckBR	0.48	0.298	0.141
PrimalLoinselect	**PrimalRoundBR**	0.011	0	0.076

Table A.2 Continued

Variable	Granger Variable	Period 1 p-value	Period 2 p-value	Period 3 p-value
PrimalLoinselect	PrimalLoinBR	0.019	0.003	0.046
PrimalLoinselect	PrimalBrisketBR	0.904	0.354	0.154
PrimalLoinselect	PrimalShortPla~BR			0.997
PrimalLoinselect	PrimalFlankBR	0.604	0.104	0.217
PrimalLoinselect	PrimalRibUG	0.407	0.017	0.302
PrimalLoinselect	PrimalChuckUG	0.592	0.554	0
PrimalLoinselect	PrimalRoundUG	0.631	0.928	0.926
PrimalLoinselect	PrimalLoinUG	0.028	0.569	0.415
PrimalLoinselect	PrimalBrisketUG	0.079	0.077	0.532
PrimalLoinselect	PrimalShortPlat~G		0.989	0.129
PrimalLoinselect	PrimalFlankUG	0.358	0.013	0.001
PrimalLoinselect	ALL	0	0	0
PrimalBrisketse~t	FRSH90	0.082	0.44	0.023
PrimalBrisketse~t	PrimalRibselect	0.458	0.091	0.055
PrimalBrisketse~t	PrimalChuckselect	0	0.06	0.947
PrimalBrisketse~t	PrimalRoundselect	0.691	0.039	0.204
PrimalBrisketse~t	PrimalLoinselect	0.318	0.922	0.866
PrimalBrisketse~t	PrimalShortPlat~t	0.338	0.473	
PrimalBrisketse~t	PrimalFlankselect	0.281	0.125	0.927
PrimalBrisketse~t	PrimalRibCH	0.137	0.602	0.668
PrimalBrisketse~t	PrimalChuckCH	0.16	0.303	0.354
PrimalBrisketse~t	PrimalRoundCH	0.013	0.017	0.945
PrimalBrisketse~t	PrimalLoinCH	0.993	0.158	0.095
PrimalBrisketse~t	PrimalBrisketCH	0.113	0.629	0.259
PrimalBrisketse~t	PrimalShortPlat~H	0.334	0.859	0.605
PrimalBrisketse~t	PrimalFlankCH	0.421	0.206	0.246
PrimalBrisketse~t	PrimalRibPR	0.014	0.002	0.814
PrimalBrisketse~t	PrimalChuckPR	0.071	0.544	0.833
PrimalBrisketse~t	PrimalRoundPR	0.02	0.012	0.946
PrimalBrisketse~t	PrimalLoinPR	0	0.003	0.877
PrimalBrisketse~t	PrimalBrisketPR	0.103	0.61	0.402
PrimalBrisketse~t	PrimalShortPla~PR		0.663	0.61
PrimalBrisketse~t	PrimalFlankPR	0.388	0.162	0.201
PrimalBrisketse~t	PrimalRibBR	0.165	0.083	0.887
PrimalBrisketse~t	PrimalChuckBR	0.004	0.182	0.245
PrimalBrisketse~t	PrimalRoundBR	0	0	0.176
PrimalBrisketse~t	PrimalLoinBR	0.702	0.248	0.333
PrimalBrisketse~t	PrimalBrisketBR	0.141	0.282	0.661
PrimalBrisketse~t	PrimalShortPla~BR			0.907
PrimalBrisketse~t	PrimalFlankBR	0.879	0.7	0.96
PrimalBrisketse~t	PrimalRibUG	0.188	0.507	0.119
PrimalBrisketse~t	PrimalChuckUG	0.002	0.378	0.004
PrimalBrisketse~t	PrimalRoundUG	0.607	0.278	0.748
PrimalBrisketse~t	PrimalLoinUG	0.855	0.512	0
PrimalBrisketse~t	PrimalBrisketUG	0.295	0.045	0.017
PrimalBrisketse~t	PrimalShortPlat~G		0.17	0.867
PrimalBrisketse~t	PrimalFlankUG	0.771	0.142	0.884
PrimalBrisketse~t	ALL	0	0	0

Table A.2 Continued

Variable	Granger Variable	Period 1 p-value	Period 2 p-value	Period 3 p-value
PrimalShortPlat~t	FRSH90	0.854	0.426	
PrimalShortPlat~t	PrimalRibselect	0.281	0.01	
PrimalShortPlat~t	PrimalChuckselect	0.023	0.334	
PrimalShortPlat~t	PrimalRoundselect	0.866	0.361	
PrimalShortPlat~t	PrimalLoinselect	0.035	0.605	
PrimalShortPlat~t	PrimalBrisketse~t	0.576	0.466	
PrimalShortPlat~t	PrimalFlankselect	0.507	0.259	
PrimalShortPlat~t	PrimalRibCH	0.018	0.149	
PrimalShortPlat~t	PrimalChuckCH	0.891	0.195	
PrimalShortPlat~t	PrimalRoundCH	0.384	0.264	
PrimalShortPlat~t	PrimalLoinCH	0.997	0.361	
PrimalShortPlat~t	PrimalBrisketCH	0.379	0.786	
PrimalShortPlat~t	PrimalShortPlat~H	0.056	0.04	
PrimalShortPlat~t	PrimalFlankCH	0.112	0.294	
PrimalShortPlat~t	PrimalRibPR	0.202	0.059	
PrimalShortPlat~t	PrimalChuckPR	0.997	0.592	
PrimalShortPlat~t	PrimalRoundPR	0.443	0.226	
PrimalShortPlat~t	PrimalLoinPR	0.014	0.267	
PrimalShortPlat~t	PrimalBrisketPR	0.392	0.781	
PrimalShortPlat~t	PrimalShortPla~PR		0.113	
PrimalShortPlat~t	PrimalFlankPR	0.068	0.269	
PrimalShortPlat~t	PrimalRibBR	0.019	0.364	
PrimalShortPlat~t	PrimalChuckBR	0.594	0.019	
PrimalShortPlat~t	PrimalRoundBR	0.014	0.004	
PrimalShortPlat~t	PrimalLoinBR	0.767	0.314	
PrimalShortPlat~t	PrimalBrisketBR	0.643	0.01	
PrimalShortPlat~t	PrimalShortPla~BR			
PrimalShortPlat~t	PrimalFlankBR	0.049	0.337	
PrimalShortPlat~t	PrimalRibUG	0.575	0.005	
PrimalShortPlat~t	PrimalChuckUG	0.029	0.429	
PrimalShortPlat~t	PrimalRoundUG	0.497	0.399	
PrimalShortPlat~t	PrimalLoinUG	0.387	0.912	
PrimalShortPlat~t	PrimalBrisketUG	0.425	0.061	
PrimalShortPlat~t	PrimalShortPlat~G		0.848	
PrimalShortPlat~t	PrimalFlankUG	0.603	0.373	
PrimalShortPlat~t	ALL	0	0.004	
PrimalFlankselect	FRSH90	0.551	0.971	0.826
PrimalFlankselect	PrimalRibselect	0.447	0.068	0.269
PrimalFlankselect	PrimalChuckselect	0.019	0	0.276
PrimalFlankselect	PrimalRoundselect	0.26	0.134	0.111
PrimalFlankselect	PrimalLoinselect	0.218	0.497	0.019
PrimalFlankselect	PrimalBrisketse~t	0.78	0.648	0.608
PrimalFlankselect	PrimalShortPlat~t	0.027	0.678	
PrimalFlankselect	PrimalRibCH	0.107	0.536	0.823
PrimalFlankselect	PrimalChuckCH	0.537	0.005	0.938
PrimalFlankselect	PrimalRoundCH	0.72	0.729	0.282
PrimalFlankselect	PrimalLoinCH	0.198	0.627	0.779
PrimalFlankselect	PrimalBrisketCH	0.547	0.944	0.045

Table A.2 Continued

Variable	Granger Variable	Period 1 p-value	Period 2 p-value	Period 3 p-value
PrimalFlankselect	PrimalShortPlat~H	0.026	0.95	0.217
PrimalFlankselect	PrimalFlankCH	0.38	0.584	0.519
PrimalFlankselect	PrimalRibPR	0.938	0.101	0.102
PrimalFlankselect	PrimalChuckPR	0.587	0.484	0.377
PrimalFlankselect	PrimalRoundPR	0.818	0.649	0.884
PrimalFlankselect	PrimalLoinPR	0.742	0.468	0
PrimalFlankselect	PrimalBrisketPR	0.561	0.953	0.026
PrimalFlankselect	PrimalShortPla~PR		0.813	0.775
PrimalFlankselect	PrimalFlankPR	0.325	0.542	0.688
PrimalFlankselect	PrimalRibBR	0.147	0.497	0.862
PrimalFlankselect	PrimalChuckBR	0.362	0.469	0.475
PrimalFlankselect	PrimalRoundBR	0.017	0.001	0.973
PrimalFlankselect	PrimalLoinBR	0.112	0.74	0.31
PrimalFlankselect	PrimalBrisketBR	0.788	0.06	0.54
PrimalFlankselect	PrimalShortPla~BR			0.041
PrimalFlankselect	PrimalFlankBR	0.083	0.986	0.799
PrimalFlankselect	PrimalRibUG	0.519	0.053	0.011
PrimalFlankselect	PrimalChuckUG	0.008	0.703	0
PrimalFlankselect	PrimalRoundUG	0.93	0.195	0.95
PrimalFlankselect	PrimalLoinUG	0.399	0.434	0.063
PrimalFlankselect	PrimalBrisketUG	0.238	0.489	0.1
PrimalFlankselect	PrimalShortPlat~G		0.672	0.145
PrimalFlankselect	PrimalFlankUG	0.2	0.639	0.113
PrimalFlankselect	ALL	0	0	0
PrimalRibCH	FRSH90	0.364	0.003	0.417
PrimalRibCH	PrimalRibselect	0.011	0.003	0.016
PrimalRibCH	PrimalChuckselect	0.001	0.013	0.776
PrimalRibCH	PrimalRoundselect	0.122	0.8	0.096
PrimalRibCH	PrimalLoinselect	0.88	0.008	0.543
PrimalRibCH	PrimalBrisketse~t	0.001	0.465	0.112
PrimalRibCH	PrimalShortPlat~t	0.859	0.529	
PrimalRibCH	PrimalFlankselect	0.706	0.305	0.897
PrimalRibCH	PrimalChuckCH	0.893	0.54	0.925
PrimalRibCH	PrimalRoundCH	0.853	0.614	0.559
PrimalRibCH	PrimalLoinCH	0.345	0.674	0.097
PrimalRibCH	PrimalBrisketCH	0.928	0.572	0.007
PrimalRibCH	PrimalShortPlat~H	0.85	0.999	0.417
PrimalRibCH	PrimalFlankCH	0.536	0.398	0.027
PrimalRibCH	PrimalRibPR	0.062	0.056	0.797
PrimalRibCH	PrimalChuckPR	0.645	0.571	0.882
PrimalRibCH	PrimalRoundPR	0.709	0.62	0.231
PrimalRibCH	PrimalLoinPR	0.281	0.003	0.148
PrimalRibCH	PrimalBrisketPR	0.946	0.581	0.01
PrimalRibCH	PrimalShortPla~PR		0.722	0.135
PrimalRibCH	PrimalFlankPR	0.475	0.453	0.045
PrimalRibCH	PrimalRibBR	0.003	0.011	0.404
PrimalRibCH	PrimalChuckBR	0.447	0.585	0.016
PrimalRibCH	PrimalRoundBR	0	0.586	0.517

Table A.2 Continued

Variable	Granger Variable	Period 1 p-value	Period 2 p-value	Period 3 p-value
PrimalRibCH	PrimalLoinBR	0.512	0.639	0.166
PrimalRibCH	PrimalBrisketBR	0.287	0.509	0.45
PrimalRibCH	PrimalShortPla~BR			0.624
PrimalRibCH	PrimalFlankBR	0.072	0.392	0.308
PrimalRibCH	PrimalRibUG	0.038	0.002	0.356
PrimalRibCH	PrimalChuckUG	0.872	0.176	0.058
PrimalRibCH	PrimalRoundUG	0.518	0.423	0.252
PrimalRibCH	PrimalLoinUG	0.426	0.082	0.599
PrimalRibCH	PrimalBrisketUG	0.226	0	0.059
PrimalRibCH	PrimalShortPlat~G		0.465	0.218
PrimalRibCH	PrimalFlankUG	0.392	0.8	0.512
PrimalRibCH	ALL	0	0	0
PrimalChuckCH	FRSH90	0.014	0.75	0.012
PrimalChuckCH	PrimalRibselect	0.405	0.186	0.015
PrimalChuckCH	PrimalChuckselect	0.003	0	0.803
PrimalChuckCH	PrimalRoundselect	0.361	0.134	0.028
PrimalChuckCH	PrimalLoinselect	0.283	0.233	0.961
PrimalChuckCH	PrimalBrisketse~t	0.138	0.029	0.748
PrimalChuckCH	PrimalShortPlat~t	0.108	0.223	
PrimalChuckCH	PrimalFlankselect	0.152	0.925	0.368
PrimalChuckCH	PrimalRibCH	0.04	0.508	0.703
PrimalChuckCH	PrimalRoundCH	0.265	0.627	0.258
PrimalChuckCH	PrimalLoinCH	0.388	0.554	0.437
PrimalChuckCH	PrimalBrisketCH	0.474	0.584	0.877
PrimalChuckCH	PrimalShortPlat~H	0.104	0.411	0.239
PrimalChuckCH	PrimalFlankCH	0.378	0.127	0.877
PrimalChuckCH	PrimalRibPR	0.743	0.001	0.086
PrimalChuckCH	PrimalChuckPR	0.456	0.288	0.015
PrimalChuckCH	PrimalRoundPR	0.338	0.551	0.56
PrimalChuckCH	PrimalLoinPR	0.311	0.006	0.328
PrimalChuckCH	PrimalBrisketPR	0.483	0.563	0.891
PrimalChuckCH	PrimalShortPla~PR		0.166	0.045
PrimalChuckCH	PrimalFlankPR	0.225	0.122	0.961
PrimalChuckCH	PrimalRibBR	0.168	0.153	0.063
PrimalChuckCH	PrimalChuckBR	0.053	0	0.35
PrimalChuckCH	PrimalRoundBR	0	0	0.334
PrimalChuckCH	PrimalLoinBR	0.769	0.965	0.347
PrimalChuckCH	PrimalBrisketBR	0.419	0	0.024
PrimalChuckCH	PrimalShortPla~BR			0.64
PrimalChuckCH	PrimalFlankBR	0.049	0.059	0.729
PrimalChuckCH	PrimalRibUG	0.124	0	0.684
PrimalChuckCH	PrimalChuckUG	0	0.824	0
PrimalChuckCH	PrimalRoundUG	0.55	0.266	0.946
PrimalChuckCH	PrimalLoinUG	0.369	0.019	0.004
PrimalChuckCH	PrimalBrisketUG	0.862	0.403	0.011
PrimalChuckCH	PrimalShortPlat~G		0.31	0
PrimalChuckCH	PrimalFlankUG	0.267	0.004	0.63
PrimalChuckCH	ALL	0	0	0

Table A.2 Continued

Variable	Granger Variable	Period 1 p-value	Period 2 p-value	Period 3 p-value
PrimalRoundCH	FRSH90	0.008	0.758	0.001
PrimalRoundCH	PrimalRibselect	0.204	0.407	0.837
PrimalRoundCH	PrimalChuckselect	0.102	0.818	0.203
PrimalRoundCH	PrimalRoundselect	0.866	0.761	0.343
PrimalRoundCH	PrimalLoinselect	0.681	0.89	0.151
PrimalRoundCH	PrimalBrisketse~t	0.5	0.201	0.319
PrimalRoundCH	PrimalShortPlat~t	0.125	0.597	
PrimalRoundCH	PrimalFlankselect	0.469	0.334	0.032
PrimalRoundCH	PrimalRibCH	0.043	0.326	0.378
PrimalRoundCH	PrimalChuckCH	0.666	0.231	0.558
PrimalRoundCH	PrimalLoinCH	0.921	0.891	0.938
PrimalRoundCH	PrimalBrisketCH	0.859	0.285	0.271
PrimalRoundCH	PrimalShortPlat~H	0.121	0.454	0.002
PrimalRoundCH	PrimalFlankCH	0.539	0.608	0.539
PrimalRoundCH	PrimalRibPR	0.79	0.014	0.066
PrimalRoundCH	PrimalChuckPR	0.546	0.559	0.007
PrimalRoundCH	PrimalRoundPR	0.856	0.015	0.656
PrimalRoundCH	PrimalLoinPR	0.954	0.031	0.91
PrimalRoundCH	PrimalBrisketPR	0.86	0.276	0.255
PrimalRoundCH	PrimalShortPla~PR		0.278	0.357
PrimalRoundCH	PrimalFlankPR	0.46	0.619	0.544
PrimalRoundCH	PrimalRibBR	0.386	0.068	0.276
PrimalRoundCH	PrimalChuckBR	0.001	0.006	0.211
PrimalRoundCH	**PrimalRoundBR**	0.001	0	0
PrimalRoundCH	PrimalLoinBR	0.481	0.54	0.519
PrimalRoundCH	PrimalBrisketBR	0.892	0.005	0.526
PrimalRoundCH	PrimalShortPla~BR			0.776
PrimalRoundCH	PrimalFlankBR	0.366	0.321	0.458
PrimalRoundCH	PrimalRibUG	0.062	0.029	0.582
PrimalRoundCH	PrimalChuckUG	0.037	0.539	0
PrimalRoundCH	PrimalRoundUG	0.276	0.126	0.157
PrimalRoundCH	PrimalLoinUG	0.752	0.291	0.043
PrimalRoundCH	PrimalBrisketUG	0.454	0.435	0.496
PrimalRoundCH	PrimalShortPlat~G		0.621	0
PrimalRoundCH	PrimalFlankUG	0.446	0.005	0.021
PrimalRoundCH	ALL	0	0	0
PrimalLoinCH	FRSH90	0.452	0.412	0.715
PrimalLoinCH	PrimalRibselect	0.001	0.003	0.986
PrimalLoinCH	PrimalChuckselect	0.175	0.639	0.186
PrimalLoinCH	PrimalRoundselect	0.001	0.572	0.178
PrimalLoinCH	PrimalLoinselect	0	0.266	0.241
PrimalLoinCH	PrimalBrisketse~t	0.059	0.944	0.958
PrimalLoinCH	PrimalShortPlat~t	0.146	0.253	
PrimalLoinCH	PrimalFlankselect	0.357	0.778	0.08
PrimalLoinCH	PrimalRibCH	0.232	0.104	0.905
PrimalLoinCH	PrimalChuckCH	0.431	0.711	0.093
PrimalLoinCH	PrimalRoundCH	0.463	0.069	0.927
PrimalLoinCH	PrimalBrisketCH	0.801	0.675	0

Table A.2 Continued

Variable	Granger Variable	Period 1 p-value	Period 2 p-value	Period 3 p-value
PrimalLoinCH	PrimalShortPlat~H	0.143	0.576	0.919
PrimalLoinCH	PrimalFlankCH	0.391	0.939	0.001
PrimalLoinCH	PrimalRibPR	0.013	0.871	0.067
PrimalLoinCH	PrimalChuckPR	0.433	0.512	0.045
PrimalLoinCH	PrimalRoundPR	0.355	0.066	0.699
PrimalLoinCH	PrimalLoinPR	0.001	0.829	0.003
PrimalLoinCH	PrimalBrisketPR	0.799	0.672	0
PrimalLoinCH	PrimalShortPla~PR		0.247	0.765
PrimalLoinCH	PrimalFlankPR	0.57	0.963	0.001
PrimalLoinCH	PrimalRibBR	0.825	0.192	0.937
PrimalLoinCH	PrimalChuckBR	0.276	0.98	0.634
PrimalLoinCH	PrimalRoundBR	0.013	0.62	0.748
PrimalLoinCH	PrimalLoinBR	0.768	0.908	0.082
PrimalLoinCH	PrimalBrisketBR	0.516	0.729	0.711
PrimalLoinCH	PrimalShortPla~BR			0.501
PrimalLoinCH	PrimalFlankBR	0.565	0.907	0.971
PrimalLoinCH	PrimalRibUG	0.854	0.477	0.208
PrimalLoinCH	PrimalChuckUG	0.088	0.72	0.024
PrimalLoinCH	PrimalRoundUG	0.74	0.803	0.121
PrimalLoinCH	PrimalLoinUG	0.579	0.713	0.92
PrimalLoinCH	PrimalBrisketUG	0.011	0.227	0.725
PrimalLoinCH	PrimalShortPlat~G		0.812	0.501
PrimalLoinCH	PrimalFlankUG	0.643	0.681	0.175
PrimalLoinCH	ALL	0	0.181	0
PrimalBrisketCH	FRSH90	0.243	0.194	0.028
PrimalBrisketCH	PrimalRibselect	0.263	0.113	0.015
PrimalBrisketCH	PrimalChuckselect	0.11	0.011	0.278
PrimalBrisketCH	PrimalRoundselect	0.169	0.014	0
PrimalBrisketCH	PrimalLoinselect	0.502	0.727	0.727
PrimalBrisketCH	PrimalBrisketse~t	0.002	0.683	0.074
PrimalBrisketCH	PrimalShortPlat~t	0.847	0.483	
PrimalBrisketCH	PrimalFlankselect	0.855	0.337	0.336
PrimalBrisketCH	PrimalRibCH	0.028	0.285	0.211
PrimalBrisketCH	PrimalChuckCH	0.434	0.013	0.227
PrimalBrisketCH	PrimalRoundCH	0.053	0.101	0.7
PrimalBrisketCH	PrimalLoinCH	0.855	0.581	0.547
PrimalBrisketCH	PrimalShortPlat~H	0.858	0.547	0.614
PrimalBrisketCH	PrimalFlankCH	0.586	0.256	0.837
PrimalBrisketCH	PrimalRibPR	0.472	0	0.413
PrimalBrisketCH	PrimalChuckPR	0.324	0.959	0.882
PrimalBrisketCH	PrimalRoundPR	0.075	0.079	0.968
PrimalBrisketCH	**PrimalLoinPR**	0.083	0	0.001
PrimalBrisketCH	PrimalBrisketPR	0.195	0.48	0.406
PrimalBrisketCH	PrimalShortPla~PR		0.381	0.18
PrimalBrisketCH	PrimalFlankPR	0.493	0.275	0.951
PrimalBrisketCH	PrimalRibBR	0.133	0.057	0.775
PrimalBrisketCH	**PrimalChuckBR**	0	0.001	0.016
PrimalBrisketCH	**PrimalRoundBR**	0.01	0	0.035

Table A.2 Continued

Variable	Granger Variable	Period 1 p-value	Period 2 p-value	Period 3 p-value
PrimalBrisketCH	PrimalLoinBR	0.779	0.835	0.661
PrimalBrisketCH	PrimalBrisketBR	0.66	0.111	0.632
PrimalBrisketCH	PrimalShortPla~BR			0.433
PrimalBrisketCH	PrimalFlankBR	0.742	0.558	0.88
PrimalBrisketCH	PrimalRibUG	0.771	0.272	0.006
PrimalBrisketCH	PrimalChuckUG	0.008	0.861	0
PrimalBrisketCH	PrimalRoundUG	0.544	0.505	0.908
PrimalBrisketCH	PrimalLoinUG	0.907	0.905	0.151
PrimalBrisketCH	PrimalBrisketUG	0.2	0.171	0.001
PrimalBrisketCH	PrimalShortPlat~G		0.169	0.155
PrimalBrisketCH	PrimalFlankUG	0.242	0.005	0.663
PrimalBrisketCH	ALL	0	0	0
PrimalShortPlat~H	FRSH90	0.849	0.427	0.961
PrimalShortPlat~H	PrimalRibselect	0.279	0.01	0.195
PrimalShortPlat~H	PrimalChuckselect	0.024	0.334	0.245
PrimalShortPlat~H	PrimalRoundselect	0.864	0.358	0.007
PrimalShortPlat~H	PrimalLoinselect	0.035	0.604	0.004
PrimalShortPlat~H	PrimalBrisketse~t	0.581	0.463	0.637
PrimalShortPlat~H	PrimalShortPlat~t	0.08	0.207	
PrimalShortPlat~H	PrimalFlankselect	0.517	0.259	0.52
PrimalShortPlat~H	PrimalRibCH	0.018	0.15	1
PrimalShortPlat~H	PrimalChuckCH	0.892	0.197	0.909
PrimalShortPlat~H	PrimalRoundCH	0.386	0.264	0.209
PrimalShortPlat~H	PrimalLoinCH	0.981	0.368	0.083
PrimalShortPlat~H	PrimalBrisketCH	0.379	0.777	0.105
PrimalShortPlat~H	PrimalFlankCH	0.112	0.295	0.922
PrimalShortPlat~H	PrimalRibPR	0.202	0.061	0.228
PrimalShortPlat~H	PrimalChuckPR	0.998	0.591	0.34
PrimalShortPlat~H	PrimalRoundPR	0.444	0.226	0.383
PrimalShortPlat~H	PrimalLoinPR	0.014	0.271	0.001
PrimalShortPlat~H	PrimalBrisketPR	0.393	0.772	0.073
PrimalShortPlat~H	PrimalShortPla~PR		0.115	0.849
PrimalShortPlat~H	PrimalFlankPR	0.068	0.27	0.863
PrimalShortPlat~H	PrimalRibBR	0.019	0.365	0.68
PrimalShortPlat~H	PrimalChuckBR	0.59	0.019	0.992
PrimalShortPlat~H	PrimalRoundBR	0.015	0.004	0.168
PrimalShortPlat~H	PrimalLoinBR	0.749	0.318	0.113
PrimalShortPlat~H	PrimalBrisketBR	0.646	0.01	0.744
PrimalShortPlat~H	PrimalShortPla~BR			0.655
PrimalShortPlat~H	PrimalFlankBR	0.05	0.341	0.126
PrimalShortPlat~H	PrimalRibUG	0.571	0.005	0.668
PrimalShortPlat~H	PrimalChuckUG	0.029	0.432	0
PrimalShortPlat~H	PrimalRoundUG	0.504	0.401	0.651
PrimalShortPlat~H	PrimalLoinUG	0.386	0.909	0.793
PrimalShortPlat~H	PrimalBrisketUG	0.42	0.061	0.039
PrimalShortPlat~H	PrimalShortPlat~G		0.849	0.101
PrimalShortPlat~H	PrimalFlankUG	0.618	0.371	0.244
PrimalShortPlat~H	ALL	0	0.003	0

Table A.2 Continued

Variable	Granger Variable	Period 1 p-value	Period 2 p-value	Period 3 p-value
PrimalFlankCH	FRSH90	0.642	0.727	0.577
PrimalFlankCH	PrimalRibselect	0.829	0.219	0.858
PrimalFlankCH	PrimalChuckselect	0.183	0	0.04
PrimalFlankCH	PrimalRoundselect	0.252	0.125	0.054
PrimalFlankCH	PrimalLoinselect	0.363	0.048	0.027
PrimalFlankCH	PrimalBrisketse~t	0.853	0.092	0.493
PrimalFlankCH	PrimalShortPlat~t	0.169	0.352	
PrimalFlankCH	PrimalFlankselect	0.304	0.063	0.965
PrimalFlankCH	PrimalRibCH	0.216	0.166	0.863
PrimalFlankCH	PrimalChuckCH	0.245	0.003	0.309
PrimalFlankCH	PrimalRoundCH	0.583	0.901	0.188
PrimalFlankCH	PrimalLoinCH	0.055	0.642	0.391
PrimalFlankCH	PrimalBrisketCH	0.85	0.577	0.05
PrimalFlankCH	PrimalShortPlat~H	0.169	0.788	0.385
PrimalFlankCH	PrimalRibPR	0.561	0.416	0.115
PrimalFlankCH	PrimalChuckPR	0.278	0.437	0.879
PrimalFlankCH	PrimalRoundPR	0.509	0.97	0.999
PrimalFlankCH	PrimalLoinPR	0.342	0.632	0.01
PrimalFlankCH	PrimalBrisketPR	0.864	0.584	0.03
PrimalFlankCH	PrimalShortPla~PR		0.476	0.569
PrimalFlankCH	PrimalFlankPR	0.018	0.736	0.884
PrimalFlankCH	PrimalRibBR	0.287	0.09	0.877
PrimalFlankCH	PrimalChuckBR	0.919	0.755	0.693
PrimalFlankCH	PrimalRoundBR	0.058	0.024	0.32
PrimalFlankCH	PrimalLoinBR	0.078	0.911	0.257
PrimalFlankCH	PrimalBrisketBR	0.32	0.673	0.26
PrimalFlankCH	PrimalShortPla~BR			0.258
PrimalFlankCH	PrimalFlankBR	0.021	0.003	0.228
PrimalFlankCH	PrimalRibUG	0.328	0.585	0.005
PrimalFlankCH	PrimalChuckUG	0.495	0.35	0
PrimalFlankCH	PrimalRoundUG	0.677	0.166	0.116
PrimalFlankCH	PrimalLoinUG	0.522	0.074	0.572
PrimalFlankCH	PrimalBrisketUG	0.454	0.348	0.239
PrimalFlankCH	PrimalShortPlat~G		0.763	0.057
PrimalFlankCH	PrimalFlankUG	0.683	0.737	0.765
PrimalFlankCH	ALL	0	0	0
PrimalRibPR	FRSH90	0.729	0.299	0.929
PrimalRibPR	PrimalRibselect	0.457	0.311	0.549
PrimalRibPR	PrimalChuckselect	0.096	0.181	0.124
PrimalRibPR	PrimalRoundselect	0.216	0.057	0.015
PrimalRibPR	PrimalLoinselect	0.443	0.151	0.512
PrimalRibPR	PrimalBrisketse~t	0.651	0.592	0.314
PrimalRibPR	PrimalShortPlat~t	0.037	0.712	
PrimalRibPR	PrimalFlankselect	0.953	0.211	0.097
PrimalRibPR	PrimalRibCH	0.027	0.782	0.394
PrimalRibPR	PrimalChuckCH	0.292	0.98	0.38
PrimalRibPR	PrimalRoundCH	0.656	0.028	0.885
PrimalRibPR	PrimalLoinCH	0.994	0.889	0.508

Table A.2 Continued

Variable	Granger Variable	Period 1 p-value	Period 2 p-value	Period 3 p-value
PrimalRibPR	PrimalBrisketCH	0.783	0.444	0.487
PrimalRibPR	PrimalShortPlat~H	0.037	0.202	0.993
PrimalRibPR	PrimalFlankCH	0.253	0.207	0.567
PrimalRibPR	PrimalChuckPR	0.193	0.963	0.977
PrimalRibPR	PrimalRoundPR	0.696	0.031	0.73
PrimalRibPR	PrimalLoinPR	0.01	0	0.958
PrimalRibPR	PrimalBrisketPR	0.803	0.446	0.408
PrimalRibPR	PrimalShortPla~PR		0.127	0.631
PrimalRibPR	PrimalFlankPR	0.247	0.239	0.934
PrimalRibPR	PrimalRibBR	0.204	0.873	0.548
PrimalRibPR	PrimalChuckBR	0.18	0.772	0.091
PrimalRibPR	PrimalRoundBR	0.165	0.018	0.086
PrimalRibPR	PrimalLoinBR	0.928	0.694	0.177
PrimalRibPR	PrimalBrisketBR	0.65	0.618	0.562
PrimalRibPR	PrimalShortPla~BR			0.655
PrimalRibPR	PrimalFlankBR	0.528	0.05	0.262
PrimalRibPR	PrimalRibUG	0.342	0.026	0.429
PrimalRibPR	PrimalChuckUG	0.325	0.162	0.446
PrimalRibPR	PrimalRoundUG	0.469	0.203	0.023
PrimalRibPR	PrimalLoinUG	0.186	0.506	0.418
PrimalRibPR	PrimalBrisketUG	0.21	0.138	0.954
PrimalRibPR	PrimalShortPlat~G		0.939	0.645
PrimalRibPR	PrimalFlankUG	0.693	0.766	0.04
PrimalRibPR	ALL	0.001	0	0
PrimalChuckPR	FRSH90	0.013	0.722	0.084
PrimalChuckPR	PrimalRibselect	0.443	0.122	0.012
PrimalChuckPR	PrimalChuckselect	0.003	0	0.671
PrimalChuckPR	PrimalRoundselect	0.341	0.11	0.012
PrimalChuckPR	PrimalLoinselect	0.302	0.152	0.547
PrimalChuckPR	PrimalBrisketse~t	0.133	0.026	0.801
PrimalChuckPR	PrimalShortPlat~t	0.103	0.233	
PrimalChuckPR	PrimalFlankselect	0.151	0.138	0.827
PrimalChuckPR	PrimalRibCH	0.047	0.639	0.639
PrimalChuckPR	PrimalChuckCH	0.911	0.833	0.105
PrimalChuckPR	PrimalRoundCH	0.314	0.867	0.221
PrimalChuckPR	PrimalLoinCH	0.541	0.226	0.741
PrimalChuckPR	PrimalBrisketCH	0.536	0.596	0.783
PrimalChuckPR	PrimalShortPlat~H	0.099	0.383	0.176
PrimalChuckPR	PrimalFlankCH	0.371	0.12	0.945
PrimalChuckPR	PrimalRibPR	0.721	0	0.091
PrimalChuckPR	PrimalRoundPR	0.398	0.792	0.64
PrimalChuckPR	PrimalLoinPR	0.287	0.003	0.101
PrimalChuckPR	PrimalBrisketPR	0.545	0.574	0.856
PrimalChuckPR	PrimalShortPla~PR		0.168	0.062
PrimalChuckPR	PrimalFlankPR	0.222	0.119	0.72
PrimalChuckPR	PrimalRibBR	0.189	0.194	0.074
PrimalChuckPR	**PrimalChuckBR**	0.066	0	0.097
PrimalChuckPR	PrimalRoundBR	0	0	0.273

Table A.2 Continued

Variable	Granger Variable	Period 1 p-value	Period 2 p-value	Period 3 p-value
PrimalChuckPR	PrimalLoinBR	0.943	0.487	0.737
PrimalChuckPR	PrimalBrisketBR	0.451	0.001	0.058
PrimalChuckPR	PrimalShortPla~BR			0.559
PrimalChuckPR	PrimalFlankBR	0.05	0.703	0.078
PrimalChuckPR	PrimalRibUG	0.128	0	0.777
PrimalChuckPR	PrimalChuckUG	0	0.728	0
PrimalChuckPR	PrimalRoundUG	0.567	0.098	0.826
PrimalChuckPR	PrimalLoinUG	0.355	0.01	0.002
PrimalChuckPR	PrimalBrisketUG	0.826	0.535	0.111
PrimalChuckPR	PrimalShortPlat~G		0.109	0
PrimalChuckPR	PrimalFlankUG	0.257	0.706	0.49
PrimalChuckPR	ALL	0	0	0
PrimalRoundPR	FRSH90	0.008	0.754	0.001
PrimalRoundPR	PrimalRibselect	0.212	0.411	0.696
PrimalRoundPR	PrimalChuckselect	0.101	0.824	0.221
PrimalRoundPR	PrimalRoundselect	0.904	0.765	0.243
PrimalRoundPR	PrimalLoinselect	0.696	0.888	0.13
PrimalRoundPR	PrimalBrisketse~t	0.479	0.199	0.287
PrimalRoundPR	PrimalShortPlat~t	0.125	0.593	
PrimalRoundPR	PrimalFlankselect	0.454	0.332	0.028
PrimalRoundPR	PrimalRibCH	0.048	0.328	0.551
PrimalRoundPR	PrimalChuckCH	0.66	0.229	0.57
PrimalRoundPR	PrimalRoundCH	0.673	0.021	0.931
PrimalRoundPR	PrimalLoinCH	0.972	0.892	0.753
PrimalRoundPR	PrimalBrisketCH	0.929	0.282	0.303
PrimalRoundPR	PrimalShortPlat~H	0.122	0.461	0.002
PrimalRoundPR	PrimalFlankCH	0.527	0.608	0.507
PrimalRoundPR	PrimalRibPR	0.796	0.014	0.045
PrimalRoundPR	PrimalChuckPR	0.541	0.563	0.007
PrimalRoundPR	PrimalLoinPR	0.945	0.031	0.851
PrimalRoundPR	PrimalBrisketPR	0.93	0.273	0.282
PrimalRoundPR	PrimalShortPla~PR		0.282	0.395
PrimalRoundPR	PrimalFlankPR	0.452	0.619	0.525
PrimalRoundPR	PrimalRibBR	0.414	0.069	0.289
PrimalRoundPR	PrimalChuckBR	0.001	0.006	0.181
PrimalRoundPR	PrimalRoundBR	0.001	0	0
PrimalRoundPR	PrimalLoinBR	0.408	0.54	0.438
PrimalRoundPR	PrimalBrisketBR	0.896	0.005	0.529
PrimalRoundPR	PrimalShortPla~BR			0.72
PrimalRoundPR	PrimalFlankBR	0.376	0.323	0.425
PrimalRoundPR	PrimalRibUG	0.059	0.03	0.789
PrimalRoundPR	PrimalChuckUG	0.04	0.539	0
PrimalRoundPR	PrimalRoundUG	0.287	0.126	0.116
PrimalRoundPR	PrimalLoinUG	0.741	0.29	0.059
PrimalRoundPR	PrimalBrisketUG	0.46	0.434	0.457
PrimalRoundPR	PrimalShortPlat~G		0.622	0
PrimalRoundPR	PrimalFlankUG	0.431	0.005	0.021
PrimalRoundPR	ALL	0	0	0

Table A.2 Continued

Variable	Granger Variable	Period 1 p-value	Period 2 p-value	Period 3 p-value
PrimalLoinPR	FRSH90	0.555	0.532	0.396
PrimalLoinPR	PrimalRibselect	0.482	0.279	0.51
PrimalLoinPR	PrimalChuckselect	0.817	0.804	0.377
PrimalLoinPR	PrimalRoundselect	0.8	0.701	0.003
PrimalLoinPR	PrimalLoinselect	0.686	0.908	0.166
PrimalLoinPR	PrimalBrisketse~t	0.936	0.274	0.114
PrimalLoinPR	PrimalShortPlat~t	0.076	0.747	
PrimalLoinPR	PrimalFlankselect	0.682	0.259	0.453
PrimalLoinPR	PrimalRibCH	0.118	0.306	0.102
PrimalLoinPR	PrimalChuckCH	0.915	0.076	0.571
PrimalLoinPR	PrimalRoundCH	0.247	0	0.831
PrimalLoinPR	PrimalLoinCH	0.822	0.541	0.839
PrimalLoinPR	PrimalBrisketCH	0.257	0.032	0.014
PrimalLoinPR	PrimalShortPlat~H	0.075	0.175	0.287
PrimalLoinPR	PrimalFlankCH	0.166	0.757	0.39
PrimalLoinPR	PrimalRibPR	0.005	0.259	0.203
PrimalLoinPR	PrimalChuckPR	0.914	0.153	0.424
PrimalLoinPR	PrimalRoundPR	0.304	0	0.175
PrimalLoinPR	PrimalBrisketPR	0.245	0.033	0.012
PrimalLoinPR	PrimalShortPla~PR		0.205	0.119
PrimalLoinPR	PrimalFlankPR	0.182	0.851	0.875
PrimalLoinPR	PrimalRibBR	0.128	0.374	0.099
PrimalLoinPR	PrimalChuckBR	0.062	0.101	0.472
PrimalLoinPR	PrimalRoundBR	0.001	0.014	0.722
PrimalLoinPR	PrimalLoinBR	0.552	0.215	0.298
PrimalLoinPR	PrimalBrisketBR	0.476	0.595	0.633
PrimalLoinPR	PrimalShortPla~BR			0.909
PrimalLoinPR	PrimalFlankBR	0.648	0.277	0.802
PrimalLoinPR	PrimalRibUG	0.037	0.027	0.287
PrimalLoinPR	PrimalChuckUG	0.116	0.835	0.134
PrimalLoinPR	PrimalRoundUG	0.327	0.732	0.011
PrimalLoinPR	PrimalLoinUG	0.012	0.594	0.54
PrimalLoinPR	PrimalBrisketUG	0.191	0.837	0.767
PrimalLoinPR	PrimalShortPlat~G		0.921	0.377
PrimalLoinPR	PrimalFlankUG	0.886	0.237	0.018
PrimalLoinPR	ALL	0	0.004	0
PrimalBrisketPR	FRSH90	0.236	0.195	0.028
PrimalBrisketPR	PrimalRibselect	0.272	0.114	0.01
PrimalBrisketPR	PrimalChuckselect	0.111	0.011	0.237
PrimalBrisketPR	PrimalRoundselect	0.154	0.014	0
PrimalBrisketPR	PrimalLoinselect	0.511	0.731	0.653
PrimalBrisketPR	PrimalBrisketse~t	0.002	0.684	0.076
PrimalBrisketPR	PrimalShortPlat~t	0.846	0.482	
PrimalBrisketPR	PrimalFlankselect	0.831	0.339	0.263
PrimalBrisketPR	PrimalRibCH	0.031	0.285	0.197
PrimalBrisketPR	PrimalChuckCH	0.426	0.012	0.219
PrimalBrisketPR	PrimalRoundCH	0.06	0.1	0.708
PrimalBrisketPR	PrimalLoinCH	0.95	0.578	0.641

Table A.2 Continued

Variable	Granger Variable	Period 1 p-value	Period 2 p-value	Period 3 p-value
PrimalBrisketPR	PrimalBrisketCH	0.245	0.505	0.615
PrimalBrisketPR	PrimalShortPlat~H	0.857	0.544	0.591
PrimalBrisketPR	PrimalFlankCH	0.576	0.256	0.765
PrimalBrisketPR	PrimalRibPR	0.476	0	0.42
PrimalBrisketPR	PrimalChuckPR	0.318	0.949	0.883
PrimalBrisketPR	PrimalRoundPR	0.084	0.079	0.967
PrimalBrisketPR	PrimalLoinPR	0.08	0	0
PrimalBrisketPR	PrimalShortPla~PR		0.378	0.172
PrimalBrisketPR	PrimalFlankPR	0.486	0.275	0.961
PrimalBrisketPR	PrimalRibBR	0.144	0.057	0.726
PrimalBrisketPR	PrimalChuckBR	0	0.001	0.018
PrimalBrisketPR	PrimalRoundBR	0.01	0	0.043
PrimalBrisketPR	PrimalLoinBR	0.699	0.832	0.752
PrimalBrisketPR	PrimalBrisketBR	0.651	0.11	0.56
PrimalBrisketPR	PrimalShortPla~BR			0.434
PrimalBrisketPR	PrimalFlankBR	0.755	0.553	0.982
PrimalBrisketPR	PrimalRibUG	0.766	0.272	0.005
PrimalBrisketPR	PrimalChuckUG	0.009	0.87	0
PrimalBrisketPR	PrimalRoundUG	0.552	0.513	0.947
PrimalBrisketPR	PrimalLoinUG	0.892	0.9	0.173
PrimalBrisketPR	PrimalBrisketUG	0.201	0.171	0.001
PrimalBrisketPR	PrimalShortPlat~G		0.169	0.157
PrimalBrisketPR	PrimalFlankUG	0.251	0.005	0.705
PrimalBrisketPR	ALL	0	0	0
PrimalShortPla~BR	FRSH90		0.428	0.959
PrimalShortPla~BR	PrimalRibselect		0.009	0.196
PrimalShortPla~BR	PrimalChuckselect		0.333	0.243
PrimalShortPla~BR	PrimalRoundselect		0.358	0.007
PrimalShortPla~BR	PrimalLoinselect		0.604	0.004
PrimalShortPla~BR	PrimalBrisketse~t		0.461	0.637
PrimalShortPla~BR	PrimalShortPlat~t		0.21	
PrimalShortPla~BR	PrimalFlankselect		0.259	0.519
PrimalShortPla~BR	PrimalRibCH		0.149	0.999
PrimalShortPla~BR	PrimalChuckCH		0.196	0.909
PrimalShortPla~BR	PrimalRoundCH		0.265	0.209
PrimalShortPla~BR	PrimalLoinCH		0.367	0.084
PrimalShortPla~BR	PrimalBrisketCH		0.777	0.104
PrimalShortPla~BR	PrimalShortPlat~H		0.04	0.132
PrimalShortPla~BR	PrimalFlankCH		0.294	0.92
PrimalShortPla~BR	PrimalRibPR		0.061	0.228
PrimalShortPla~BR	PrimalChuckPR		0.591	0.341
PrimalShortPla~BR	PrimalRoundPR		0.227	0.384
PrimalShortPla~BR	PrimalLoinPR		0.27	0.001
PrimalShortPla~BR	PrimalBrisketPR		0.772	0.073
PrimalShortPla~BR	PrimalFlankPR		0.27	0.861
PrimalShortPla~BR	PrimalRibBR		0.364	0.68
PrimalShortPla~BR	PrimalChuckBR		0.019	0.993
PrimalShortPla~BR	PrimalRoundBR		0.004	0.169

Table A.2 Continued

Variable	Granger Variable	Period 1 p-value	Period 2 p-value	Period 3 p-value
PrimalShortPla~BR	PrimalLoinBR		0.316	0.113
PrimalShortPla~BR	PrimalBrisketBR		0.01	0.745
PrimalShortPla~BR	PrimalShortPla~BR			0.654
PrimalShortPla~BR	PrimalFlankBR		0.341	0.126
PrimalShortPla~BR	PrimalRibUG		0.005	0.668
PrimalShortPla~BR	PrimalChuckUG		0.429	0
PrimalShortPla~BR	PrimalRoundUG		0.399	0.647
PrimalShortPla~BR	PrimalLoinUG		0.908	0.79
PrimalShortPla~BR	PrimalBrisketUG		0.06	0.039
PrimalShortPla~BR	PrimalShortPlat~G		0.85	0.101
PrimalShortPla~BR	PrimalFlankUG		0.371	0.245
PrimalShortPla~BR	ALL		0.003	0
PrimalFlankPR	FRSH90	0.601	0.812	0.527
PrimalFlankPR	PrimalRibselect	0.823	0.258	0.842
PrimalFlankPR	PrimalChuckselect	0.132	0	0.033
PrimalFlankPR	PrimalRoundselect	0.213	0.133	0.066
PrimalFlankPR	PrimalLoinselect	0.353	0.053	0.016
PrimalFlankPR	PrimalBrisketse~t	0.832	0.089	0.464
PrimalFlankPR	PrimalShortPlat~t	0.176	0.343	
PrimalFlankPR	PrimalFlankselect	0.269	0.062	0.957
PrimalFlankPR	PrimalRibCH	0.228	0.162	0.86
PrimalFlankPR	PrimalChuckCH	0.27	0.003	0.392
PrimalFlankPR	PrimalRoundCH	0.619	0.87	0.197
PrimalFlankPR	PrimalLoinCH	0.055	0.678	0.437
PrimalFlankPR	PrimalBrisketCH	0.828	0.542	0.037
PrimalFlankPR	PrimalShortPlat~H	0.176	0.792	0.391
PrimalFlankPR	PrimalFlankCH	0.225	0.846	0.382
PrimalFlankPR	PrimalRibPR	0.602	0.406	0.128
PrimalFlankPR	PrimalChuckPR	0.314	0.436	0.901
PrimalFlankPR	PrimalRoundPR	0.543	0.938	0.963
PrimalFlankPR	PrimalLoinPR	0.294	0.666	0.01
PrimalFlankPR	PrimalBrisketPR	0.843	0.549	0.022
PrimalFlankPR	PrimalShortPla~PR		0.475	0.56
PrimalFlankPR	PrimalRibBR	0.288	0.093	0.865
PrimalFlankPR	PrimalChuckBR	0.871	0.803	0.782
PrimalFlankPR	PrimalRoundBR	0.064	0.024	0.299
PrimalFlankPR	PrimalLoinBR	0.08	0.964	0.263
PrimalFlankPR	PrimalBrisketBR	0.311	0.689	0.266
PrimalFlankPR	PrimalShortPla~BR			0.274
PrimalFlankPR	PrimalFlankBR	0.013	0.002	0.25
PrimalFlankPR	PrimalRibUG	0.383	0.592	0.005
PrimalFlankPR	PrimalChuckUG	0.513	0.345	0
PrimalFlankPR	PrimalRoundUG	0.721	0.164	0.162
PrimalFlankPR	PrimalLoinUG	0.509	0.09	0.551
PrimalFlankPR	PrimalBrisketUG	0.422	0.345	0.236
PrimalFlankPR	PrimalShortPlat~G		0.763	0.057
PrimalFlankPR	PrimalFlankUG	0.781	0.708	0.753
PrimalFlankPR	ALL	0	0	0

Table A.2 Continued

Variable	Granger Variable	Period 1 p-value	Period 2 p-value	Period 3 p-value
PrimalRibBR	FRSH90	0.366	0.06	0.809
PrimalRibBR	PrimalRibselect	0.089	0	0.873
PrimalRibBR	PrimalChuckselect	0.013	0.027	0.512
PrimalRibBR	PrimalRoundselect	0.063	0.849	0.003
PrimalRibBR	PrimalLoinselect	0.835	0.03	0.547
PrimalRibBR	PrimalBrisketse~t	0.009	0.974	0.756
PrimalRibBR	PrimalShortPlat~t	0.601	0.438	
PrimalRibBR	PrimalFlankselect	0.558	0.847	0.745
PrimalRibBR	PrimalRibCH	0	0.031	0
PrimalRibBR	PrimalChuckCH	0.687	0.556	0.668
PrimalRibBR	PrimalRoundCH	0.357	0.355	0.7
PrimalRibBR	PrimalLoinCH	0.928	0.147	0.906
PrimalRibBR	PrimalBrisketCH	0.465	0.668	0.652
PrimalRibBR	PrimalShortPlat~H	0.593	0.659	0.225
PrimalRibBR	PrimalFlankCH	0.449	0.336	0.191
PrimalRibBR	PrimalRibPR	0.616	0.02	0.082
PrimalRibBR	PrimalChuckPR	0.846	0.784	0.986
PrimalRibBR	PrimalRoundPR	0.27	0.357	0.893
PrimalRibBR	PrimalLoinPR	0.389	0.001	0.507
PrimalRibBR	PrimalBrisketPR	0.467	0.678	0.644
PrimalRibBR	PrimalShortPla~PR		0.974	0.34
PrimalRibBR	PrimalFlankPR	0.4	0.461	0.131
PrimalRibBR	PrimalChuckBR	0.982	0.597	0.18
PrimalRibBR	PrimalRoundBR	0.002	0.374	0.227
PrimalRibBR	PrimalLoinBR	0.855	0.266	0.689
PrimalRibBR	PrimalBrisketBR	0.355	0.782	0.668
PrimalRibBR	PrimalShortPla~BR			0.322
PrimalRibBR	PrimalFlankBR	0.316	0.242	0.902
PrimalRibBR	PrimalRibUG	0.027	0.087	0.727
PrimalRibBR	PrimalChuckUG	0.939	0.496	0.253
PrimalRibBR	PrimalRoundUG	0.653	0.458	0.281
PrimalRibBR	PrimalLoinUG	0.335	0.463	0.489
PrimalRibBR	PrimalBrisketUG	0.041	0.023	0.291
PrimalRibBR	PrimalShortPlat~G		0.403	0.759
PrimalRibBR	PrimalFlankUG	0.658	0.772	0.671
PrimalRibBR	ALL	0	0	0
PrimalChuckBR	FRSH90	0.048	0.917	0.116
PrimalChuckBR	PrimalRibselect	0.505	0.362	0.033
PrimalChuckBR	PrimalChuckselect	0.007	0.005	0.522
PrimalChuckBR	PrimalRoundselect	0.248	0.028	0.013
PrimalChuckBR	PrimalLoinselect	0.32	0.17	0.801
PrimalChuckBR	PrimalBrisketse~t	0.318	0.388	0.913
PrimalChuckBR	PrimalShortPlat~t	0.079	0.352	
PrimalChuckBR	PrimalFlankselect	0.139	0.867	0.284
PrimalChuckBR	PrimalRibCH	0.071	0.087	0.423
PrimalChuckBR	PrimalChuckCH	0.679	0.283	0.042
PrimalChuckBR	PrimalRoundCH	0	0.807	0.224
PrimalChuckBR	PrimalLoinCH	0.704	0.657	0.715

Table A.2 Continued

Variable	Granger Variable	Period 1 p-value	Period 2 p-value	Period 3 p-value
PrimalChuckBR	PrimalBrisketCH	0.002	0.196	0.597
PrimalChuckBR	PrimalShortPlat~H	0.075	0.781	0.096
PrimalChuckBR	PrimalFlankCH	0.547	0.221	0.961
PrimalChuckBR	PrimalRibPR	0.444	0.001	0.647
PrimalChuckBR	PrimalChuckPR	0.346	0.059	0.004
PrimalChuckBR	PrimalRoundPR	0.001	0.712	0.348
PrimalChuckBR	PrimalLoinPR	0.833	0	0.707
PrimalChuckBR	PrimalBrisketPR	0.002	0.186	0.655
PrimalChuckBR	PrimalShortPla~PR		0.528	0.03
PrimalChuckBR	PrimalFlankPR	0.349	0.226	0.924
PrimalChuckBR	PrimalRibBR	0.378	0.041	0.039
PrimalChuckBR	PrimalRoundBR	0.004	0	0.109
PrimalChuckBR	PrimalLoinBR	0.796	0.831	0.656
PrimalChuckBR	PrimalBrisketBR	0.846	0	0.169
PrimalChuckBR	PrimalShortPla~BR			0.422
PrimalChuckBR	PrimalFlankBR	0.055	0.105	0.3
PrimalChuckBR	PrimalRibUG	0.073	0.003	0.964
PrimalChuckBR	PrimalChuckUG	0	0.996	0
PrimalChuckBR	PrimalRoundUG	0.659	0.051	0.994
PrimalChuckBR	PrimalLoinUG	0.42	0.045	0.055
PrimalChuckBR	PrimalBrisketUG	0.894	0.765	0.25
PrimalChuckBR	PrimalShortPlat~G		0.136	0
PrimalChuckBR	PrimalFlankUG	0.189	0.001	0.225
PrimalChuckBR	ALL	0	0	0
PrimalRoundBR	FRSH90	0.215	0.665	0.008
PrimalRoundBR	PrimalRibselect	0.113	0.405	0.564
PrimalRoundBR	PrimalChuckselect	0.093	0.965	0.117
PrimalRoundBR	PrimalRoundselect	0.959	0.839	0.162
PrimalRoundBR	PrimalLoinselect	0.246	0.968	0.424
PrimalRoundBR	PrimalBrisketse~t	0.579	0.449	0.349
PrimalRoundBR	PrimalShortPlat~t	0.035	0.533	
PrimalRoundBR	PrimalFlankselect	0.5	0.496	0.05
PrimalRoundBR	PrimalRibCH	0.266	0.391	0.627
PrimalRoundBR	PrimalChuckCH	0.643	0.582	0.71
PrimalRoundBR	PrimalRoundCH	0.941	0.021	0.981
PrimalRoundBR	PrimalLoinCH	0.646	0.881	0.801
PrimalRoundBR	PrimalBrisketCH	0.639	0.237	0.413
PrimalRoundBR	PrimalShortPlat~H	0.034	0.406	0
PrimalRoundBR	PrimalFlankCH	0.378	0.502	0.329
PrimalRoundBR	PrimalRibPR	0.584	0.006	0.069
PrimalRoundBR	PrimalChuckPR	0.569	0.299	0.035
PrimalRoundBR	PrimalRoundPR	0.681	0.015	0.412
PrimalRoundBR	PrimalLoinPR	0.885	0.009	0.659
PrimalRoundBR	PrimalBrisketPR	0.637	0.229	0.381
PrimalRoundBR	PrimalShortPla~PR		0.228	0.728
PrimalRoundBR	PrimalFlankPR	0.323	0.524	0.366
PrimalRoundBR	PrimalRibBR	0.709	0.112	0.282
PrimalRoundBR	PrimalChuckBR	0.002	0.003	0.157

Table A.2 Continued

Variable	Granger Variable	Period 1 p-value	Period 2 p-value	Period 3 p-value
PrimalRoundBR	PrimalLoinBR	0.821	0.686	0.55
PrimalRoundBR	PrimalBrisketBR	0.604	0.009	0.507
PrimalRoundBR	PrimalShortPla~BR			0.771
PrimalRoundBR	PrimalFlankBR	0.373	0.255	0.36
PrimalRoundBR	PrimalRibUG	0.063	0.042	0.989
PrimalRoundBR	PrimalChuckUG	0.007	0.837	0
PrimalRoundBR	PrimalRoundUG	0.306	0.03	0.057
PrimalRoundBR	PrimalLoinUG	0.363	0.561	0.015
PrimalRoundBR	PrimalBrisketUG	0.569	0.817	0.3
PrimalRoundBR	PrimalShortPlat~G		0.752	0
PrimalRoundBR	PrimalFlankUG	0.46	0.001	0.04
PrimalRoundBR	ALL	0	0	0
PrimalLoinBR	FRSH90	0.39	0.766	0.751
PrimalLoinBR	PrimalRibselect	0.001	0.188	0.444
PrimalLoinBR	PrimalChuckselect	0.109	0.006	0.132
PrimalLoinBR	PrimalRoundselect	0	0.995	0.102
PrimalLoinBR	PrimalLoinselect	0	0.571	0.337
PrimalLoinBR	PrimalBrisketse~t	0.298	0.349	0.905
PrimalLoinBR	PrimalShortPlat~t	0.726	0.078	
PrimalLoinBR	PrimalFlankselect	0.293	0.302	0.131
PrimalLoinBR	PrimalRibCH	0.16	0.071	0.565
PrimalLoinBR	PrimalChuckCH	0.905	0.479	0.094
PrimalLoinBR	PrimalRoundCH	0.104	0.463	0.856
PrimalLoinBR	PrimalLoinCH	0	0.014	0
PrimalLoinBR	PrimalBrisketCH	0.338	0.008	0
PrimalLoinBR	PrimalShortPlat~H	0.715	0.874	0.58
PrimalLoinBR	PrimalFlankCH	0.107	0.191	0.004
PrimalLoinBR	PrimalRibPR	0.245	0.103	0.497
PrimalLoinBR	PrimalChuckPR	0.838	0.664	0.049
PrimalLoinBR	PrimalRoundPR	0.07	0.439	0.963
PrimalLoinBR	PrimalLoinPR	0.004	0.032	0.025
PrimalLoinBR	PrimalBrisketPR	0.334	0.008	0.001
PrimalLoinBR	PrimalShortPla~PR		0.454	0.261
PrimalLoinBR	PrimalFlankPR	0.159	0.221	0.001
PrimalLoinBR	PrimalRibBR	0.406	0.041	0.783
PrimalLoinBR	PrimalChuckBR	0.317	0.317	0.461
PrimalLoinBR	PrimalRoundBR	0.137	0.053	0.52
PrimalLoinBR	PrimalBrisketBR	0.821	0.9	0.17
PrimalLoinBR	PrimalShortPla~BR			0.564
PrimalLoinBR	PrimalFlankBR	0.781	0.851	0.398
PrimalLoinBR	PrimalRibUG	0.495	0.467	0.177
PrimalLoinBR	PrimalChuckUG	0.233	0.255	0.013
PrimalLoinBR	PrimalRoundUG	0.368	0.817	0.078
PrimalLoinBR	PrimalLoinUG	0.63	0.157	0.803
PrimalLoinBR	PrimalBrisketUG	0.219	0.435	0.354
PrimalLoinBR	PrimalShortPlat~G		0.379	0.298
PrimalLoinBR	PrimalFlankUG	0.254	0.547	0.128
PrimalLoinBR	ALL	0	0	0

Table A.2 Continued

Variable	Granger Variable	Period 1 p-value	Period 2 p-value	Period 3 p-value
PrimalBrisketBR	FRSH90	0.119	0.84	0.991
PrimalBrisketBR	PrimalRibselect	0.731	0.032	0.002
PrimalBrisketBR	PrimalChuckselect	0.003	0.004	0.048
PrimalBrisketBR	PrimalRoundselect	0.007	0.021	0
PrimalBrisketBR	PrimalLoinselect	0.898	0.249	0.383
PrimalBrisketBR	PrimalBrisketse~t	0.065	0.766	0.432
PrimalBrisketBR	PrimalShortPlat~t	0.88	0.295	
PrimalBrisketBR	PrimalFlankselect	0.721	0.174	0.697
PrimalBrisketBR	PrimalRibCH	0.011	0.131	0.468
PrimalBrisketBR	PrimalChuckCH	0.811	0.004	0.603
PrimalBrisketBR	PrimalRoundCH	0.115	0.16	0.681
PrimalBrisketBR	PrimalLoinCH	0.994	0.053	0.358
PrimalBrisketBR	PrimalBrisketCH	0.281	0.092	0.058
PrimalBrisketBR	PrimalShortPlat~H	0.871	0.282	0.469
PrimalBrisketBR	PrimalFlankCH	0.833	0.103	0.649
PrimalBrisketBR	PrimalRibPR	0.103	0	0.477
PrimalBrisketBR	PrimalChuckPR	0.633	0.973	0.589
PrimalBrisketBR	PrimalRoundPR	0.15	0.124	0.974
PrimalBrisketBR	PrimalLoinPR	0.035	0	0.03
PrimalBrisketBR	PrimalBrisketPR	0.253	0.084	0.119
PrimalBrisketBR	PrimalShortPla~PR		0.132	0.094
PrimalBrisketBR	PrimalFlankPR	0.728	0.099	0.966
PrimalBrisketBR	PrimalRibBR	0.028	0.002	0.196
PrimalBrisketBR	PrimalChuckBR	0.021	0.001	0.03
PrimalBrisketBR	PrimalRoundBR	0.114	0	0.088
PrimalBrisketBR	PrimalLoinBR	0.513	0.191	0.343
PrimalBrisketBR	PrimalShortPla~BR			0.251
PrimalBrisketBR	PrimalFlankBR	0.19	0.137	0.66
PrimalBrisketBR	PrimalRibUG	0.288	0.106	0.35
PrimalBrisketBR	PrimalChuckUG	0.001	0.532	0
PrimalBrisketBR	PrimalRoundUG	0.956	0.575	0.609
PrimalBrisketBR	PrimalLoinUG	0.358	0.896	0.441
PrimalBrisketBR	PrimalBrisketUG	0.753	0.155	0
PrimalBrisketBR	PrimalShortPlat~G		0.067	0.084
PrimalBrisketBR	PrimalFlankUG	0.748	0.001	0.702
PrimalBrisketBR	ALL	0	0	0
PrimalShortPla~BR	FRSH90			0.975
PrimalShortPla~BR	PrimalRibselect			0.193
PrimalShortPla~BR	PrimalChuckselect			0.249
PrimalShortPla~BR	PrimalRoundselect			0.007
PrimalShortPla~BR	PrimalLoinselect			0.004
PrimalShortPla~BR	PrimalBrisketse~t			0.638
PrimalShortPla~BR	PrimalShortPlat~t			
PrimalShortPla~BR	PrimalFlankselect			0.526
PrimalShortPla~BR	PrimalRibCH			0.992
PrimalShortPla~BR	PrimalChuckCH			0.915
PrimalShortPla~BR	PrimalRoundCH			0.209
PrimalShortPla~BR	PrimalLoinCH			0.084

Table A.2 Continued

Variable	Granger Variable	Period 1 p-value	Period 2 p-value	Period 3 p-value
PrimalShortPla~BR	PrimalBrisketCH			0.106
PrimalShortPla~BR	PrimalShortPlat~H			0.132
PrimalShortPla~BR	PrimalFlankCH			0.923
PrimalShortPla~BR	PrimalRibPR			0.23
PrimalShortPla~BR	PrimalChuckPR			0.342
PrimalShortPla~BR	PrimalRoundPR			0.381
PrimalShortPla~BR	PrimalLoinPR			0.001
PrimalShortPla~BR	PrimalBrisketPR			0.074
PrimalShortPla~BR	PrimalShortPla~PR			0.847
PrimalShortPla~BR	PrimalFlankPR			0.862
PrimalShortPla~BR	PrimalRibBR			0.681
PrimalShortPla~BR	PrimalChuckBR			0.993
PrimalShortPla~BR	PrimalRoundBR			0.167
PrimalShortPla~BR	PrimalLoinBR			0.113
PrimalShortPla~BR	PrimalBrisketBR			0.75
PrimalShortPla~BR	PrimalFlankBR			0.13
PrimalShortPla~BR	PrimalRibUG			0.664
PrimalShortPla~BR	PrimalChuckUG			0
PrimalShortPla~BR	PrimalRoundUG			0.648
PrimalShortPla~BR	PrimalLoinUG			0.788
PrimalShortPla~BR	PrimalBrisketUG			0.038
PrimalShortPla~BR	PrimalShortPlat~G			0.101
PrimalShortPla~BR	PrimalFlankUG			0.252
PrimalShortPla~BR	ALL			0
PrimalFlankBR	FRSH90	0.539	0.356	0.342
PrimalFlankBR	PrimalRibselect	0.785	0.215	0.89
PrimalFlankBR	PrimalChuckselect	0.225	0.007	0.016
PrimalFlankBR	PrimalRoundselect	0.508	0.938	0.116
PrimalFlankBR	PrimalLoinselect	0.927	0.212	0.009
PrimalFlankBR	PrimalBrisketse~t	0.874	0.649	0.659
PrimalFlankBR	PrimalShortPlat~t	0.758	0.172	
PrimalFlankBR	PrimalFlankselect	0.118	0.137	0.732
PrimalFlankBR	PrimalRibCH	0.726	0.512	0.903
PrimalFlankBR	PrimalChuckCH	0.247	0.003	0.84
PrimalFlankBR	PrimalRoundCH	0.877	0.842	0.289
PrimalFlankBR	PrimalLoinCH	0.971	0.743	0.481
PrimalFlankBR	PrimalBrisketCH	0.717	0.896	0.015
PrimalFlankBR	PrimalShortPlat~H	0.755	0.86	0.212
PrimalFlankBR	PrimalFlankCH	0.02	0.953	0.313
PrimalFlankBR	PrimalRibPR	0.368	0.009	0.144
PrimalFlankBR	PrimalChuckPR	0.247	0.295	0.547
PrimalFlankBR	PrimalRoundPR	0.797	0.775	0.882
PrimalFlankBR	PrimalLoinPR	0.326	0.306	0.028
PrimalFlankBR	PrimalBrisketPR	0.731	0.887	0.011
PrimalFlankBR	PrimalFlankPR	0.002	0.396	0.652
PrimalFlankBR	PrimalFlankPR		0.995	0.963
PrimalFlankBR	PrimalRibBR	0.609	0.553	0.785
PrimalFlankBR	PrimalChuckBR	0.819	0.909	0.463

Table A.2 Continued

Variable	Granger Variable	Period 1 p-value	Period 2 p-value	Period 3 p-value
PrimalFlankBR	PrimalRoundBR	0.038	0.005	0.183
PrimalFlankBR	PrimalLoinBR	0.802	0.915	0.337
PrimalFlankBR	PrimalBrisketBR	0.997	0.159	0.385
PrimalFlankBR	PrimalShortPla~BR			0.413
PrimalFlankBR	PrimalRibUG	0.234	0.118	0.006
PrimalFlankBR	PrimalChuckUG	0.173	0.071	0
PrimalFlankBR	PrimalRoundUG	0.975	0.077	0.093
PrimalFlankBR	PrimalLoinUG	0.992	0.596	0.797
PrimalFlankBR	PrimalBrisketUG	0.065	0.699	0.457
PrimalFlankBR	PrimalShortPlat~G		0.988	0.042
PrimalFlankBR	PrimalFlankUG	0.562	0.748	0.772
PrimalFlankBR	ALL	0	0	0
PrimalRibUG	FRSH90	0.577	0.01	0.079
PrimalRibUG	PrimalRibselect	0.001	0.186	0.113
PrimalRibUG	PrimalChuckselect	0.001	0	0.51
PrimalRibUG	PrimalRoundselect	0.212	0.176	0.051
PrimalRibUG	PrimalLoinselect	0.104	0.117	0.955
PrimalRibUG	PrimalBrisketse~t	0.151	0.63	0.741
PrimalRibUG	PrimalShortPlat~t	0.859	0.899	
PrimalRibUG	PrimalFlankselect	0.016	0.252	0.346
PrimalRibUG	PrimalRibCH	0.006	0.223	0.879
PrimalRibUG	PrimalChuckCH	0.237	0.484	0.159
PrimalRibUG	PrimalRoundCH	0.667	0.705	0.459
PrimalRibUG	PrimalLoinCH	0.66	0.719	0.054
PrimalRibUG	PrimalBrisketCH	0.391	0.26	0.004
PrimalRibUG	PrimalShortPlat~H	0.856	0.278	0.611
PrimalRibUG	PrimalFlankCH	0.175	0.397	0.375
PrimalRibUG	PrimalRibPR	0.091	0.272	0.087
PrimalRibUG	PrimalChuckPR	0.316	0.681	0.128
PrimalRibUG	PrimalRoundPR	0.788	0.749	0.936
PrimalRibUG	PrimalLoinPR	0.009	0.021	0.924
PrimalRibUG	PrimalBrisketPR	0.381	0.266	0.007
PrimalRibUG	PrimalShortPla~PR		0.231	0.834
PrimalRibUG	PrimalFlankPR	0.17	0.419	0.716
PrimalRibUG	PrimalRibBR	0	0.029	0.748
PrimalRibUG	PrimalChuckBR	0.823	0.811	0.175
PrimalRibUG	PrimalRoundBR	0.002	0.005	0.594
PrimalRibUG	PrimalLoinBR	0.319	0.635	0.038
PrimalRibUG	PrimalBrisketBR	0.659	0.292	0.719
PrimalRibUG	PrimalShortPla~BR			0.289
PrimalRibUG	PrimalFlankBR	0.685	0.043	0.016
PrimalRibUG	PrimalChuckUG	0.018	0.824	0.184
PrimalRibUG	PrimalRoundUG	0.893	0.878	0.098
PrimalRibUG	PrimalLoinUG	0.19	0.126	0.012
PrimalRibUG	PrimalBrisketUG	0.284	0.854	0.817
PrimalRibUG	PrimalShortPlat~G		0.863	0.581
PrimalRibUG	PrimalFlankUG	0.005	0.053	0.41
PrimalRibUG	ALL	0	0	0

Table A.2 Continued

Variable	Granger Variable	Period 1 p-value	Period 2 p-value	Period 3 p-value
PrimalChuckUG	FRSH90	0.001	0.964	0.099
PrimalChuckUG	PrimalRibselect	0.937	0.179	0.421
PrimalChuckUG	PrimalChuckselect	0.03	0	0.403
PrimalChuckUG	PrimalRoundselect	0.587	0.299	0.183
PrimalChuckUG	PrimalLoinselect	0.572	0.301	0.762
PrimalChuckUG	PrimalBrisketse~t	0.065	0.186	0.521
PrimalChuckUG	PrimalShortPlat~t	0.293	0.252	
PrimalChuckUG	PrimalFlankselect	0.045	0.236	0.153
PrimalChuckUG	PrimalRibCH	0.166	0.423	0.357
PrimalChuckUG	PrimalChuckCH	0.545	0.435	0.102
PrimalChuckUG	PrimalRoundCH	0.736	0.616	0.417
PrimalChuckUG	PrimalLoinCH	0.997	0.395	0.906
PrimalChuckUG	PrimalBrisketCH	0.924	0.431	0.222
PrimalChuckUG	PrimalShortPlat~H	0.288	0.379	0.008
PrimalChuckUG	PrimalFlankCH	0.259	0.356	0.791
PrimalChuckUG	PrimalRibPR	0.755	0.005	0.466
PrimalChuckUG	PrimalChuckPR	0.343	0.611	0.003
PrimalChuckUG	PrimalRoundPR	0.863	0.563	0.462
PrimalChuckUG	PrimalLoinPR	0.112	0.007	0.486
PrimalChuckUG	PrimalBrisketPR	0.912	0.415	0.267
PrimalChuckUG	PrimalShortPla~PR		0.138	0.26
PrimalChuckUG	PrimalFlankPR	0.164	0.368	0.714
PrimalChuckUG	PrimalRibBR	0.302	0.147	0.303
PrimalChuckUG	PrimalChuckBR	0.009	0.095	0.56
PrimalChuckUG	PrimalRoundBR	0	0	0.205
PrimalChuckUG	PrimalLoinBR	0.613	0.891	0.956
PrimalChuckUG	PrimalBrisketBR	0.483	0.001	0.062
PrimalChuckUG	PrimalShortPla~BR			0.111
PrimalChuckUG	PrimalFlankBR	0.111	0.448	0.376
PrimalChuckUG	PrimalRibUG	0.12	0.034	0.956
PrimalChuckUG	PrimalRoundUG	0.67	0.036	0.533
PrimalChuckUG	PrimalLoinUG	0.881	0.556	0.57
PrimalChuckUG	PrimalBrisketUG	0.455	0.632	0.263
PrimalChuckUG	PrimalShortPlat~G		0.962	0
PrimalChuckUG	PrimalFlankUG	0.065	0.001	0.127
PrimalChuckUG	ALL	0	0	0
PrimalRoundUG	FRSH90	0.006	0.905	0.006
PrimalRoundUG	PrimalRibselect	0.746	0.672	0.677
PrimalRoundUG	PrimalChuckselect	0.015	0.636	0.207
PrimalRoundUG	PrimalRoundselect	0.117	0.028	0.335
PrimalRoundUG	PrimalLoinselect	0.824	0.668	0.537
PrimalRoundUG	PrimalBrisketse~t	0.828	0.307	0.407
PrimalRoundUG	PrimalShortPlat~t	0.327	0.961	
PrimalRoundUG	PrimalFlankselect	0.935	0.862	0.596
PrimalRoundUG	PrimalRibCH	0.377	0.614	0.216
PrimalRoundUG	PrimalChuckCH	0.868	0.267	0.296
PrimalRoundUG	PrimalRoundCH	0.359	0.009	0.364
PrimalRoundUG	PrimalLoinCH	0.923	0.967	0.619

Table A.2 Continued

Variable	Granger Variable	Period 1 p-value	Period 2 p-value	Period 3 p-value
PrimalRoundUG	PrimalBrisketCH	0.501	0.717	0.673
PrimalRoundUG	PrimalShortPlat~H	0.321	0.275	0.004
PrimalRoundUG	PrimalFlankCH	0.389	0.757	0.721
PrimalRoundUG	PrimalRibPR	0.238	0.036	0.895
PrimalRoundUG	PrimalChuckPR	0.77	0.851	0.005
PrimalRoundUG	PrimalRoundPR	0.492	0.007	0.102
PrimalRoundUG	PrimalLoinPR	0.26	0.01	0.291
PrimalRoundUG	PrimalBrisketPR	0.505	0.713	0.582
PrimalRoundUG	PrimalShortPla~PR		0.249	0.449
PrimalRoundUG	PrimalFlankPR	0.267	0.793	0.689
PrimalRoundUG	PrimalRibBR	0.46	0.389	0.282
PrimalRoundUG	PrimalChuckBR	0.003	0.058	0.144
PrimalRoundUG	PrimalRoundBR	0	0	0
PrimalRoundUG	PrimalLoinBR	0.563	0.676	0.499
PrimalRoundUG	PrimalBrisketBR	0.791	0.34	0.681
PrimalRoundUG	PrimalShortPla~BR			0.717
PrimalRoundUG	PrimalFlankBR	0.155	0.83	0.164
PrimalRoundUG	PrimalRibUG	0.135	0.157	0.696
PrimalRoundUG	PrimalChuckUG	0.001	0.855	0
PrimalRoundUG	PrimalLoinUG	0.73	0.81	0.383
PrimalRoundUG	PrimalBrisketUG	0.33	0.265	0.22
PrimalRoundUG	PrimalShortPlat~G		0.765	0
PrimalRoundUG	PrimalFlankUG	0.734	0.176	0.023
PrimalRoundUG	ALL	0	0	0
PrimalLoinUG	FRSH90	0.896	0.073	0.195
PrimalLoinUG	PrimalRibselect	0.863	0.025	0.216
PrimalLoinUG	PrimalChuckselect	0.356	0.007	0.066
PrimalLoinUG	PrimalRoundselect	0.022	0.29	0.21
PrimalLoinUG	**PrimalLoinselect**	0.045	0.093	0
PrimalLoinUG	PrimalBrisketse~t	0.062	0.723	0.706
PrimalLoinUG	PrimalShortPlat~t	0.365	0.775	
PrimalLoinUG	PrimalFlankselect	0.069	0.254	0.68
PrimalLoinUG	PrimalRibCH	0.066	0.566	0.024
PrimalLoinUG	PrimalChuckCH	0.806	0.15	0.203
PrimalLoinUG	PrimalRoundCH	0.549	0.494	0.462
PrimalLoinUG	PrimalLoinCH	0.438	0.86	0.223
PrimalLoinUG	PrimalBrisketCH	0.598	0.127	0.029
PrimalLoinUG	PrimalShortPlat~H	0.361	0.474	0.36
PrimalLoinUG	PrimalFlankCH	0.099	0.751	0.875
PrimalLoinUG	PrimalRibPR	0.042	0.544	0.274
PrimalLoinUG	PrimalChuckPR	0.854	0.978	0.032
PrimalLoinUG	PrimalRoundPR	0.66	0.481	0.956
PrimalLoinUG	PrimalLoinPR	0.001	0.058	0.18
PrimalLoinUG	PrimalBrisketPR	0.589	0.127	0.023
PrimalLoinUG	PrimalShortPla~PR		0.35	0.739
PrimalLoinUG	PrimalFlankPR	0.094	0.687	0.604
PrimalLoinUG	PrimalRibBR	0.004	0.292	0.077
PrimalLoinUG	PrimalChuckBR	0.374	0.356	0.708

Table A.2 Continued

Variable	Granger Variable	Period 1 p-value	Period 2 p-value	Period 3 p-value
PrimalLoinUG	PrimalRoundBR	0.015	0.073	0.49
PrimalLoinUG	PrimalLoinBR	0.524	0.206	0.886
PrimalLoinUG	PrimalBrisketBR	0.595	0.418	0.687
PrimalLoinUG	PrimalShortPla~BR			0.404
PrimalLoinUG	PrimalFlankBR	0.827	0.728	0.979
PrimalLoinUG	PrimalRibUG	0.931	0	0.002
PrimalLoinUG	PrimalChuckUG	0.08	0.609	0
PrimalLoinUG	PrimalRoundUG	0.786	0.084	0.067
PrimalLoinUG	PrimalBrisketUG	0.056	0.599	0.078
PrimalLoinUG	PrimalShortPlat~G		0.62	0.119
PrimalLoinUG	PrimalFlankUG	0.159	0.12	0.112
PrimalLoinUG	ALL	0	0	0
PrimalBrisketUG	FRSH90	0.011	0.294	0.088
PrimalBrisketUG	PrimalRibselect	0.679	0.074	0.023
PrimalBrisketUG	PrimalChuckselect	0.002	0.259	0.105
PrimalBrisketUG	PrimalRoundselect	0.764	0.175	0
PrimalBrisketUG	PrimalLoinselect	0.109	0.064	0.595
PrimalBrisketUG	PrimalBrisketse~t	0.014	0.666	0.564
PrimalBrisketUG	PrimalShortPlat~t	0.639	0.6	
PrimalBrisketUG	PrimalFlankselect	0.654	0.188	0.944
PrimalBrisketUG	PrimalRibCH	0.149	0.137	0.443
PrimalBrisketUG	PrimalChuckCH	0.253	0.27	0.399
PrimalBrisketUG	PrimalRoundCH	0.132	0.051	0.615
PrimalBrisketUG	PrimalLoinCH	0.155	0.249	0.293
PrimalBrisketUG	PrimalBrisketCH	0.319	0.99	0.282
PrimalBrisketUG	PrimalShortPlat~H	0.642	0.341	0.03
PrimalBrisketUG	PrimalFlankCH	0.895	0.121	0.985
PrimalBrisketUG	PrimalRibPR	0.195	0.053	0.089
PrimalBrisketUG	PrimalChuckPR	0.122	0.466	0.873
PrimalBrisketUG	PrimalRoundPR	0.162	0.043	0.522
PrimalBrisketUG	PrimalLoinPR	0.001	0.029	0.002
PrimalBrisketUG	PrimalBrisketPR	0.293	0.969	0.465
PrimalBrisketUG	PrimalShortPla~PR		0.259	0.005
PrimalBrisketUG	PrimalFlankPR	0.96	0.108	0.912
PrimalBrisketUG	PrimalRibBR	0.211	0.009	0.707
PrimalBrisketUG	PrimalChuckBR	0.028	0.058	0.016
PrimalBrisketUG	PrimalRoundBR	0.007	0.006	0.005
PrimalBrisketUG	PrimalLoinBR	0.075	0.582	0.147
PrimalBrisketUG	PrimalBrisketBR	0.035	0.528	0.725
PrimalBrisketUG	PrimalShortPla~BR			0.473
PrimalBrisketUG	PrimalFlankBR	0.516	0.921	0.645
PrimalBrisketUG	PrimalRibUG	0.287	0.528	0.1
PrimalBrisketUG	PrimalChuckUG	0.155	0.194	0
PrimalBrisketUG	PrimalRoundUG	0.762	0.501	0.556
PrimalBrisketUG	PrimalLoinUG	0.7	0.695	0.855
PrimalBrisketUG	PrimalShortPlat~G		0.073	0.114
PrimalBrisketUG	PrimalFlankUG	0.86	0.132	0.556
PrimalBrisketUG	ALL	0	0	0

Table A.2 Continued

Variable	Granger Variable	Period 1 p-value	Period 2 p-value	Period 3 p-value
PrimalShortPlat~G	FRSH90		0.42	0.95
PrimalShortPlat~G	PrimalRibselect		0.009	0.196
PrimalShortPlat~G	PrimalChuckselect		0.329	0.244
PrimalShortPlat~G	PrimalRoundselect		0.333	0.007
PrimalShortPlat~G	PrimalLoinselect		0.601	0.004
PrimalShortPlat~G	PrimalBrisketse~t		0.432	0.637
PrimalShortPlat~G	PrimalShortPlat~t		0.207	
PrimalShortPlat~G	PrimalFlankselect		0.255	0.518
PrimalShortPlat~G	PrimalRibCH		0.146	1
PrimalShortPlat~G	PrimalChuckCH		0.178	0.911
PrimalShortPlat~G	PrimalRoundCH		0.261	0.208
PrimalShortPlat~G	PrimalLoinCH		0.361	0.084
PrimalShortPlat~G	PrimalBrisketCH		0.759	0.104
PrimalShortPlat~G	PrimalShortPlat~H		0.04	0.132
PrimalShortPlat~G	PrimalFlankCH		0.292	0.92
PrimalShortPlat~G	PrimalRibPR		0.062	0.229
PrimalShortPlat~G	PrimalChuckPR		0.599	0.342
PrimalShortPlat~G	PrimalRoundPR		0.223	0.382
PrimalShortPlat~G	PrimalLoinPR		0.284	0.001
PrimalShortPlat~G	PrimalBrisketPR		0.753	0.072
PrimalShortPlat~G	PrimalShortPla~PR		0.114	0.85
PrimalShortPlat~G	PrimalFlankPR		0.268	0.862
PrimalShortPlat~G	PrimalRibBR		0.369	0.679
PrimalShortPlat~G	PrimalChuckBR		0.017	0.996
PrimalShortPlat~G	PrimalRoundBR		0.005	0.169
PrimalShortPlat~G	PrimalLoinBR		0.31	0.112
PrimalShortPlat~G	PrimalBrisketBR		0.007	0.745
PrimalShortPlat~G	PrimalShortPla~BR			0.654
PrimalShortPlat~G	PrimalFlankBR		0.368	0.127
PrimalShortPlat~G	PrimalRibUG		0.005	0.669
PrimalShortPlat~G	PrimalChuckUG		0.414	0
PrimalShortPlat~G	PrimalRoundUG		0.443	0.647
PrimalShortPlat~G	PrimalLoinUG		0.918	0.79
PrimalShortPlat~G	PrimalBrisketUG		0.06	0.039
PrimalShortPlat~G	PrimalFlankUG		0.348	0.245
PrimalShortPlat~G	ALL		0.003	0
PrimalFlankUG	FRSH90	0.301	0.617	0.799
PrimalFlankUG	PrimalRibselect	0.251	0.104	0.17
PrimalFlankUG	PrimalChuckselect	0.219	0.001	0.014
PrimalFlankUG	PrimalRoundselect	0.192	0.266	0.055
PrimalFlankUG	PrimalLoinselect	0.669	0.071	0.012
PrimalFlankUG	PrimalBrisketse~t	0.556	0.906	0.772
PrimalFlankUG	PrimalShortPlat~t	0.3	0.508	
PrimalFlankUG	PrimalFlankselect	0	0	0.202
PrimalFlankUG	PrimalRibCH	0.031	0.347	0.37
PrimalFlankUG	PrimalChuckCH	0.986	0.004	0.956
PrimalFlankUG	PrimalRoundCH	0.994	0.454	0.257
PrimalFlankUG	PrimalLoinCH	0.568	0.319	0.544

Table A.2 Continued

Variable	Granger Variable	Period 1 p-value	Period 2 p-value	Period 3 p-value
PrimalFlankUG	PrimalBrisketCH	0.997	0.658	0.041
PrimalFlankUG	PrimalShortPlat~H	0.298	0.952	0.044
PrimalFlankUG	PrimalFlankCH	0.082	0.501	0.501
PrimalFlankUG	PrimalRibPR	0.647	0.067	0.021
PrimalFlankUG	PrimalChuckPR	0.995	0.376	0.558
PrimalFlankUG	PrimalRoundPR	0.9	0.397	0.976
PrimalFlankUG	PrimalLoinPR	0.58	0.215	0
PrimalFlankUG	PrimalBrisketPR	0.994	0.662	0.026
PrimalFlankUG	PrimalShortPla~PR		0.748	0.972
PrimalFlankUG	PrimalFlankPR	0.066	0.49	0.778
PrimalFlankUG	PrimalRibBR	0.079	0.143	0.837
PrimalFlankUG	PrimalChuckBR	0.543	0.543	0.891
PrimalFlankUG	PrimalRoundBR	0.079	0.005	0.83
PrimalFlankUG	PrimalLoinBR	0.66	0.658	0.353
PrimalFlankUG	PrimalBrisketBR	0.806	0.226	0.403
PrimalFlankUG	PrimalShortPla~BR			0.581
PrimalFlankUG	PrimalFlankBR	0.353	0.423	0.784
PrimalFlankUG	PrimalRibUG	0.364	0.072	0.086
PrimalFlankUG	**PrimalChuckUG**	0.078	0.041	0
PrimalFlankUG	PrimalRoundUG	0.93	0.078	0.802
PrimalFlankUG	PrimalLoinUG	0.426	0.456	0.525
PrimalFlankUG	PrimalBrisketUG		0.739	0.272
PrimalFlankUG	PrimalBrisketUG	0.233	0.409	0.029
PrimalFlankUG	ALL	0	0	0