DISTRIBUTION OF U.S. BEEF EXPORTS IN THE INTERNATIONAL MARKET

by

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ABSTRACT

The beef industry is a very important in the food sector of agriculture and over the past two decades the United States beef industry has faced many challenges. Over time the distribution of beef exports have changed due to food safety issues and government policies, not just in the U.S., but on a global scale forcing U.S. beef producers to diversify their export outputs to other countries that were not previously strong leaders in the export business. The U.S. must be strategic in their production decisions in order to continue to compete on a global level to avoid significant loss during adverse conditions. One of the major challenges that the U.S. industry has faced is the discovery of BSE in late 2003 in the state of Washington, which led to the closing of many borders to countries who had a significant impact on the beef industry in the U.S.

Since U.S. beef is highly regarded by consumers for its quality worldwide, it is important to understand what changes have taken place in the past to have a full understanding of what changes need to be made in the future. The objective of this thesis is to look at how the distribution of the value, volume and price of U.S. beef exports have changed over the past two decades. By looking at how this has changed we will be able to see what countries are emerging as important customers and how others have declined. This is extremely important since some of the major importing countries have changed or put restrictions on the U.S. beef industry over the past two decades and the industry needs to understand these changes so that they can remain strong in the export sector. By analyzing the global trends of U.S. beef exports by value, volume and price across principal regions of the world, research will show us how to change for future changes. By assessing

the effect of the discovery of BSE in the U.S on changes in the distribution of beef exports across the global regions, research will show who emerged when other countries declined. By using this research, the foregoing results will be helpful to inform the industry on what export market strategy can be developed for the U.S. beef industry.

The results suggest that BSE had some negative effect on the U.S. beef industry in terms of the value and volume but did not have an impact on the price per pound of beef. Some regions had a larger impact than others when BSE was discovered, such as East Asia, but during this other regions, such as North America, came through and became the leaders in exports for U.S. beef. While there was some growth from the Rest of the World, there was not enough of an impact to compete with the foregoing countries.

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CHAPTER I: INTRODUCTION

The agri-food sector is a vast, diverse industry that is in a state of constant change. These changes are predicted on changes emanating from the marketplace, from consumers and competitors, both domestic and foreign, and from the biotic and edaphic conditions under which the industry works. The agri-food sector's players are, therefore, in constant search for strategies that would allow them to sustain their competitiveness in this changing environment. This is extremely important since they must remain competitive in this industry to compete on a global level.

The beef industry is one of the agri-food sector's many industries. The industry comprises genetics suppliers, beef producers, feedlot operators, beef processors, further processors, exporters, distributors, retailers and all of their supporting service providers. Whenever a market situation disrupts the demand for beef, the effects of that disruption is felt throughout the beef supply chain. For example, a regulatory change in a major importing or exporting country could alter the demand for beef in ways that lead to significant changes in production of beef cattle. Being at the proverbial end of the supply chain, beef producers, thus, have to be strategic in their production decisions in order to avoid significant losses during adverse conditions and seize the benefits of beneficial changes.

Over the past two decades the United States beef industry has faced many challenges. For example, the discovery of bovine spongiform encephalopathy (BSE) or Mad Cow Disease, led to the closing of borders to some significant importing countries such as Japan and South Korea. This single event alone may have engendered significant changes in the U.S. beef industry, at many levels of the supply chain. Additionally, there

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have been increasing changes in the domestic demand as per capita consumption of beef decreases in competition to white meats, such as chicken. Economic Research Service (ERS) data show that per capita annual consumption of beef was 103.3 pounds in 1980 and only 84.8 pounds in 2010, a decline of nearly 18 percent. This has happened as domestic expenditure on food has increased from $1,357 per capita per annum to $4,043 (in current dollars). Thus, the share of the beef industry's share of U.S. consumer's total food expenditure may be declining. The decline in market share translates directly into declines in production if the export market is unable to make up the difference.

1.1 Research Problem

Research shows that U.S. beef is highly regarded by consumers for its quality in many markets. High quality U.S. beef has taken a lead position in international markets with the help of the U.S. Meat Export Federation (USMEF). Working as a non-profit trade association for meat exporters, USMEF works closely with U.S. meat exporters to increase exports, collecting and sharing intelligence as well as facilitating promotions and undertaking market development in collaboration with the industry. USMEF has the ability through its worldwide network of offices to help U.S. beef companies and their products to become integral parts of international trade in the red meat market. (U.S. Meat Export Federation) In spite of the organizations effort, the economic and policy environments in many countries and regions have had adverse effects on the demand for US beef.

The problem that this research seeks to address is a relatively simple one. How has the distribution of the value, volume and price of U.S. beef exports changed over the past two decades? Does the effect of BSE explain the shifts that have occurred over the period and what countries have emerged as important customers and others declined? This problem is important because it allows for the understanding of how the beef industry may

undertake its intelligence development protocols going forward based on how history has

evolved on changing market fortunes.

1.2 Objectives

The overall research objective is to evaluate the changes the distribution of value,

volume and price of U.S. beef exports over the past 22 years. The specific objectives as

follows:

1. Analyze the global trend of U.S. beef exports by value, volume and price

   across the principal regions of the world

2. Assess the effect of the discovery of BSE in the U.S. on changes in the

   distribution of U.S. beef exports across different global regions

3. Use the foregoing results to inform export market development strategy for

   the U.S. beef industry.

1.3 Outline of Thesis

The next chapter provides a review of the literature on beef exports and the factors

that define demand for U.S. beef in international markets. The review is divided into two

segments. The first assesses the demand for beef on a global scale looking at countries that

export beef as well as countries that consume beef. It attempts to understand the factors

that influence demand for foreign beef globally and the U.S. position in that market and

how unforeseen events effect the market. The second segment evaluates risk and trade for

the U.S. beef industry in current markets such as Japan and South Korea after the discovery

of BSE in the U.S. The purpose of this literature review is to provide input into how the

U.S. industry positions itself for building future opportunities despite a major setback from

BSE. The third chapter focuses on describing the data and methods used in this research.

The summary of results from the analyses are presented and discussed in Chapter 4 dealing

with growth rates by region and analysis by region and specific countries in the regions.

Chapter 5 presents the summary, conclusions and strategic implications for export market

development for the US beef industry. It also presents suggestions for future research that

may be undertaken.

CHAPTER II: LITERATURE REVIEW

In this section, we provide a brief overview of the literature on beef trade and some of the recent forces that have affected it. We begin with an overview of global trade, identifying the major players in the industry and end with the suggestion that understanding the trends in U.S. beef exports is essential for the long term competitiveness of the U.S. beef industry. The second part of this section focused on the food safety aspects of the industry and how a singly phytosanitary event can significantly disrupt an industry's fortunes. This is done only to provide a caution to the industry to build significant resilience into its systems to more effectively deal with such low risk high consequence events.

2.1 Global Beef Market Overview

Beef is the third most widely consumed protein available in the world, accounting for 25 percent of meat production worldwide (Raloff, 2003). As with all products, nations exhibit different levels of comparative advantage in production, leading to some countries becoming net exporters and others becoming net importers. Indeed, some of the top consumers of beef are also net exporters, providing some insights into how domestic consumption of a product may drive its growth into the international market. Some of the world's top producing countries of beef include the India, Brazil and China. Given the direct relationship between beef production and cattle numbers, the top 10 cattle and beef producing countries are presented in Table 2.1. The table shows that while India is the world's leading cattle producing country, the U.S. is by far the largest beef producing country (on carcass weight basis). This may be attributable to the high productivity of U.S. beef producers and processing facilities, allowing the U.S. industry to harvest larger volumes of production from live cattle than many other countries.

Table 2.1: Top-Ranking Cattle and Beef Producing Countries

Rank	Country	1000 Herd	Country	1000 MT (CWE)
1	India	58,300	United States	11,789
2	Brazil	49,400	Brazil	9,300
3	China	41,000	EU-27	7,920
4	United States	35,300	China	5,550
5	EU-27	30,150	Argentina	2,800
6	Argentina	13,200	India	2,760
7	Australia	10,158	Australia	2,075
8	Russia	6,970	Mexico	1,735
9	Mexico	6,797	Russia	1,260
10	Colombia	5,675	Pakistan	1,250

The Foreign Agricultural Service (FAS) of the USDA (2013) reports that global meat exports – including beef, pork and poultry – have grown over 40 percent in less than 10 years. The same report is forecasting that 2014 will see this continued growth and demand because of cheaper feed supplies and rising import demand. Most of this import demand is from China and Hong Kong, while U.S. production of beef is forecast to drop due to continually shrinking cattle supplies. Global consumption of beef has continually increased and is forecasted above 2013's record with international trade expected to continue to reach new records.

A report from the Foreign Agricultural Service of USDA (2013) shows that Brazil has expanded its herd as well as increased its feedlots. The herd expansion is aided by government programs allowing them to improve their pastures and using higher quality

genetics in their herd. Brazil has also seen higher cattle prices with cheaper feed prices which will encourage producers to use more feed to maintain weights as well as an increase in consumption of beef. Brazil will still expand consumption modestly into the future but will be controlled by inflation and rising debt from consumers.

India has seen an increase in their beef production as well as their bovine herd from 2003 to 2013. This demand is related to dairy products since dairy prices have increased as well as government programs encouraging production of beef herd growth. They are also expecting beef exports to increase by 6 percent or more which will account for around 20 percent of the world trade. India has an advantage to expand their export sells by selling halal meat that is lower quality and compares to other markets. They still have some constraints to expand to new markets because they have not been able to get a status classification with the World Organization for Animal Health concerning foot and mouth disease (Foreign Agricultural Service - USDA 2013).

Australia's beef production has been increasing since 2004 at a steady rate due to an increased demand in the global market. Australia had begun to increase its production in 1998 to 2000. Historically, most of Australia's beef had been exported to North Asia and North America, but in recent years Australia has diversified its market to other countries such as South Asia, China and the Middle East. Some of the changes in Australia's export numbers can be attributed to tighter cattle supplies which was followed by widespread rain which had an impact on their production of grass-fed beef. (Meat and Livestock Australia, 2012)

The U.S. has been one of the world's largest beef producers for many years, but declining cattle herds, drought conditions across the U.S. and increased feed costs have

caused exports to decline in recent years. The discovery of BSE in the U.S. increased its trade deficit in beef and veal products. The FAS (2013) has forecasted both production and consumption in the U.S. to decrease by 6 percent and 5 percent respectively, probably influenced by declining cattle inventories.

Some of the smaller countries like Uruguay and Paraguay have had herd expansions which have enabled them to increase their presence on the global beef market. Most of this trade is related to certain countries with Uruguay exporting mainly to China and Paraguay exporting mainly to Russia (FAS, 2013).

The demand for beef has many forces that effect consumption and some of these forces can be attributed to relative prices of competing meats, consumer income, health and nutrition concerns, food safety and changing consumer preferences (Schroeder and Mark., 2000). It is important for the industry to understand these forces so that they can adjust their product to cater to the needs of the consumer, since consumers are the main drivers behind any product and when consumer preferences change, it effects the industry.

Changes in food safety practices effect how consumers purchase a product, for instance, if there is a recall on a food product the consumer is not likely to go out and purchase the product until they know it is safe for consumption. When consumer incomes change, so do the types and quality of products they buy, for instance, if consumer's incomes increase they are more likely to buy higher quality, higher priced cuts of beef, such as rib eye steak, but if incomes decrease, consumers are more likely to purchase lower quality, lower priced cuts of beef such as ground beef or another less expensive protein source such as chicken or pork. If another type of protein source is priced lower than one, consumers may be more likely to purchase this whether it is based on one factor, or a

combination of a few factors, such as income or preference. Some consumers look at the health aspect of a food source when purchasing a product and that could be constructed on if the product is lean or healthy to consume based on a personal preference or a health concern for the consumer.

On the whole, it is clear that both beef production and consumption are increasing on a global level. Analyzing the performance of the U.S. beef industry in these changes in the global beef market provides insights into where opportunities may lie and also what policy initiatives may be pursued to improve the industry's competitiveness in those countries. The literature review has provided some overview of the trends around the world and the forces that may be influencing them. The remaining sections of the research focus on the U.S. and the trends in the industry in the hope of providing some input to the conversation about strategic directions that the industry might take to position itself to seize emerging opportunities even as it protects it current markets.

2.2 Risk and Trade: BSE in the U.S.

BSE was discovered in one dairy cow in Canada in early 2003 and in Washington State on December 23, 2003. The immediate response of the market to these discoveries was a total "shut down" of the major beef export markets to both the U.S. and Canada. There is significant research on the effects of the ban on beef exports to Japan after the BSE discovery. We focus on a few of these works to illustrate the importance of international trade rules in ensuring the long-term competitiveness and sustainability of whole industries. The analysis of events can be broken down into six segments (Figure 2.1).

It shows that at the discovery or the onset of the event, there is often panic in the industry in which the event occurred because it is unclear at that stage how widespread it is

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and what its potential risks are on others segments in the supply chain. As a result of the

uncertainty about the extent and depth of the event, importers often rush to halt their

imports in anticipation of government policy changes in the sanitary and phytosanitary

regulations. These triggers are enshrined in the World Trade Organization's agreements

guiding food safety and consumer protection. These policy changes have the immediate

effect of triggering market losses for exporters, reducing trade and increasing domestic

availability of the affected product. Assuming the product is not considered compromised

by the exporting country's government, the effect of this increased inventory is market

price depression in the domestic market as the industry finds ways to dispose of the

proportion of the production that had previously gone to exports. The result of this

situation is declines in domestic prices as supply exceeds the pre-established market

clearing levels in the domestic market. The whole industry's supply chain comes under

pressure as each stage in the supply makes rapid adjustments to its operations to minimize

the effects of the disruption. As individual firms work on their own operations to minimize

the effect of the price declines and loss of markets, industry representatives frequently

initiate government-level conversations to initiate negotiations with trading partners to

alleviate the initial response to the event.

Figure 2.1: The Flow of Response to Adverse Events in Internationally-Trade Food Products

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┌──────────────┐      ┌──────────────┐      ┌──────────────┐
│ Discovery or │  →   │ Export Bans  │  →   │   Market     │
│ Event Onset  │      │              │      │   Losses     │
└──────────────┘      └──────────────┘      └──────────────┘
                                                    ↓
┌──────────────┐      ┌──────────────┐      ┌──────────────┐
│ Negotiation  │  ←   │ Processor and│  ←   │   Policy     │
│ of Changes   │      │   Producer   │      │   Changes    │
│              │      │   Impacts    │      │              │
└──────────────┘      └──────────────┘      └──────────────┘
```
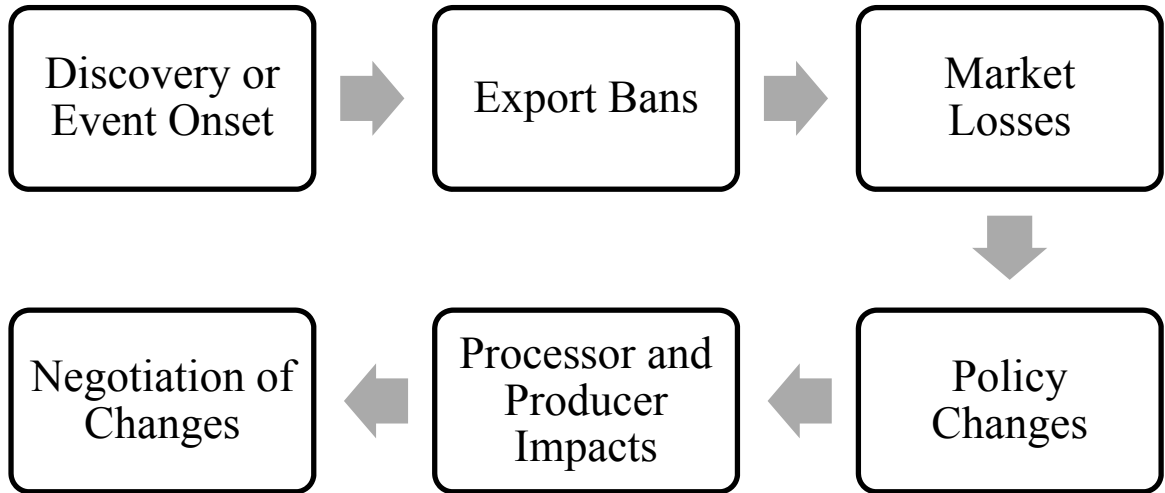
These negotiations with policymakers at the governmental levels often lead to policy changes in how markets would be reopen again. They often involve changes in the oversight protocols in production to minimize the risk of the event occurring or institute hazard control points to address them effectively should they become inevitable. These policy negotiations, therefore, often lead to changes in producers' and processors operations, affecting their costs and their systems. The implementation of these changes lead to reopening of markets and as confidence begin to build, government and trade level negotiators continue to work on changes to the immediate policies that were implemented at the onset of the event to eliminate costs that contribute nothing to the objective of food safety or the triggering concerns. This model is applied to explore the BSE event in the U.S. and its effects.

The Food Safety Inspection Service (FSIS) of USDA is responsible for the safety of the U.S. food supply and was responsible for issuing rules as to what was allowed and what

was not allowed in the human food supply, specifically specified risk materials (SRM). The Animal and Plant Health Inspection Service (APHIS) stepped up BSE surveillance efforts conducting testing on as many cattle as possible in a 12 to 18 month period beginning in June 2004 (Coffey et al., 2005).

Coffey et al (2005) looked at the costs associated with BSE regulations as well as the market response to the December 23rd 2003 case on both the export and domestic markets, including the costs of testing for BSE. The regulations that were introduced in 2004 led to many changes, mainly dealing with changes in cattle procurement, employment, employee training requirements, food safety plans, capital investments, and marketing opportunities for the beef industry. Coffey and his colleagues note that on average, firms incurred additional labor costs of $0.45 per head of daily capacity. "The one-time costs of training employees to comply with new FSIS rules varied from $13,800 to $100,000 across firms" (Coffey et al., 2005, p. 3). Coffey et al. state that the new regulations resulted in revenue losses due to products being banned from the food supply. They also estimate that firms that previously sold small intestines estimated an average loss of $3.68 per head in potential revenue, contingent on the availability of export markets (Coffey et al., 2005)

Coffey et al. (2005) stated that within days of the BSE announcement in December 2003, 53 countries had banned imports of U.S. cattle and beef products which included major markets such as Japan, Mexico, South Korea and Canada. The result of the ban caused beef exports to plummet by about 82% below 2003 level. This automatically increased inventory in the domestic market, leading to declining prices. The domestic market for cattle prices fell by about 16% but recovering early in 2004 becoming clear that

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U.S. consumer demand had only been impacted minimally, if at all. When the market closed to Japan, a major importer of U.S. beef and beef by-products not valued by U.S. consumers, the results were immediate (Coffey et al., 2005).

New rules implemented by FSIS in January of 2004, mandated U.S. meat slaughters, processors, and fabricators that they designate the brain, skull, eyes, spinal cord, vertebral column, trigeminal ganglia and dorsal root ganglia from 30 months of age or older as specified risk materials (SRM). The rule, specifically titled "Prohibition on the Use of Specified Risk Materials for Human Food and Requirements for the Disposition of Non-Ambulatory Disabled Cattle" (69 FR 1862) stipulated that SRMs are inedible and prohibits use for human food. It requires that establishments that process slaughter cattle, or establishments that process carcasses or parts of cattle, develop, implement and maintain, written procedures for the removal, segregation and disposition of materials designated as SRMs. It also requires that all non-ambulatory disabled cattle presented for slaughter be condemned and prescribes requirements for handling and disposition of such cattle.

Marsh et al. (2008) also estimated economic losses to the U.S. beef industry caused by increased regulatory costs and reduced exports to Japan and South Korea. These were estimated using excess demand and excess supply relationships coupled with price elasticity estimates previously reported in other studies. These changes in beef supply availability in terms of export and import market shares. An increase in the U.S. beef import market share is assumed to increase domestic beef supplies and cause cattle prices to decline. Conversely, an increase in U.S. beef export market share is assumed to reduce domestic beef supplies and cause cattle prices to increase. They used time-series data for the period 1970-2005 for their econometric analysis. Data for livestock sectors were

obtained from the USDA Red Meats yearbook and USDA Livestock, Dairy and Poultry

Situation Outlook Reports, corn and hay price data were obtained from the USDA Feed

Yearbook and USDA Agricultural Statistic's series. The food marketing cost index was

obtained from USDA's Agricultural Outlook series (Marsh et al., 2008).

Marsh et al. (2008) found that U.S. beef import and export shares had trended

upward between 1970 and 2002. Between 1982 and 2003, export markets shares increased

more than import shares. In addition, the import market share was somewhat more variable

than the export market share prior to 2003. Several assumptions about the changes in U.S.

imports and exports of beef are required to estimate the impacts on cattle prices of North

American BSE events. The objective was to estimate these impacts given the market

conditions that existed in 2005. The U.S. beef export share was 8.71% in 2002, but

declined to 1.72% in 2004 as access to foreign markets were restricted. Also in 2004 the

import share decreased from 15.9% in 2002 to 14.4% in response to the ban on cattle

imports from Canada (Marsh et al., 2008).

In December of 2005, the Japanese reopened their border to U.S. beef on a limited

basis while South Korea remained closed. The results provided by Marsh et al, indicate

that if Japan had resumed imports of U.S. beef at pre-BSE levels in 2005 and the U.S. had

resumed normal beef trade relations with Canada, then the U.S. cattle prices would have

increased by $3.81 per cwt and $5.75 per cwt, respectively, relative to 2004 prices. Other

potentially important factors, such as the effects of by-product trade are not included, but

over 40% of U.S. beef by-products are exported, and changes in beef by-products values

from trade sanctions would also be bid into cattle prices. The study provided some new

evidence about the direct effects of the May 2003 and December 2003 BSE events on

domestic demand for beef products in both Canada and the U.S. The impacts of Japanese beef import restrictions on U.S. cattle prices were substantial, thus, the demand for U.S. beef was affected to a much greater degree by reactions of foreign governments to the BSE announcements than by reactions of U.S. households (Marsh 2008).

Coffey et al. (2005) suggested that there were many changes in the beef packing sector after the BSE discovery which included regulatory mandates concerning changes in procurement, changes in employment, employee training, Hazard Analysis Critical Control Points (HACCP), Sanitation Standard Operating Procedures (SSOP) and record keeping, facility modification investment and lost products. The changes in procurement involved in fed slaughter indicated that it was not desirable to purchase these animals because of the increased costs they bring to the firm. While few packers are able to use source verification agreements to identify groups of cattle where there are no over 30 months of age, these agreements represent a small portion of cattle available for slaughter (Coffey et al, 2005).

With respect to the changes in employment regulations from the BSE incident, the beef packing segment spent about $14.7 million in 2004 on wages for additional jobs to comply with BSE regulations. Beef packing and processing firms have found it necessary to specifically train employees in several areas to endure compliance with FSIS Interim Final Rules. Average training costs for one firm were $41,317, but companies costs ranged from $13,800 to $100,000. Training costs associated with beef export verification programs were also found to be highly variable across firms, but nominal (Coffey et al, 2005). Employee-related costs related to HACCP and SSOP were determined to be minimal, according to Coffey et al. (2005).

The facility modification investment showed that BSE regulatory changes influenced capital investments made by meat packers. Certain regulations required firms to purchase new equipment while the value of some existing investments also was influenced by the regulatory changes. Also, certain equipment once used became idled because of the regulatory changes. For example, equipment purchased for dentition to prove age of animals (Coffey et al., 2005).

FSIS Interim Final Rules removed specific products from the food supply that were previously being sold by several meat packers and processors domestically and/or internationally. For example, products that included brains from over 30 month cattle (OTM), small intestines of all cattle, and bone-in cuts from OTM cattle containing vertebral column were all condemned (Coffey 2005, 38). Prior to the 2004 BSE regulations, most of the small intestines were processed to varying degrees and sold to Mexico and as edible product to Japan and South Korea.

CHAPTER III: DATA AND METHODS

This chapter will discuss the data and methods used in this research. The chapter is divided into two components. The first presents the sources of the data that were used in the research while the second provides an overview of the methods that were employed. The discussion in this section provides a context for understanding the strengths and limitations of the results that are presented in the next chapter.

3.1 Data Collection Methods

The data used for this research were drawn from a large database on trade information developed and managed by USDA's Foreign Agriculture Service (FAS). The FAS links U.S. agriculture to the rest of the world and enhances export opportunities and global food security. Their staff, which are stationed in over 169 countries, are the voice for U.S. agriculture around the world and work to advance opportunities for U.S. agriculture and supports U.S. foreign policy in foreign countries. They expand and maintain access to foreign markets for the U.S. by removing trade barriers and enforcing the U.S. right's under current trade agreements. The data are available from Global Agriculture Trade System (GATS) portal. The GATS search engine provides data on various dimensions of international agricultural and food trade including fish, forestry products and textile products. The range of the time series data spans the inception of the BICO-HS10 coding system in 1989 to present.

To address the question driving this research, we needed data on the volume and value of beef exported from the U.S. to various countries around the world. We started by collecting secondary data from GATS database using the regional aggregations. This encompassed 13 regions on five continents. The regions are presented as in table 3.1.

Table 3.1: Regional Aggregation for Assessing U.S. Beef Exports (1990-2012) Based on GATS Database

1. Caribbean	2. European Union
3. Central America	4. Former Soviet Union
5. South America	6. Middle East
7. East Asia	8. North Africa
9. South Asia	10. North America
11. Southeast Asia	12. Sub-Saharan Africa
13. Europe (outside the EU)	

It is important to recognize there are a few countries in a number of these regions that account for the majority of U.S. exports to the region. In addition, we show that not all of these regions are of critical strategic importance for the U.S. beef industry. As such, our analysis are structured to focus on the region as a whole and then specifically on important countries in that region. This was aimed to provide insights into emerging markets that may not be visible when considered in the context of the larger markets or when considered within their regional situations. The data drawn from GATS was time series from 1990 to 2012 (the latest with complete information). The GATS data are reported in metric tons for volume and in current U.S. dollars for value.

3.2 Method

Two major approaches were used in this research: literature review and statistical/econometric analyses. The statistical analyses focused on summary statistics and comparisons across regions and the identification of the principal destinations of U.S. beef in each region. The summary statistics offered an overview of volume, value and price

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across the regions considered in the study. The study also conducted regression analyses for each of the regions, estimating the growth rates for volume, value and price of beef exports, especially the effect of the BSE in the U.S. The growth rates are compared in a pairwise fashion to determine if there are statistical differences between the growth rates in the different regions. Clear dominant regions with the highest growth rates were then selected for further analyses.

The analytical process is described in Figure 3.1. It indicates that in Step 1 the trend in each region is estimated using the best-fitting model that has time (in years) and the BSE even dummy on the right hand side and volume, value and price on the left hand side for each region. Step 2 compares the estimated growths rates for volume and value in each region and test for the statistical differences in a pairwise manner across the regions. The objective is to identify clearly dominant regions with the highest growth rates. Step 3 order ranks the dominant regions by the volume and value growth rates. Regions with high value and volume growth provide opportunities for securing the long-term competitiveness of the U.S. beef industry in the global market. The final step involves identifying the two or three countries in each of the top regions that are driving the regions performance for further analyses.

Figure 3.1: Analytical Overview
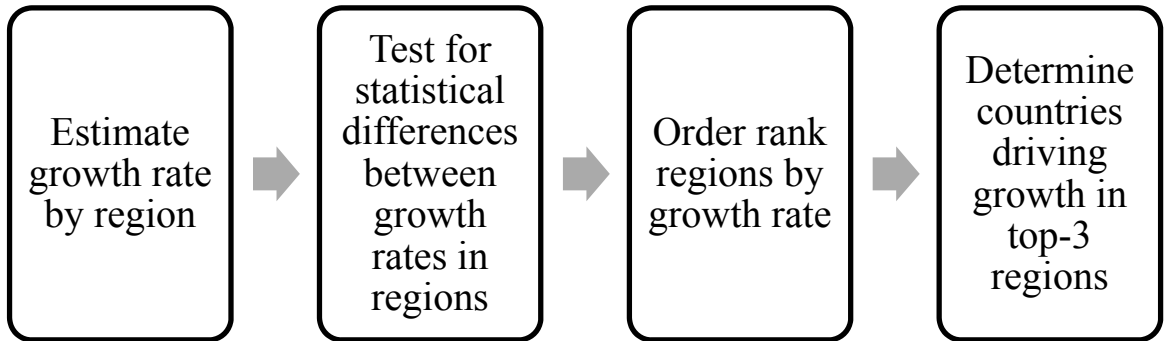
Step 1 is defined by the Equation 1 below:

$$Q_{it} = f(t, D, \varepsilon) \quad i = 1, 2, 3 \tag{1}$$

where t is year and i refers to 1= North America, 2= East Asia and 3 is the Rest of the

World, D is the BSE dummy and ε is the regression error term that is assumed to be

independently and identically distributed with a mean of zero and a standard deviation of

unity. Q is the volume of exports to destination i in time t. The first derivative of Equation

(1) provides the estimate of the growth rate. Equation (2) tests the statistical difference

between the estimated growth rates in the regions:

$$\frac{dQ_{it}}{dt} = \beta_i \quad i = 1, 2, 3 \tag{2}$$

$$\begin{aligned} H_o &: \beta_i = \beta_j \quad i \neq j \\ H_1 &: \beta_i \neq \beta_j \quad i \neq j \end{aligned} \tag{3}$$

where β is the estimated growth rate. The hypothesis in Equation (3) states that the

estimated growth rate for Region i is equal to that for Region j. If this is the case, then

there is no growth rate advantage between Region i and Region j and there is no clear

dominance of either region. On the other hand, if the hypothesis is rejected, then one

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region is clearly dominant and calls for the Step 3 analysis of the countries within the

region that are shown to contribute to the estimated trends. Equation (4) to Equation (6) are

explained in the same manner as the foregoing equations except that V_i defines the value of

exports to Region i and α_i is the estimated growth rate in value for Region i. All other

variables are as defined.

$$V_{it} = f(t, D, \varepsilon) \quad i = 1, 2, 3 \tag{4}$$

$$\frac{dV_{it}}{dt} = \alpha_i \quad i = 1, 2, 3 \tag{5}$$

$$\begin{aligned} H_o &: \alpha_i = \alpha_j \quad i \neq j \\ H_1 &: \alpha_i \neq \alpha_j \quad i \neq j \end{aligned} \tag{6}$$

CHAPTER IV: DATA RESULTS AND ANALYSIS

The results are presented in this chapter. The first section presents the summary statistics of volume and value of U.S. beef exports to the different regions. The second section presents the results of the econometric analysis of the regions and the estimated growth rates and the ranking of the growth rates by region with the view to identifying the dominant regions by growth in both volume and value. The third section presents the results of the analyses of the countries in the dominant regions with the view of identifying the extent to which specific country characteristics influence their demand for U.S. beef. The implications and lessons from the foregoing are presented in the final section of the chapter.

4.1 Summary of Statistics

The data show that there are three major regions for U.S. beef exports, despite the 11 regions that were presented in Chapter 2, as destination of exports from the U.S.: North America; East Asia; and the Rest of the World (ROW). Thus, the ROW encompasses the Former Soviet Union, the European Union, Southeast Asia, North Africa, Caribbean, Middle East, South America, Central America, Sub-Saharan Africa, Other Europe, Oceania and South Asia.

East Asia and North America have maintained a lion's share of U.S. beef exports over the duration of the analysis (1990-2012), as shown in Figure 4.1. The figure shows that there are two distinct periods: the period prior to 2004 and the period thereafter. The former period showed a consistent dominance of East Asia as the destination of U.S. beef exports, accounting for an average of 68% of total value of beef exports. North America's share averaged about 25% during this period while the ROW was a meager 6.9% in the

period before BSE. The figure shows that U.S. beef exports to East Asia collapsed in 2004, with virtually nothing moving into that market and contributing a value of less than 1%. The slack, was picked up by the two remaining regions, essentially North America, which increased its share of total value from 31.3% in 2003 to 82.4% the next year. On average, North America's share in the post-BSE era has been about 58% while the ROW's share has been about 19.4% and East Asia's at 22.4%.

Figure 4.1: Distribution of Total Value of US Beef Exports
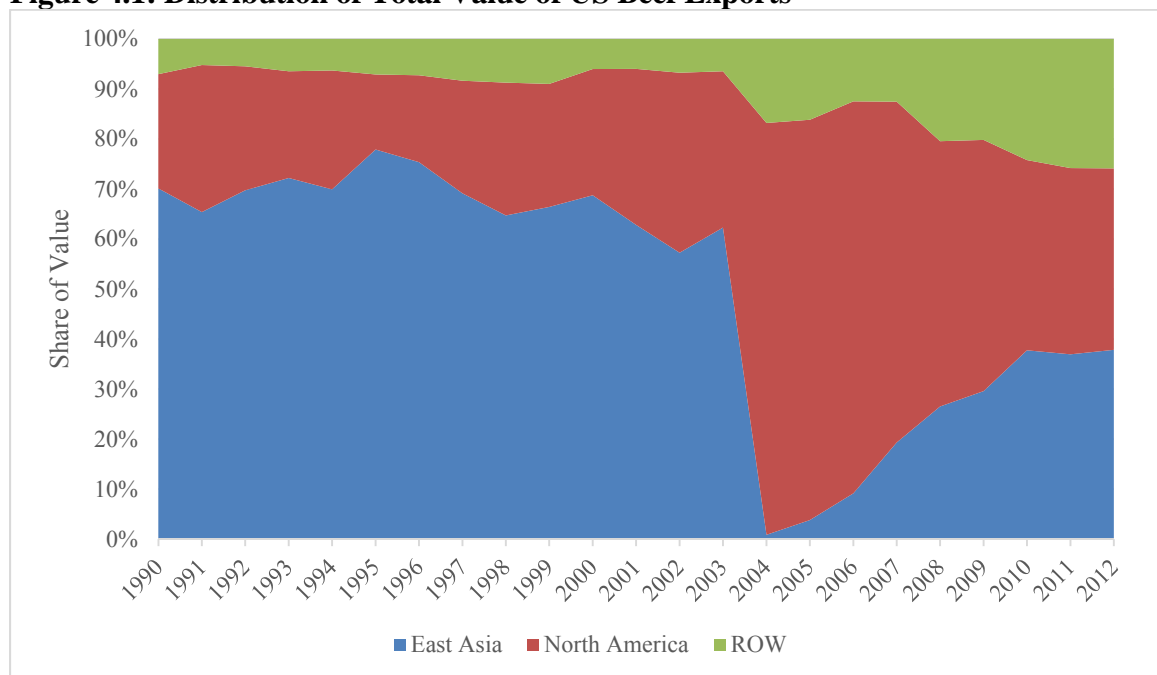
Volume distribution follows a similar trend, as presented in Figure 4.2. However, the average shares before BSE and after BSE differ quite a bit. For example, the average share of the ROW before BSE was 13.5% compared to 29.3% in the post-BSE era. For East Asia, which had the average share of value of 58.2% in the pre-BSE era compared with 17.5% in the post-BSE era. North America's volume averaged 28.3% before BSE and climbed to 53.3% in the post-BSE period.

Figure 4.2: Distribution of Total Volume of US Beef Exports (1990-2012)
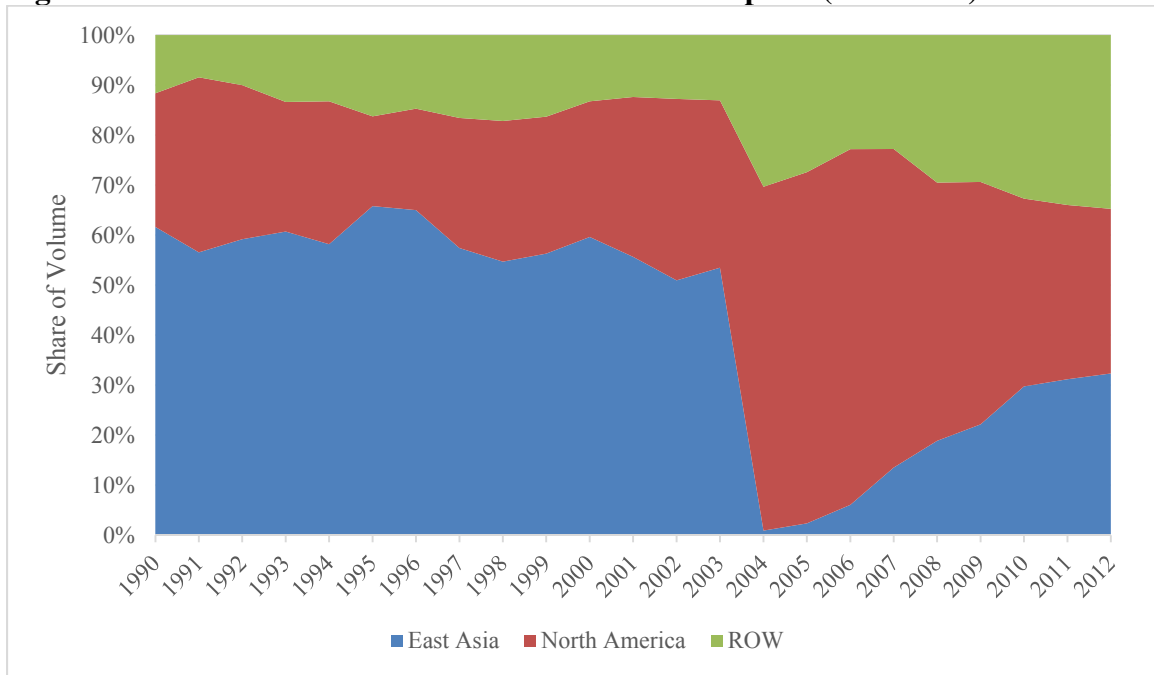
Table 4.1 shows the mean value, volume and imputed price for the three regions. The mean volume in all three regions were determined to be statistically different from each other at the 1% level. That is:

$$\overline{Q_i} \neq \overline{Q_j} \quad i \neq j, \text{East Asia, N. America, ROW}$$

This test was true when evaluated under the pre-BSE and post-BSE periods. However, the average shipments to both North America and the ROW were higher than the average shipments to East Asia in the post-BSE period while the opposite is true in the pre-BSE period. When we do not control for BSE in the estimation of the mean volume of shipment, it is found that shipments to East Asia dominates shipments to the other two regions. This means that East Asia is the principal export destination for U.S. beef even with the BSE crisis.

Table 4.1: Summary Statistics of U.S. Beef Exports by Volume, Value and Imputed Price for Principal Regional Markets (1990-2012)

Variable	Unit	N	Mean	Std. Dev.	Min	Max
Volume - East Asia	MMT	23	407.00	236.00	2.96	763.00
Volume - N. America	MMT	23	324.00	114.00	136.00	492.00
Volume - ROW	MMT	23	179.00	101.00	50.30	436.00
Value - East Asia	$ Mil.	23	1570.00	785.00	6.90	2540.00
Value - N. America	$ Mil.	23	1060.00	516.00	429.00	2020.00
Value - ROW	$ Mil.	23	385.00	382.00	112.00	1420.00
Price - East Asia	$/#	23	$4.08	$0.83	$2.33	$5.70
Price - N. America	$/#	23	$3.19	$0.69	$2.50	$5.37
Price - ROW	$/#	23	$1.91	$0.63	$1.28	$3.62

The mean value of shipments to East Asia was $1.57 billion between 1990 and 2012 compared with $1.06 billion for North America, and while the standard deviation for East Asia was higher, their coefficients of variation were about the same. This indicates that despite the BSE incidence, the variability in the value of shipments in the two regions was about equal. The mean value of shipments from the rest of the world was relatively small compared to the East Asian and North American values, coming in at less than a quarter of East Asia's. Thus, for all intents and purposes, these two regions remain the principal destinations of value for U.S. beef exports.

The imputed price is the quotient of value from exports in any year to volume exported in the same year. Despite the collapse of exports to East Asia after BSE, Table 4.1 shows that the mean imputed price without controlling for BSE is highest in East Asia at $4.08/pound, followed by $3.19/pound in North America and $1.91/pound in the ROW. The low mean price in the ROW may be indicative of the relative quality of beef that is shipped to the ROW as a whole. Recall that this includes all regions with the exception of East Asia and North America, as presented in Table 3.1, and while this included countries such as those in the European Union, where high quality products are expected, it also

included countries in Sub-Saharan Africa where income and economic conditions dictate that lower quality products will be the affordable options.

The price coefficient of variation, which measures the stability of the price variable, is estimated at 32.9% in the ROW, compared to 20.3% in East Asia and 21.6% in North America. This higher variability in prices is expected in the ROW because of the higher competition among exporters since they are all selling a commodity. In other words, exporters in general would serve their best markets – i.e., highest value and volume markets – and dispose of any inventory in other markets at prices that facilitate movement of products. This is because for perishable products, selling the product once produced is in the long-run more profitable than storing it in anticipation of better prices. Furthermore, we have already established that products that go to these tertiary markets are probably not the highest quality products to start with.

4.2 Growth Rates by Region

The growth rates for each region for the three variables of interest – volume, value and price – are estimated using linear regression models. Linear regression was chosen because it presented the best results from a number of alternative specifications of the relationship between volume, value and price on the one hand and time on the other. The incidence of BSE is included in each of the models as a dummy variable to control for the effect of that on volume shipped, value of shipment and by deduction for the price received by pound of shipment.

4.2.1 East Asia

Table 4.2 presents the results of the estimated growth rate in U.S. beef export volume, value and imputed price for East Asia between 1990 and 2012, controlling for the BSE incidence in 2003. It shows that the volume shipped to East Asia increased at the rate

of about 3.6 x 10^7 pounds per year between 1990 and 2012 and the coefficient was

statistically significant at the 1% level. It also shows that the discovery of BSE had a

negative effect on the growth curve, shifting it down, on average, by nearly 7.9 x 10^8

pounds per year over the duration. The coefficient of the BSE dummy variable was also

statistically significant at the 1% level. The overall model was also determined to be

statistically significant at the 1% level with an F(2,20) of 128.48, with an R-square of

92.78% and an adjusted R^2 of 92.06%.

Table 4.2: Growth Rate Estimates for Volume, Value and Imputed Price of US Beef Exports to East Asia (1990-2012)

East Asia Volume (#)	Coefficient	Std. Err.	t	P>t
Year	3.59E+07	3924376	9.16	0.000
BSE	-7.87E+08	5.33E+07	-14.76	0.000
_cons	-7.12E+10	7.84E+09	-9.09	0.000
F (2, 20)	**128.48**			
Prob > F	**0.00**			
R^2	**0.9278**			
East Asia Value ($)	Coefficient	Std. Err.	t	P>t
Year	1.06E+08	2.59E+07	4.08	0.001
BSE	-2.31E+09	3.57E+08	-6.45	0.000
_cons	-2.09E+11	5.16E+10	-4.04	0.001
F (2, 20)	**23.22**			
Prob > F	**0.00**			
R^2	**0.7180**			
East Asia Price ($/#)	Coefficient	Std. Err.	t	P>t
Year	-0.04	0.05	-0.81	0.429
BSE	1.36	0.77	1.76	0.093
_cons	78.89	93.04	0.85	0.406
F (2, 20)	**3.54**			
Prob > F	**0.048**			
R^2	**0.7064**			

The value shipped to East Asia increased at the rate of about $1.06 x 10^7 per year

between 1990 and 2012 and the coefficient was statistically significant at the 1% level. It

also shows that the discovery of BSE had a negative effect on the value of shipments to

East Asia, shifting it down, on average, by nearly 2.31×10^9 per year over the duration. The coefficient of the BSE dummy variable was also statistically significant at the 1% level. The overall model was also determined to be statistically significant at the 1% level with an F(2,20) of 23.22, with an R-square of 71.8% and an adjusted R^2 of 68.98%.

Table 4.2 also shows that the imputed price of U.S. beef exports to East Asia has been virtually flat over the period, with the estimated coefficient (growth rate) showing a negative, but not statistically significant value. On the other hand, the effect of BSE on price was interestingly positive in East Asia, albeit barely statistically significant. The reason for this positive effect of the BSE incident in East Asia may be that the policy response in the region to the BSE incidence reduced availability of beef, increasing prices in general and allowing the U.S. to benefit from that increase when it re-entered the market. It is important to reiterate that the effect was virtually flat (not statistically significant from zero).

4.2.2 North America

Table 4.3 presents the results of the estimated growth rate in U.S. beef export volume, value and imputed price for North America between 1990 and 2012, controlling for the BSE incidence in 2003. It shows that the volume shipped to North America increased at the rate of about 2.07×10^7 pounds per year between 1990 and 2012 and the coefficient was statistically significant at the 1% level. It also shows that the discovery of BSE adversely affected the volume of North American shipments, with the intercept shifting down by nearly 1.07×10^8 pounds, a coefficient that was statistically significant at the 5% level. The overall model was determined to be statistically significant at the 1% level with an F(2,20) of 34.84 and an R-square of 75.20%.

Table 4.3 Growth Rate Estimates for Volume, Value, and Imputed Price of U.S. Beef Exports to North America (1990-2012)

North America Volume (#)	Coefficient	Std. Err.	t	P>t
Year	2.07E+07	3129858	6.61	0.000
BSE	-1.07E+08	4.82E+07	-2.22	0.038
_cons	-4.10E+10	6.25E+10	-6.56	0.000
F (2, 20)	34.84			
Prob > F	0.000			
R^2	0.752			
North America Value ($)	Coefficient	Std. Err.	t	P>t
Year	6.91E+07	1.28E+07	5.4	0.000
BSE	1.06E+07	2.08E+08	0.05	0.96
_cons	-1.37E+11	2.55E+10	-5.37	0.000
F (2, 20)	64.88			
Prob > F	0			
R^2	0.8417			
North America Price ($/#)	Coefficient	Std. Err.	t	P>t
Year	0.15	0.031	0.48	0.638
BSE	0.85	0.329	2.58	0.018
_cons	-27.42	63.21	-0.43	0.669
F (2, 20)	10.53			
Prob > F	0.0008			
R^2	0.4811			

The value shipped to North America increased at the rate of about $6.91 x 10^7 per year between 1990 and 2012 and the coefficient was statistically significant at the 1% level. It also shows that the discovery of BSE had a positive effect on the growth curve, shifting it upwards, on average, by nearly 1.06 x 10^7 dollars per year over the duration. The coefficient of the BSE dummy variable was not statistically significant at the 1% level. The overall model was also determined to be statistically significant at the 1% level with an F(2,20) of 64.88, with an R-square of 84.17% and an adjusted R2 of 82.58%.

The price of U.S. beef shipped to North America increased at the rate of about

$0.02 per pound per year between 1990 and 2012 but the coefficient was not statistically

significant. However, the effect of the discovery of BSE was positive and statistically

significant at the 5% level, shifting up the intercept by $0.85 per pound. This effect

suggests that the higher volume of shipments to North America after the BSE incidence did

not lead to depression of prices. The overall model was also determined to not be

statistically significant at the 1% level with an $F(2,20)$ of 10.53, with an R-square of 48.1%.

4.2.3 Rest of the World

Table 4.4 presents the results of the estimated growth rate in U.S. beef export

volume, value and imputed price for the Rest of the World between 1990 and 2012,

controlling for the BSE incidence in 2003. It shows that the volume shipped to the Rest of

the World increased at the rate of about 1.68×10^7 pounds per year between 1990 and 2012

and the coefficient was statistically significant at the 1% level. However, the incidence of

BSE had no statistically significant effect on shipments to the Rest of the World, despite a

negative coefficient. The overall model was also determined to be statistically significant

at the 1% level with an $F(2,20)$ of 20.38, with an R-square of 70.12%.

The value shipped to the Rest of the World increased at the rate of about 4.39×10^7

dollars per year between 1990 and 2012 and the coefficient was statistically significant at

the 5% level. It also shows that the discovery of BSE had a negative effect on the growth

curve, shifting it down, on average, by nearly 3.81×10^7 dollars per year over the duration.

The coefficient of the BSE dummy variable was not statistically significant. The overall

model was also determined to be statistically significant at the 1% level with an $F(2,20)$ of

7.63, with an R-square of 54.44%.

Table 4.4 Growth Rate Estimates for Volume, Value and Imputed Price of U.S. Beef Exports to the Rest of the World (1990-2012)

Rest of the World Volume (#)	Coefficient	Std. Err.	t	P>t
Year	1.68E+07	3657666	4.59	0.000
BSE	-7.44E+07	5.19E+07	-1.43	0.167
_cons	-3.34E+10	7.30E+09	-4.58	0.000
F (2, 20)	**20.38**			
Prob > F	**0.000**			
R²	**0.7012**			
Rest of the World Value ($)	Coefficient	Std. Err.	t	P>t
Year	4.39E+07	1.69E+07	2.60	0.017
BSE	-3.81E+07	2.09E+08	-0.18	0.857
_cons	-8.74E+10	3.37E+10	-2.59	0.017
F (2, 20)	**7.63**			
Prob > F	**0.0035**			
R²	**0.5444**			
Rest of the World Price ($/#)	Coefficient	Std. Err.	t	P>t
Year	0.0035	0.035	0.1	0.921
BSE	0.675	0.431	1.57	0.133
_cons	-5.55	71.59	-0.08	0.939
F (2, 20)	**3.74**			
Prob > F	**0.0416**			
R²	**0.3223**			

Neither time nor the incidence of BSE had any statistically significant effect on the imputed price of U.S. beef shipped to the Rest of the World. Thus, unlike East Asia and especially North America, where the BSE incidence had a statistically positive effect on imputed prices, its effect on prices in the rest of the world was statistically negligible. This may be a result of the make-up of the Rest of the World group/region, with effects across

that group being so diverse that they end up "cancelling" each other out. The analyses in the next sub-section shed some light on this possibility.


4.3 Major Importing Country Analysis

An analyses of the volume and value of shipments data show a few countries account for the majority of value and volume in each of the regions. This section zeroes in on the major export-destination country with the view to identify any statistically significant effects in them with respect to their growth rates and the effect of the BSE incidence.

4.3.1 East Asian Countries

The principal destinations of U.S. beef in East Asia between 1990 and 2012 were Japan and South Korea with Hong Kong, Taiwan, China, Macau and Mongolia being minor destinations. Japan's share of U.S. beef shipments to East Asia have declined over the time period under consideration even as those of South Korea and the Rest of East Asia has increased. On average, Japan accounted for 60.7% of total shipments to East Asia while 19.9% was South Korea's average share compared to 19.3% for the Rest of East Asia. The respective standard deviations are 22.3%, 11.8% and 23.5%. Thus, South Korea and Japan's share of U.S. beef exports to East Asia have been more stable over the past quarter century than that of the Rest of East Asia.

Figure 4.3: Distribution of US Beef Export Volume to East Asia (1990-2012)
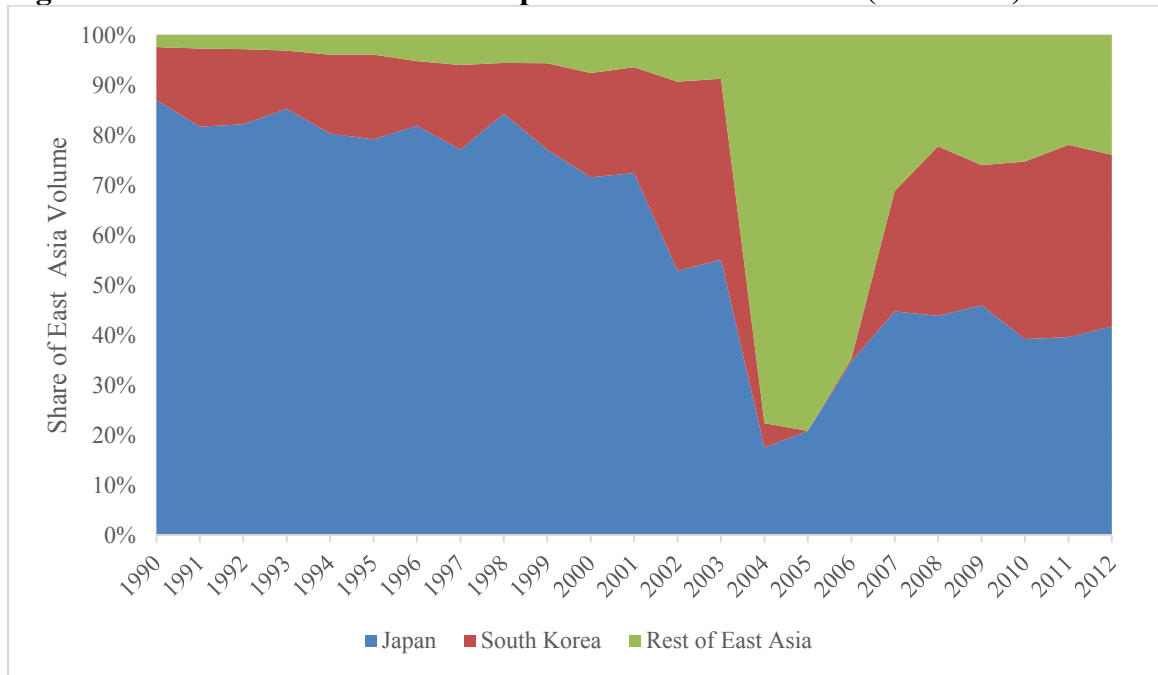
Japan's share of U.S. beef value to East Asia has declined over the time period under consideration even as those of South Korea and the Rest of East Asia has increased. On average, Japan accounted for 64.3% of total shipments to East Asia while 17.7% was South Korea's average share compared to 18.0 % for the Rest of East Asia. The respective standard deviations are 21.4%, 11.4% and 22.1%. Thus, South Korea and Japan's share of U.S. beef exports to East Asia have been more stable over the past quarter century than that of the Rest of East Asia.

Figure 4.4: Distribution of US Beef Export Value to East Asia (1990-2012)
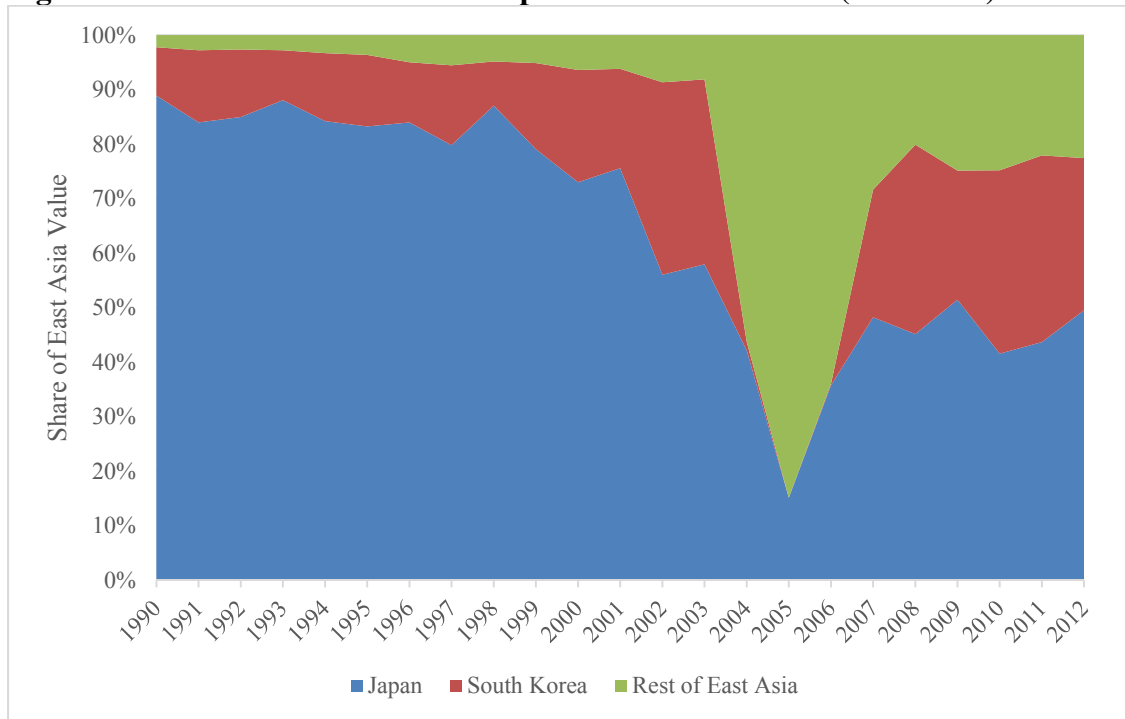
There is a positive correlation between the relationship in value and volume of U.S. beef exports to South Korea for the time period at 0.9446 and is statistically significant at the 5% level. There is also a positive correlation between the relationship in value and volume of U.S. beef exports to Japan for the time period at 0.9602 and that is statistically significant at the 5% level. Because both countries are positively correlated, the relationship between the two variables, volume and value, move together in a positive manner throughout the time period. There is also positive correlation in the relationship between volume in South Korea and Japan that is statistically significant at the 5% level, meaning that when the volume in South Korea changed, it did the same in Japan. There is also positive correlation in the relationship between the volume in South Korea to the value of Japan that is significant at the 5% level, meaning that when the volume in South Korea changed it did the same for value in Japan.

**Table 4.5 Correlation Between Japan and South Korea**

	South Korea Volume	South Korea Value	Japan Volume	Japan Value
South Korea Volume	1.0000			
South Korea Value	0.9446*	1.0000		
Japan Volume	0.4891*	0.3125	1.0000	
Japan Value	0.4489*	0.3324	0.9602*	1.0000

* = Statistically significant at 5% level

4.3.2 North American Countries

The principal destinations of U.S. beef in North America between 1990 and 2012 were Canada and Mexico with Greenland as the other country not contributing to the total at all for the entire time period. Canada's share of U.S. beef shipments to North America have declined over the time period, under consideration even as those of Mexico have increased. On average, Mexico accounted for 63.2% of total shipments to North America while 36.8% was Canada's average share compared to 0.0% for the Rest of North America. The respective standard deviations are 14.9%, 14.9% and 0.0%. Thus, both Canada and Mexico's share of U.S. beef exports to North America have been more stable over the past quarter century than the Rest of North America.

Figure 4.5: Distribution of US Beef Export Volume to North America (1990-2012)
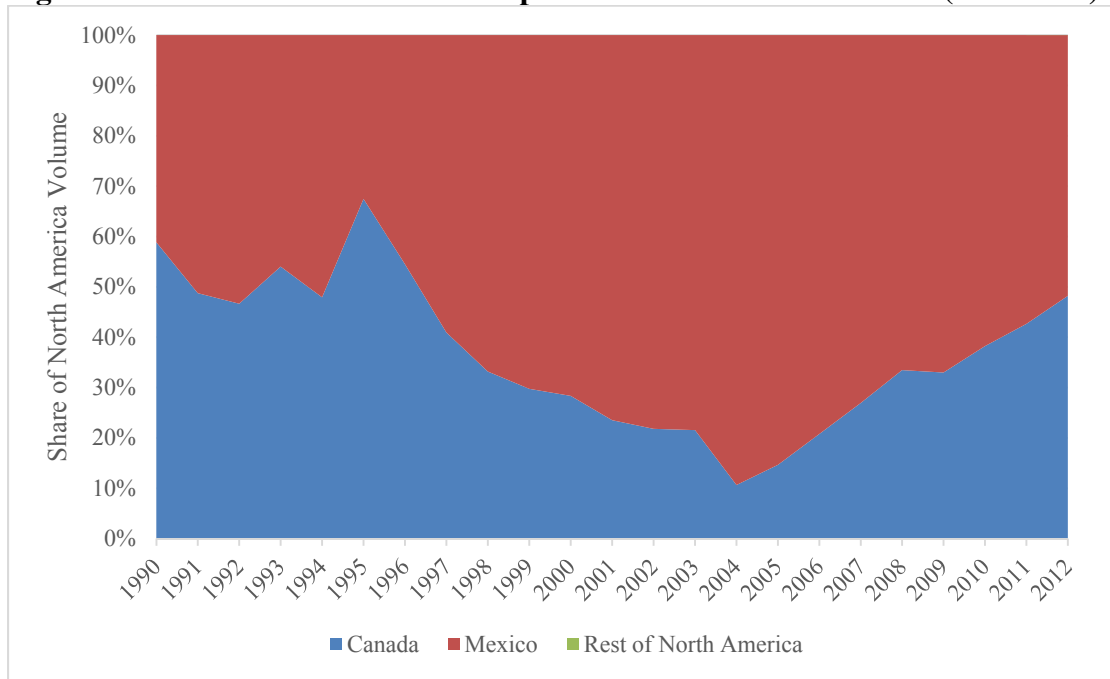
Canada's share of U.S. beef shipments to North America have declined over the time period, under consideration even as those of Mexico have increased. On average, Mexico accounted for 55.2% of total shipments to North America while 44.8% was Canada's average share compared to 0.0% for the Rest of North America. The respective standard deviations are 17.7%, 17.7% and 0.0%. Thus, both Canada and Mexico's share of U.S. beef exports to North America have been more stable over the past quarter century than the Rest of North America.

Figure 4.6: Distribution of US Beef Export Value to North America (1990-2012)
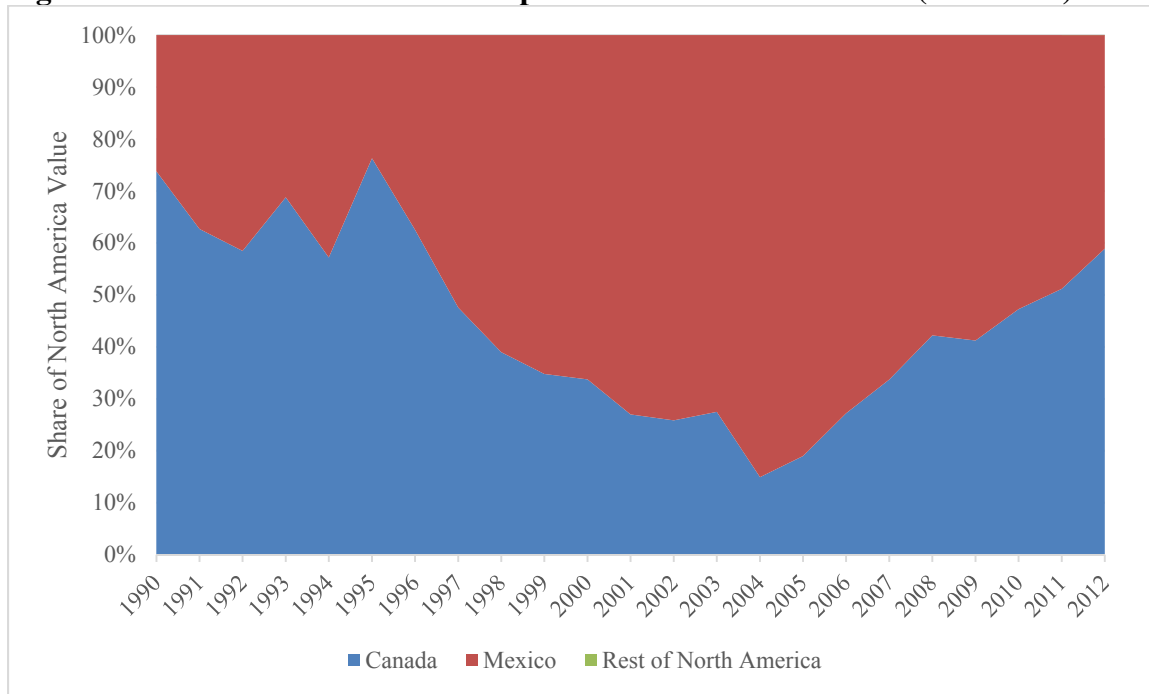
There is a positive correlation between the relationship in value and volume of U.S. beef exports to Canada for the time period at 0.9235 and is statistically significant at the 5% level. There is also a positive correlation between the relationship in value and volume of U.S. beef exports to Mexico for the time period at 0.9443 and that is statistically significant at the 5% level. Because both countries are positively correlated, the relationship between the two variables, value and volume, move together in a positive manner throughout the time period. They are both strongly correlated as well, meaning that the relationship between the two variables move closely together. This tells us that when one variable, such as volume changes, it is likely that value will change was well. There is a small correlation between the value and volume between Mexico and Canada but not strong enough to hinder a relationship between the two. There is a small correlation between the value in Canada and the value in Mexico of 0.4336 significant at the 5% level

to show these two variables tend to move somewhat together when there is change, which

tells us that when the average value changes in Canada, it only slightly changes in Mexico.

Table 4.6 Correlation Between Mexico and Canada

	Canada Volume	Canada Value	Mexico Volume	Mexico Value
Canada Volume	1.0000			
Canada Value	0.9235*	1.0000		
Mexico Volume	0.1478	0.1743	1.0000	
Mexico Value	0.3408	0.4336*	0.9443*	1.0000

*= Statistically significant at 5% level

CHAPTER V: SUMMARY AND CONCLUSION

In this final chapter, we present the summary of the findings and their implications for U.S. beef export strategy. The weaknesses of the study are also identified and recommendations for future research provided.

5.1 Summary of Findings

The problem facing U.S. beef exports was due to a drastic change in the distribution of U.S. beef exports to major exporting countries. By looking at the changes in the distribution of value, volume and price over a period of time (1990-2012), the research revealed that there were changes over the period of time concerning the major players in the export market. Overall East Asia held the majority of the shares until 2003 when North America became the major player in U.S. beef exports from 2003 on. The Rest of the World, while minimal, showed some gain in the market over the entire time period. By breaking down the distribution into shares of value and volume the research revealed that each of these in the respective regions affected one another as well as the major countries in the regions and by running a regression analysis the research determined how much effect the incidence of BSE had on the changes in distribution.

There was much change in the distribution of U.S. beef exports to the regions over the time period. When East Asia began to decline their imports of U.S. beef, North America picked them up. Both the countries of Japan and South Korea greatly decreased imports of U.S. beef, Japan went from 72% in 2001 to 18% in 2004 overall decreasing at an average rate of 60.7% over the time period. South Korea began to decrease from 38% in 2002 to 1% in 2006 overall decreasing at an average rate of 19.9% over the time period.

In terms of value and volume, the region of East Asia had a positive linear growth rate but was adversely affected after the discovery of BSE which had a negative effect on

the growth rate of U.S. beef exports. In terms of price there was a negative effect on the growth curve per year telling us that something was causing the price to decrease prior to the discovery of BSE and there was a positive effect on the growth curve after BSE which tells us that BSE did not have an effect on price.

When you rank the regions in East Asia based on growth rates of U.S. beef exports you see that the region of East Asia had a coefficient of variation of 50% for value and 58% for volume meaning that there is probability in the dispersion of the variation for value and for volume over the entire time period observed. When the mean increased by one, the standard deviation will increase by 50% and 58% respectively for East Asia. The same is true for the following summary of findings. The coefficient of variation for price was 20%, meaning that the overall probability of dispersion in variation is not likely to happen over the period of time observed and was a good fit for the model.

By breaking it down into the regions of Japan and South Korea, Japan had a coefficient of variation of 59% for value and 67% for volume which tells us that there is probability in the dispersion of the variation over the entire time period. In terms of price, the coefficient of variation was 21%, meaning that the overall probability of dispersion in variation is not likely to happen over the period of time observed. For the region of South Korea the coefficient of variation for value was 73% and 76% for volume, meaning that overall the probability of dispersion in variation of value and volume is likely over the entire time period observed. The coefficient of variation for price was 35%, meaning that the overall probability of dispersion in variation is not likely to happen over the period of time observed. When you compare between Japan and South Korea, South Korea has more variance in the dispersion of value, volume and price than Japan did for the time

period telling us there were a lot more changes taking place in how South Korea imported beef from the U.S. over Japan. Despite all the changes in the distribution over time, Japan still holds the majority of the share of U.S. beef exports for East Asia over South Korea.

In terms of correlation coefficients both Japan and South Korea are highly correlated in terms of value and volume meaning that when the value of U.S. beef exports move, so do the volume and since they are positive and strong it means that they move closely together. The correlation for South Korea is 0.94 respectively and for Japan is 0.96 which are both statistically significant at the 5% level. What is interesting is that the volume for both Japan and South Korea are correlated at 0.48 which is statistically significant at the 5% level. This tells us that when the volume in South Korea changes, so does the volume in Japan, but not as close as the foregoing. The value for Japan and volume for South Korea are correlated at 0.44 which is also statistically significant at the 5% level. This tells us that when the volume in South Korea changes, so does the value in Japan, but not as closely.

In terms of value and volume, the region of North America had a positive linear growth rate but was adversely affected after the discovery of BSE which had a negative effect on the growth rate of U.S. beef exports. In terms of price there was a positive effect on the growth curve per year as well as a positive effect on the growth curve after BSE.

When you rank the regions in North America based on growth rates of U.S. beef exports, you see that the region of North America had a coefficient of variation of 49% for value and 35% for volume, meaning that there is probability in the dispersion of the variation for value and for volume over the entire time period observed. The coefficient of

variation for price was 22%, meaning that the overall probability of dispersion in variation is not likely to happen over the period of time observed.

By breaking it down into the regions of Canada and Mexico, Canada had a coefficient of variation of 58% for value and 34% for volume which tells us there is probability in the dispersion of the variation for value and for volume over the entire time period observed. In terms of price, the coefficient of variation was 23%, meaning that the overall probability of dispersion in variation is not likely to happen over the period of time observed. For the region of Mexico the coefficient of variation for value was 57% and 48% for volume, meaning that there is probability in the dispersion of the variation for value and for volume over the entire time period. The coefficient of variation for price was 22%, meaning that the overall probability of dispersion in variation is not likely to happen over the period of time observed. When you compare between Canada and Mexico, Mexico has more variance in the dispersion of value, volume and price than Canada did for the time period telling us there were a lot more changes taking place in how Mexico imported beef from the U.S. over Canada. . Despite all the changes in the distribution over time, Mexico still holds the majority of the share of U.S. beef exports for North America over Canada.

In terms of correlation coefficients both Canada and Mexico are highly correlated in terms of value and volume, meaning that when the value of U.S. beef exports move, so does the volume and since they are positive this means that they move together. The correlation for Canada is 0.92 respectively and for Mexico is 0.94 which are both statistically significant at the 5% level. What is interesting is that the value for both Canada and Mexico are correlated at 0.43 which is statistically significant at the 5% level. This tells us that when the value in Canada changes so does the value in Mexico.

In terms of value and volume, the Rest of the World had a positive linear growth rate but was adversely affected after the discovery of BSE which had a negative effect on the growth rate of U.S. beef exports. In terms of price there was a positive effect on the growth curve per year as well as a positive effect on the growth curve after BSE. The overall trend analysis from 1990 to 2012 also showed an increase in imports for U.S. beef. When the observation was broken down into two periods – 1990 to 2003 and 2004 to 2012 – the forecasted trend shows an increase for both periods for the region, which is on track with the overall forecasted trend.

Overall, East Asia and North America remain the major players in the U.S. beef export market. By looking at past changes in distribution in the market we will be able to determine and forecast what changes could take place in the future. This would allow the U.S. to determine where to focus their market output so that they can remain to be one of the top exporters in the world. Since beef is a widely sought after commodity it is imperative that we continue to be competitive in this market.

5.2 Conclusions

The results show us that the objective is true in that the distribution of the value, volume and price of U.S. beef exports have changed over time. At first when you look at the impact of BSE on the effect of distribution it seems that it had a major impact overall, but after completing the analysis the research shows that there was minimal impact from the occurrence of BSE on the distribution of U.S. beef. There was a major change after the discovery of BSE in late 2003 but other changes were taking place prior to that. When other countries began to decrease their imports of U.S. beef, such as Japan and South Korea, other countries were beginning to increase their imports of U.S. beef, such as

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Canada, Mexico, Russia, Vietnam and Egypt. Because of these changes the U.S. did not really lose any volume on the export market, they just redistributed their exports to countries that would accept their product.

We know that the discovery of BSE had a major impact on how the distribution of U.S. beef exports changed over a short time period. Countries that held a high value to U.S. beef, such as Japan and South Korea, no longer held the value as high and dramatically decreased their imports of U.S. beef. Other countries, such as Canada and Mexico, picked up the slack and increased their volume of U.S. beef exports but did not hold the value as high as the Japan and South Korea did. While Canada and Mexico dramatically increased the volume of U.S. beef exports the value still remained relatively low compared to where Japan and South Korea were. East Asia overall paid an average of $4.08 per pound of U.S. beef with Japan paying higher prices than South Korea. Overall North America on average paid around $3.19 per pound for U.S. beef with Canada paying a higher average price than Mexico.

When you look at the analysis for the first time period from 1990 to 2003, the value and volume of U.S. beef exports to East Asia was very unpredictable increasing and decreasing several times over the time period. This tells us that East Asia was already diversifying their supply of beef from other countries. For the second time period from 2004 to 2012, the value took a major hit in 2004 but showed continual growth into 2012 as well as increasing the volume and price. The difference between the value and volume in the first period shows that East Asia did not hold as much value on U.S. beef exports. In the second time period the difference between the value and volume showed that they held a much higher value on beef exports and this is based on the reduced volume compared to

the first time period. The price was not affected as severely as the value and volume was and remained somewhat steady throughout the entire time period which tells us that average price per pound was stable compared to the value and volume.

When you look at the analysis for the first time period from 1990 to 2003, the value and volume of U.S. beef exports to North America was very somewhat predictable increasing over most of the time period. This tells us that North America was slowly increasing the volume of U.S. beef exports as well as increasing the value. For the second time period from 2004 to 2012, the value and volume took a minor hit in 2004 but showed continual growth into 2012. Since there was not much difference between the value and volume in the first period, this tells us that North America held the value and volume at a somewhat equal level. In the second time period there was a difference between the value and volume, when the value continued to increase the volume began to decrease telling us that in this time period, North America held a higher value to U.S. beef exports and this is based on the reduced volume compared to the first time period. The price was not affected as severely as the value and volume was and remained somewhat steady throughout the entire time period slowly increasing in the second time period. This tells us that average price per pound was stable compared to the value and volume.

The region of ROW was comprised of three major countries that contributed to the distribution of U.S beef exports and these other countries included Russia, Vietnam and Egypt. These countries slowly but gradually increased their intake of U.S. beef with Russia and Vietnam under Egypt in 1990 with little change for Egypt remained the leader for ROW in 2012 with Russia coming in second and Vietnam coming in last. While these countries increased their volume the comparison to value was not as competitive as East

Asia and North America. They held a much lower value to U.S. beef exports averaging around $1.34 per pound for Russia and $1.14 per pound for Egypt. The interesting observation was that Vietnam held a much higher value per pound than the other two countries in the region with their highest price at $14.03 per pound in 1994

When you look at the analysis for the first time period from 1990 to 2003, the value and volume of U.S. beef exports to the Rest of the World was somewhat unpredictable slowly increasing over the time period. This tells us that the Rest of the World did not import much beef from the U.S. until 2004 when it began to increase. For the second time period from 2004 to 2012, the value began to increase in a major way in 2004 showing continual growth into 2012 as well as increasing the volume and price. The difference between the value and volume in the first period shows that the Rest of the World did not have much difference between the value and volume of U.S. beef exports. In the second time period the difference between the value and volume showed that they held it the same compared to the first time period. The price was interesting because it was decreasing from 1990 to 2004 and increased into 2012 along with the value and volume which tells us that average price per pound was stable compared to the value and volume.

5.3 Further Research and Recommendations

Only two major regions were looked at compared to the Rest of the World and the result of this was based on the share distribution of each region. There is a much bigger picture than what is painted in this paper and it would be interesting to look at this deeper to see what causes attributed to these changes in distribution besides BSE. We know that BSE had a minimal impact on changes in exports and policy for both the U.S. and foreign countries that the U.S. trades with, but there are also other factors that contribute to these changes prior to BSE. The analysis showed that even before the discovery of BSE, East

Asia was having major changes in their imports of U.S beef. To look at what caused that further research needs to be done to see where other countries were importing beef from or if the region alone was getting this protein source from somewhere else such as pork or chicken.

Countries like Japan and South Korea have scare resources when it comes to certain products which is why they look at countries like the U.S. to get products they cannot produce. Because of the lack of land and natural resources to raise and feed cattle, Japan and South Korea must look outside of their country to gain this protein source. Since other countries compete with the U.S. for East Asia's imports, it is important for the U.S. to understand what they expect in a product and provide that at a cost they are willing to pay.

Over the past two decades the world has underwent many changes, some of these changes include population, income, environmental changes and changes in natural resources. The past few years in the U.S. have seen many changes in environment with the Great Plains region facing a major drought period which adversely affects how producers can raise and feed cattle. This drought has also affected the cost and supply of feed needed to raise the cattle which has caused some ranchers to sell off some or most of their cattle herds because they simply cannot afford to feed them.

Some of the decreases in exports could be attributed to a decrease in the U.S. cattle herd which would hinder the supply to export, population decreases in countries primarily exported to, changes in trade policy by either government to restrict or ban imports of U.S. beef, or income loss in importing countries since an income loss could result in consumers buying a lower cost protein source. Some of the increases could be attributed to a decrease in the countries local protein source, population increase in the countries primarily exported

to, changes in trade policy by either government to allow U.S. beef into the country or income increases since an increase in income could result in an increase in consumption of a higher protein source. By conducting further research into these avenues one would be able to see if they had any type of impact on the changes in distribution.

By looking at each trade policy in each country where exports have increased, we would be able to see what changes took place and if this allowed for the U.S. to export more beef to this country or region. Since we know that Japan and South Korea had put restrictions on beef exports after the discovery of BSE and in the past two years the restrictions have been lessened to allow older cattle for export. When trade changes take place there are always going to be countries who lose business and countries who will gain business based on these trade changes. By looking at who these countries are will help the U.S. change their trade practices so that they can diversify that market.

There is not one factor that can be attributed to the changes in exports from the U.S. and by conducting further research and focusing on one region at a time, an individual will be able to see what external and internal factors attributed to the changes in distribution over time to each region. There may be various issues that prevent equilibrium from being possible in a region.

Another factor that would aid the U.S. in increasing beef exports would be to look at other top exporting countries to see what they are doing to gain business in the importing countries. There is much diversity in the market today for any product and because there are other countries that produce beef besides the U.S., it is imperative that the U.S. be aware of this diversity and take measures to ensure good relationships with countries that value the high quality beef that the U.S. produces. Because beef has such a large supply

chain it is imperative that all aspects of the supply chain work together to ensure that we are exporting to the countries that value our beef just as much as we do. Some of the countries that we currently export to are not growing the market, we are simply just trading the market with them and it would be imperative for the U.S. to trade with countries that will continually grow the market.

When East Asia restricted access for U.S. beef exports North America absorbed the supply that was going to East Asia. At the same time, the countries in the Rest of the World stepped up and began to absorb some of the exports as well. Because of this change in diversity the U.S. did not really lose any ground on their exports but gained relations with other countries that are continuing to grow and strengthen their export demand even though it is a very smaller percent compared to North America and East Asia. This type of change in diversity is imperative for the U.S. to continue to be a strong leader in U.S. beef exports.

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