

**The Impact of Food Safety Fears and Policy on International Trade:
Trade Creation, Diversion, and Depression as a Result of Bovine Spongiform Encephalopathy**

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Abstract

In December of 2003, the U.S. Secretary of Agriculture announced the presence of Bovine Spongiform Encephalopathy (BSE) within a cow in the state of Washington. The announcement prompted the cessation of beef imports by the largest traditional beef trading partners with the United States, resulting in immediately realized losses to the U.S. industry. This thesis evaluates the short- and long-term impact this discovery and subsequent policies had on the global beef market. We utilize market share analysis to examine the loss realized by the U.S. over a 13-year time frame, then employ a log-linear gravity model with fixed effects to quantify the changes in global export and import values and quantities using a novel bilateral trade database spanning 16 years. We find that the policies implemented immediately on discovery of the single BSE case were often slow to be rescinded even though additional related cases of BSE were not found in the United States. We also find that the removal of said policies does not guarantee full reentry of U.S. beef products, even after a lag of several years. Finally, we find that both traditional and newly emerging suppliers of beef and beef products contributed to the slow reentry of U.S. beef within critical markets. The losses and implications of the aforementioned policies detailed within this thesis suggests a different approach be undertaken by regulators should another similar threat to the U.S. food supply emerge in the future.

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General Audience Abstract

This thesis evaluates the impact of the 2003 discovery of Bovine Spongiform Encephalopathy, widely known as “mad cow disease”, within the state of Washington. This event had a significant immediate and lasting negative impact on international beef trade, and was especially damaging to U.S. producers. Upon the announcement, many of the largest traditional importing nations of U.S. beef halted all purchases in order to protect their domestic food supplies. While extensive research has been produced looking at the immediate impact to U.S. producers, no similar study exists that exhaustively looks at both the short- and long-term impact on the global market for beef. We find that the policies put into place were unnecessary and highly destructive to U.S. producers, and beneficial to many of the largest competitors in the global beef market. Furthermore, our main findings indicate that the removal of these policies did not quickly allow the reentry of U.S. exports to these traditional markets. The results of this paper suggests a different approach be taken by policymakers should another threat to the U.S. food supply emerge in the future.

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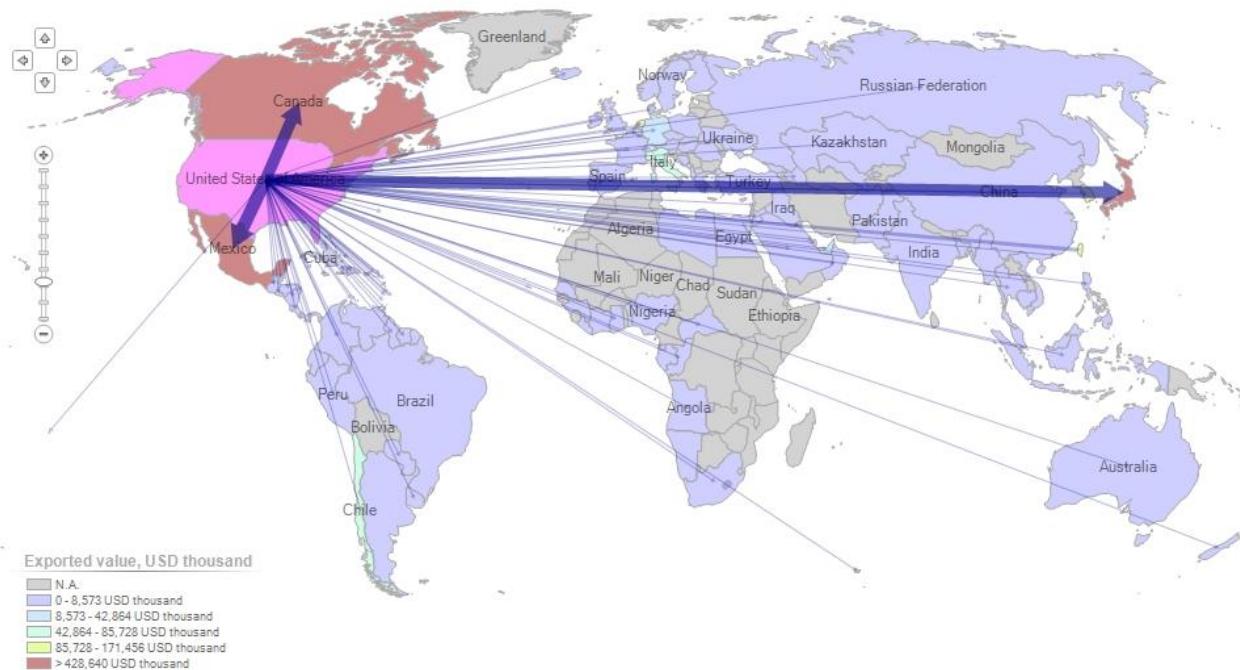
Chapter 1: Introduction

Considerable research has been performed on the impact of preferential and free trade agreements between nations on international trade flows. Less is known about the significance of more recent partial or complete closures of national borders based on sanitary and phytosanitary grounds on the diversion of goods to third countries or non-traditional markets, or how nations recoup previously held market shares from competitors once borders are reopened. This paper will evaluate the long term influence of the 2003 discovery of Bovine Spongiform Encephalopathy (BSE) within a cow in the state of Washington, originally imported from Canada, on both international trade patterns and fluctuations in market share composition. The discovery prompted import restrictions from a large majority of the U.S. beef export market, including Canada and Mexico, with each policy varying in length and specificity. While the majority of these policies have been removed, several significant markets remain closed, or have policies in place restricting certain categories of beef that did not exist prior to the discovery of BSE, adding further strain and unnecessary costs on U.S. producers. Furthermore, the removal of restrictions on agricultural products does not guarantee smooth reentry into these markets, and analysis will be performed to see how long it has taken, if at all, for the U.S. to fully recoup lost market shares.

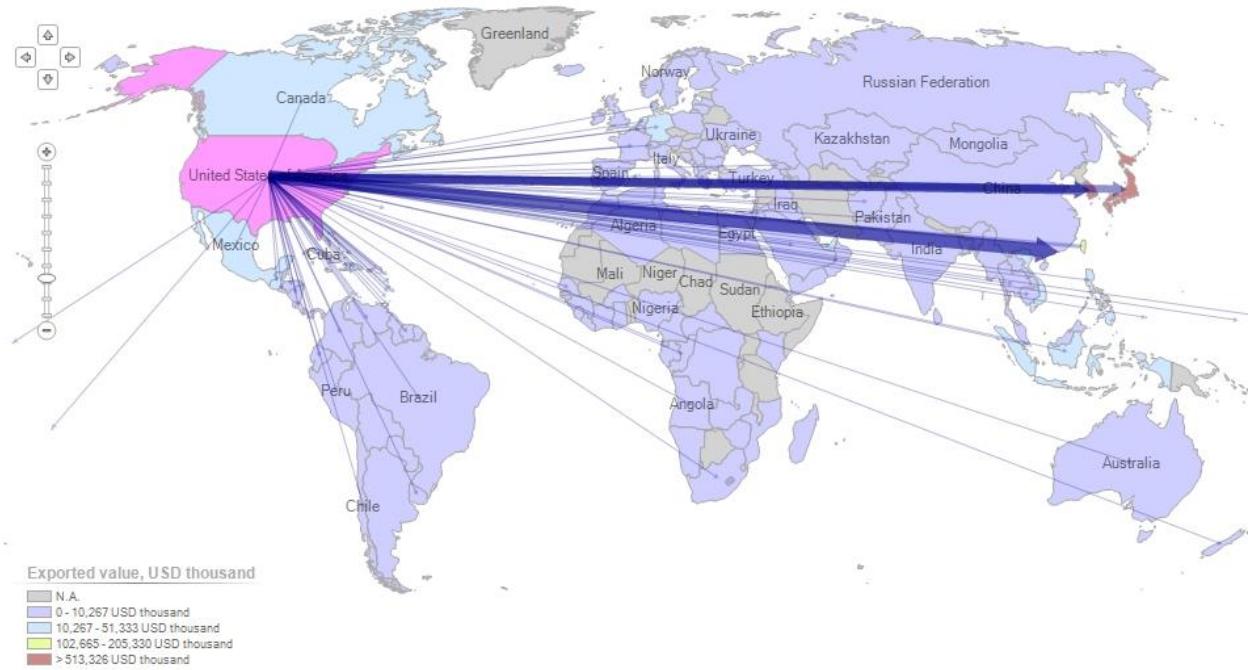
Additionally, evaluation of these policies will be conducted in order to determine why the reactions were so severe given both the knowledge available in 2003 about BSE and the small scale of the U.S. outbreak in comparison to other nations where BSE was present. December 23, 2015 marked the 12-year anniversary of the discovery, and while there has been significant and extensive research on individual nation beef consumption patterns, global price fluctuations, regulatory costs, and other repercussions, to our knowledge no comprehensive study has yet been conducted evaluating trade creation and diversion effects, or global beef market share fluctuations as a result of the U.S. case of BSE.

Evaluating negative demand shocks to sectors of the U.S. economy is essential in determining what policies should be evaluated in the future should a situation such as the BSE discovery arise again.

The USDA reports agriculture and agriculture-related industries represented 4.8 percent of U.S. gross domestic product (GDP) in 2014, a contribution of \$835 billion (Glaser 2016). The U.S. is the largest beef producer in the world, and prior to 2003, the largest beef exporter. Exports represent a critical variable in the economic stability and prosperity of U.S. farmers, who rely in part on foreign sales. Any barriers to trade can have serious long term implications, be they tariff or non-tariff measures. The two largest beef exclusive HS codes, HS 0201 and HS 0202, with combined 2014 exports standing at \$5.9 billion, comprise the bulk of U.S. beef exports. The following two figures show the direction and magnitude of these two exported products in 2014, providing a visual illustration of how U.S. producers rely on a wide variety of foreign purchasers across the globe.



**Figure 1. List of Importing Markets for a Product Exported by the United States of America in 2014.
Product: HS 0201 Meat of bovine animals, fresh or chilled.**



**Figure 2. List of Importing Markets for a Product Exported by the United States of America in 2014.
Product: HS 0202 Meat of bovine animals, frozen.**

As can be seen, the composition of the two HS codes is critical in determining the market in which demand exists and that can be supplied by U.S. producers. This is largely due to the transportation limitations that exist on HS 0201, which is comprised of only chilled beef, whereas HS 0202 is comprised of frozen beef products. Preceding the Washington BSE case, U.S. domination of the global beef market was evident, with the U.S. Meat Export Federation estimating that in 2000; roughly 18 percent of the value of beef production was derived from foreign purchasers. Three years later, U.S. beef exports reached a record level of \$3.6 billion, or 6 percent of total U.S. agricultural exports. With the BSE case discovered and policies limiting U.S. exports applied in many markets, foreign sales from 2003 to 2004 declined by over \$2 billion. Thus, food safety fears and public perception about health risks, both domestically and abroad, can have adverse effects on sectors critical to the U.S. economy.

1.1 Food Safety and Regulation

As globalization moves forward, producers continue to become further dependent upon foreign markets as a significant source of revenue, while consumers increasingly rely on agricultural trade for dietary purposes and relative stability in food prices. However, the past decade has seen significant disruptions to the global meat market caused by legitimate, and in some instances unnecessary, food safety fears. The most significant recent threats to agricultural trade have been the spread of transboundary diseases such as BSE, avian influenza (AI), and foot-and-mouth disease (FMD).¹ The size of these threats and their economic impacts depend greatly upon factors such as country size, export and import levels, and consumer perceptions, prompting varied reactions by nations when they are determined to be at-risk. Elected officials face great scrutiny and often respond drastically to perceived dangers concerning imported food. The harmful impact of trade barriers being implemented due to food safety fears was not first observed in the BSE case, as regulatory authorities have attempted to combat these negative trade disruptions for many decades.

In the past six decades, international trade has grown at exponential levels and concerns about food safety have followed suit. In order to address these concerns, the Codex Alimentarius Commission was established in 1962 by the Food and Agriculture Organization (FAO) of the United Nations (UN), in conjunction with the World Health Organization (WHO) in order to set standards and guidelines to both protect consumer health and establish fair practices in trade. However, these guidelines are not binding, and sovereign nations are free to use policy as they see fit to protect their food supplies. The 1994 Uruguay Round of Multilateral Trade Negotiations, negotiated within the General Agreement on Tariffs and Trade (GATT), along with creating the World Trade Organization (WTO), further addressed issues of agriculture and food safety, primarily through the establishment of the Agreement on the Application of

¹ BSE and AI are defined as food safety threats due to potential transmission to humans via consumption or direct contact with infected animals. FMD is not a food safety issue as defined by the U.S. Food and Drug Administration, the U.S. Centers for Disease Control and Prevention, and the World Health Organization.

Sanitary and Phytosanitary Measures, widely referred to as the SPS Agreement. The agreement's central goal is to protect human and animal health by establishing both rights and obligations of participatory nations (WTO members) in regard to policies related to food safety. The SPS agreement requires that policies are non-discriminatory and based on up-to-date scientific evidence. However, if a nation determines there is scientific uncertainty, use of a precautionary principle is within their rights. Described as a "safety first" mechanism, the principle will allow reduced or completely restricted import of what the nation determines to be at-risk products. This principle allowed for the emergency measures taken by several WTO members in wake of the 2003 U.S. BSE case. Out of 169 complaints in the WTO SPS committee related to human health measures from 1995-2004, 74 were related to transmissible spongiform encephalopathies (TSEs) which include BSE (Josling, Roberts, and Orden 2004). Within that time frame, BSE and the goal of protecting human health was the largest disruptor of international trade.

1.2 BSE within the United Kingdom

Fears about threats to food safety and security were compounded by the well-known and highly publicized history of BSE, dating back to the first confirmed case in 1986 within the United Kingdom. Despite steps taken by the British government to combat the spread of the disease, the number of infected cattle reached 100 thousand in 1993 (Pickelsimer and Wahl 2002). In 1996, ten years after the first BSE case, U.K. scientists reluctantly confirmed the relationship between BSE and variant Creutzfeldt-Jakob disease (vCJD), following the first recorded human death in 1995 and despite extensive reassurances by U.K. public officials about the absence of risk posed by BSE to human health. The announcement greatly accelerated concerns about the dangers posed by importing from at-risk nations, resulting in an overwhelming number of bans on imports of U.K. beef and beef products from a majority of traditional importers, including the U.S. In the 1990s consumers were relatively aware of the dangers associated with BSE due to the spread of the disease in the 1980s, but the announced confirmation by the U.K. government of the connection to vCJD prompted a global panic. Domestic demand within the nation plummeted, and a majority of traditional importers of U.K. beef enacted new regulations in order to

completely close their borders to any foreign purchases from the region (Wales, Harvey, and Warde 2006). The BSE crisis within the U.K. was seen as a management failure, with knowledge about the risks to human health posed by BSE existing by U.K. regulatory officials well in advance of the 1996 announcement (Ashraf 2000). In retrospect, given the minimal knowledge available to global regulators about the risks associated with BSE, the drastic measures taken were not excessive or unnecessarily distortive, and were deemed mandatory at the time in order to protect animal and human health.

1.3 BSE within the United States

Following the May 2003 discovery of BSE within a single animal in Canada, the U.S. banned the import of all live Canadian cattle, easing the restrictions months later in August, allowing the import of boneless meat from animals less than 30 months of age. Upon the December 2003 announcement of a BSE positive cow within the state of Washington, despite the Canadian origin of the animal, the global response to U.S. imports was severe and in turn highly destructive to the U.S. beef industry. In comparison to the massive presence of BSE within the U.K., with at least 100 thousand infected animals; the single cattle within the U.S. posed little or no threat to food supplies. From 1990 to 2003, NAFTA (Canada and Mexico), Japan, South Korea, Hong Kong, and Russia accounted for 95 percent of total U.S. beef exports, with the United States largest trading partners, Canada and Mexico, importing 50 percent less beef in the immediate wake of the discovery under measures quickly implemented but also rescinded shortly after. The closure of over 30 export destinations, including the largest importers of U.S. beef and beef products, Mexico, Japan, South Korea, and Taiwan², caused beef export volumes to decrease significantly from their pre-BSE levels. Exports to Canada and Mexico recovered quickly, with U.S.-Mexico beef trade resuming as early as March of 2004. Due to the large percentage of total U.S. beef exports traditionally destined for these markets, specifically the Asian nations, their sudden reductions in imports had the most devastating impact.

² Includes the region known as Chinese Taipei; however, we will use Taiwan for the remainder of the paper.

Japan, South Korea, and Taiwan are unique in their significance to U.S. beef exports; due in part to the large volume of imports prior to the discovery of BSE by each nation, and the utilization of strict and relatively long lasting import bans post-BSE. The 2000-2002 average imports from the United States for Japan and South Korea were 317 thousand metrics tons and 160 thousand metric tons, respectively. Taiwan, despite a lower 2000-2002 average of 12 thousand metric tons, was still considered a critical export market for U.S. beef. As previously stated, imports by Canada and Mexico in the years of the outbreak decreased by significant volumes, in part due to increased supplies within their own nations; however, exports to Japan and South Korea decreased to zero. Australia, New Zealand, and certain South American nations were responsible for filling the lost supply from the United States, and within certain categories, have continued to maintain a greater market share than the U.S. even after overall U.S. export volumes have recovered. Differences in quality and deficiencies in quantities in the initial years following the 2003 announcement hindered Australian and New Zealand suppliers from completely satisfying high demand within nations that restricted U.S. beef, and other animal sickness fears such as FMD, restricted the South American suppliers. Despite the increased production domestically within nations such as Japan and South Korea, and increased imports from non-traditional suppliers, these alternative sources of beef were not able to completely fill the void left by the bans on the U.S. Two more confirmed cases within the U.S., in June of 2005 and March 2006 further eroded confidence in U.S. beef. However, the subsequent removal of trade restrictions saw imports from the U.S. increase substantially. Partial beef trade between the United States and Japan resumed in December of 2005, Taiwan removed restrictions in April of 2005, and South Korea followed suit in 2008 (Mathews et al. 2006, Mathews 2008). Competition from Australia, New Zealand, and certain other small suppliers contributed to the slow speed at which the U.S. has been able to regain the previously high level of market share within the Asian region. Further detail is presented within the market share analysis portion of this paper, along with export values, detailing the slow rate of U.S. export growth within the largest traditional markets. The United States has been unable to regain pre-BSE market share levels within both South Korea and Japan, but overall export values are

greater than before the Washington case, due to the emergence of new non-traditional markets, and larger import volumes by most nations.

The majority of BSE-related policies that completely closed the largest markets have been lifted; however specific measures are still in place. As of December 2015, Colombia, Malaysia, Peru, South Korea, Taiwan, Thailand, Japan, Singapore, Russia, Indonesia, and Ukraine had BSE-related product or cattle age restrictions on U.S. beef. Nations also implement policies concerning the import of live cattle from the U.S., with Ecuador, Colombia, South Korea, Taiwan, Peru, and Singapore currently adopting these measures. (USDA 2016) Policies such as these that add additional verification costs impede the ability of U.S. producers to effectively compete on the global market. Nations reported by the USDA that are still completely closed to U.S. beef due to BSE include Argentina, Australia, Bolivia, Brazil, Kenya, Morocco, Paraguay, South Africa, Venezuela, and Saudi Arabia.³

1.4 Objectives of the Research and Structure of the Paper

Nations react quickly using the previously mentioned measures in banning products they believe pose a serious risk to their food supply, and are hesitant to remove them once in place. This is evident when evaluating aggregated U.S. beef exports at both the four-digit and six-digit HS code level from 2001-2014, and will be provided in detail later within this paper. We will present the argument that the restrictions placed on the U.S., which were similar to the policies implemented on the U.K., were unnecessary and highly distortive, and that the long term consequences of these policies do not reflect the minimal danger presented by the single cow in Washington. The previously mentioned lack of knowledge about the diseases in 1996 warranted the policies implemented by importers of U.K. beef, however the overreaction by regulators in 2003 to the discovery of a single infected animal not born in the U.S. was

³ The policies listed were implemented due to the 2003 discovery, with the exception of Saudi Arabia, who reopened their borders quickly in 2004, but halted imports again due to a 2012 atypical case. Atypical BSE is defined as being a distinct strain of prion disease that does not match patterns associated with typical BSE, and has the potential to arise spontaneously (Biacabe et al. 2008).

excessive and driven by public perceptions as opposed to basing policy on the wealth of science and knowledge available about BSE. The high risk of transmission between animals for the majority of diseases considered risks to food safety is not applicable to BSE, nor is the disease contagious, creating justifiable concerns about the severity of international trade restrictions when cases are discovered.

In order to articulate the argument that the policies implemented were highly distortive and caused undue burden on U.S. producers, we will present a detailed retrospective market shift-share analysis of U.S. beef products before BSE was discovered in the state of Washington, in the initial years of the discovery, and in the years since up to 2014. Objectives include determining how significant the decline of U.S. beef exports to our traditional trading partners was, how exports have recovered since, and if competitors to the U.S. were able to enter these newly open markets and maintain a presence after U.S. reentry. Furthermore, we will evaluate if the 2003 U.S. BSE case has had a long term impact on the ability of U.S. producers to compete within the global beef market, specifically by comparing current market share levels to the years before the BSE case. Values of the largest globally traded beef HS codes will be presented, along with frequently used tools to perform ex-post international trade analysis.

Evaluation of both traditional and non-traditional markets will be conducted in order to determine the levels of trade diversion and trade creation to both the largest and smallest participants in global beef trade, providing a comprehensive analysis on the impact of the policies adopted restricting U.S. beef. Finally, we will develop a formal econometric model to test and quantify the magnitude of global beef trade fluctuations conditional on the beef bans put in place by several of our major trading partners. To accomplish this objective, we will develop a multi-country, product-line, dynamic panel data model of bilateral beef trade, examining the degree to which the BSE policy bans have both depressed and deflected U.S. and major competing supplies of beef exports.

The first chapter of this paper provided an introduction of the 2003 BSE case and a brief history of the disease, along with objectives of the paper and the motivation behind this research. The second

chapter presents further detail about the spread of the disease, policies historically undertaken by governments to protect domestic food supplies, consumer responses to food safety threats, and evaluation of some of the current literature that addresses the specific case within the state of Washington and other threats to food safety. Chapter 3 presents our market share analysis data, revealed comparative advantage indices, U.S. export quantities and values, imports of beef products at the HS four-digit level and the HS six-digit level of both traditional importers and non-traditional importers. Chapter 4 will present our econometric analysis, and Chapter 5 will provide summary and concluding remarks.

Chapter 2: Food Safety, Policy, and the Global Spread of BSE

2.1 A Brief History of Food Safety

Extensive research has been performed concerning how nations react to the discovery of food safety related fears, such as disruptions to world trade patterns after the link was discovered between BSE and human vCJD (Josling, Roberts and Orden 2004). Nations adopt strict policies to protect their domestic food supplies often with little or no consideration of what impact these measures have on either their traditional trading partners, or non-traditional nations not expressively addressed within the new policy. If trade volume of a product is large enough that country-specific import restrictions have an impact upon world prices and global trade patterns, developing nations can be affected, despite not implementing any new policies regarding their own imports. The significance of these embargos on poorer nations can be even more substantial than the impact on the targeted nation, altering the developing nation's ability to participate in world trade, specifically within agricultural markets which are often a key industry within such nations (Josling, Roberts and Orden 2004). Unnevehr (2000) examined the difficulties faced by less developed country (LDC) exporters competing within global agricultural markets, as they are highly dependent upon foreign sales, noting that fresh food products account for half of all agricultural exports to high income nations. Sudden shifts within these markets, such as the 2003 global reduction in U.S. beef imports, create a wide range of effects on nations who depend on and expect relative stability in global trade values. Unexpected policy changes can either have severe adverse effects on nations who are the most susceptible to damage when radical shifts to the global trading system occur, or potential benefits to these nations can be realized by way of newly acquired export destinations once traditional suppliers are removed.

Negotiations on policies and standards specifically related to BSE began in 1986 by the World Organization for Animal Health (OIE), prompted by the discovery within the U.K., in order to establish an international standard and decrease uncertainty in the case of future outbreaks (Kerr et al. 2007). These

standards work to increase restrictions as nations are determined to be at a higher risk for the presence of BSE; however complete embargos, such as the ones implemented by multiple nations in the wake of the U.S. case, are never recommended by the OIE. The OIE defines levels of BSE risk in two categories, negligible and controlled, and assigns levels to nations based on their respective history of BSE, or lack thereof. As previously mentioned, the standards and procedures agreed upon by the majority of nations participating in these negotiations have not been adhered to historically, with economic protectionism and consumer awareness driving policies in place of scientific standards. The OIE has commissioned these standards and science-based regulations regarding global beef trade to reduce risk and increase efficiency, however sovereign nations have no obligation to adhere to these standards. This disregard of scientific certainty and accepted lack of efficiency was perhaps most predominately displayed by the Japanese testing of every cow after BSE was discovered within their own domestic supply.

Notable use of SPS regulations to protect domestic food supplies existed well before the U.S. BSE case. Peterson and Orden (2005) evaluated effects of sanitary regulations on world poultry trade, along with the effects of removal of tariffs and tariff-rate quotas, noting that due to the susceptibility of poultry to infectious diseases and microbial contamination, many nations quickly impose restrictions on imports to safeguard their food supplies. The variability of import restrictions by nation on poultry products, be it based on threats of safety such as Newcastle Disease, or processing standards, reduces efficiency and any opportunity of increased trade. The authors used a competitive partial-equilibrium spatial model with heterogeneous goods to report that global trade would expand by 25% if nontechnical trade barriers were removed by major importers.

Importing nations reacting to food safety concerns frequently switch to disease free countries to replace the sudden loss in supply, as demonstrated in the years following the global spread of BSE. Exporters are also prompted to locate alternate destinations for their products once shut out of traditional markets. This was recently evident with the European Union greatly increasing shipments of pork to Asia following Russian restrictions due to an outbreak of African swine fever, along with the Russian response

to sanctions imposed as a result of their involvement within the Ukrainian crisis. Prior to these restrictions, Russia was the EU's largest market, and the surge in exports to Asia subsequently depressed U.S. exports to the region. The USDA reports that EU pork shipments to all importers increased by 7 percent from 2013 to 2015, surpassing the 1 percent growth rate of the U.S., with forecasts calling for this trend to continue into 2016 as the U.S. struggles to maintain competitiveness (USDA 2016).

Reductions in global trade due to the largest food safety threats within food production has resulted in an economic cost of at least \$80 billion from 1997 to 2009, prompting the need for greater levels of preventative measures being taken to safeguard a critical sector of the global economy (World Bank 2012). The danger posed by potential chemical, microbial, or physical risks to food supplies has been enhanced by the gradual consolidation of the global agricultural industry. The increased concentration of animal production and its connection to food safety risk was demonstrated in the 1997 swine fever epidemic in the Netherlands, primarily caused by movement of people and equipment between farms (Stegeman et al. 2000). The wealth of knowledge associated with food safety risks, combined with increasing consumer awareness concerning food origins has led to these severe and excessive reactions by policymakers. Within the United States, 83 percent of all beef is processed by four beef packers, causing speculation that one infected animal can spread the food-safety risk to millions of consumers in a relatively short time period, leading to policies that enforce complete restrictions on imports (Hendrickson and Heffernan 2007). Mathews et al. (2003, 2006) denotes four periods where BSE prompted regulatory and policy responses, in 1986, 1996, 2000, and 2003, noting that economic effects often last longer than those of the disease outbreak.

Aside from BSE, other significant livestock disease threats to global agriculture exist, most notably the recent outbreak of AI, where related bans on poultry in the early 2000s have had a global economic impact of over \$10 billion (Kilpatrick et al. 2006). AI has been reported in North America, Europe, Asia, Australia, Africa, and South America as far back as 1955. A 2013 outbreak within multiple U.S. states once the virus spread from Asia, to the European Union, to the U.S., has led to the reduction or

complete restriction of U.S. poultry imports by some of the largest trading partners including Mexico, Canada, Hong Kong, and China. High levels of transmission between animals and the well documented history of AI prompted nations to again react severely to this recent outbreak, inflicting high costs upon U.S. producers and consumers. Roughly 10 percent of egg laying hens, along with 3 percent of total turkeys and nearly 17 percent of the nation's poultry were required to be destroyed, while producers were also burdened with drastic price volatility (U.S. Senate, 2015). The outbreak affected 48 million birds within 15 U.S. states, prompting a shortage large enough to force the U.S. to import eggs from the European Union for the first time in a decade, increasing the domestic price paid by U.S. consumers.

The emergence of threats to food supplies has historically caused consumption patterns to shift dramatically. This was evident following the initial discovery of BSE within the U.K., and with the subsequent discoveries in the European Union and Japan. Embargos placed upon the U.S. and Canada once BSE reached North America was initially thought to alter these patterns both domestically and abroad. However, while there was speculation that U.S. domestic beef demand could fall by as much as 15 percent prompting a sharp decline in prices, there was not a significant domestic response to the discovery of BSE in 2003. Fluctuations in U.S. consumer activity concerning beef purchases were dependent upon trend and seasonality, not perceived threats concerning food safety (Kuchler and Tegne 2006). Total U.S. beef consumption was recorded at 27.9 billion lbs. in 2002, 27.0 billion lbs. in 2003, 27.8 billion lbs. in 2004, and 27.8 billion lbs. in 2005. While domestic consumption within the U.S. was not affected by the discovery in Washington, U.S. beef exports as a percent of production decreased from 9 percent in 2002 and 9.6 percent in 2003 to 1.9 percent in 2004 and 2.8 percent in 2005, showing the differences in global consumer perceptions concerning the disease, as reflected in import policy decisions. As of 2014, the U.S. exports 11 percent of total beef production, exceeding pre-BSE levels.

In stark contrast to the previously evaluated U.S. purchasing patterns, consumer responses within Germany, Japan, and several other Asian nations were severe. McCluskey et al. (2005) used data taken from consumer surveys to evaluate willingness to pay price premiums for BSE-tested beef within Japan

after Japanese beef sales and imports declined by 70 percent in 2001. Their single-bounded dichotomous choice contingent valuation model revealed that on average, consumers were willing to pay 50 percent more for beef that had been tested as opposed to non-tested, potentially contaminated beef. Pennings et al. (2002) showed that domestic responses within the U.S., Germany, and the Netherlands to food safety fears were largely dependent upon consumer perceptions of being exposed to risk. German consumer purchases deviated away from traditional peaks and declines due to the discovery of BSE within their nation in 2000, but the response was not as extreme as was observed in Japan and other Asian nations. Bialowas et al. (2007) estimated a dynamic almost ideal demand system (AIDS) of household food consumption to evaluate BSE impacts upon meat consumption within the United Kingdom, concluding again that change in domestic demand is dependent upon consumer perception of the risks involved. The authors reported that extensive media coverage on BSE that took place within the United Kingdom contributed to their findings that between 1990 and 2005, meat consumption was reduced by around 70 pounds per person per year as of 2006.

Demand for beef within Japan had been increasing since the reduction of tariffs and quantitative import restrictions began in 1990, quickly gaining the attention of global beef producers. Despite the increasing desire for beef, Japanese consumers proved to be highly responsive to both price fluctuations and food safety fears. The emergence of BSE eroded Japanese confidence in their own beef suppliers, prompting a shift towards other sources of protein, such as pork and fish (Obara et al. 2010). Public perception about potential threats to food supplies is largely driven by media coverage within the nation. Sato and Campbell (2014) found that between 2002 and 2006, BSE-related newspaper articles increased within both the U.S. and Japan; however Japanese articles had a heavier focus on food safety and were significantly more persistent. Furthermore, the Japanese media called for stronger trade policy, driving consumer opinion about continued imports from the U.S. South Korea was the second largest export destination for U.S. beef in 2003, and similar to the Japanese, Korean consumers have proved to be highly responsive to food safety fears. The ban on U.S. imports precipitated higher beef prices within the nation,

prompting domestic production to increase over 50 percent from 2003-2011 (Giamalva 2013). Despite the decreases in domestic consumption of beef within several nations in reaction to the presence of BSE within the U.S., total global beef exports and total beef production did not decrease from 2003 to 2004 (Taha and Hahn 2013). Further detail concerning individual nation beef consumption patterns will be provided within the Trade Diversion and Creation as a Result of BSE to Traditional Markets section of this paper.

2.2 BSE within the United Kingdom and the European Union

Prior to the establishment of the relationship between BSE and vCJD, steps were taken by the European Union (EU) and other nations to restrict the import of what they determined to be certain at-risk live cattle from the U.K., dependent upon the age of the animal. The presence of BSE has overwhelmingly been within animals over the age of 4 years; however there have been rare cases where the disease was present within animals as young as 20 months. Policies were also adopted requiring that U.K. bone-in beef exported to the EU originated from herds where BSE had not been present within the previous two years (Fox and Peterson, 2002). In 1994 stricter policies were implemented by the EU, extending the requirement that bone-in beef imports from the U.K. not be from a herd where BSE was confirmed in the previous six years. Japan had initially banned imports of beef from the U.K. in 1951, the import of live cattle in 1990, meat and bone meal (MBM) in 1996, and ruminant products to feed domestic cattle in 2001. Israel was the first single nation to completely halt the import of U.K. live cattle directly due to BSE concerns in June of 1988, followed by Australia discontinuing their imports of live cattle, semen, and embryos in July of the same year. In July of 1989 New Zealand, Sweden, and the U.S. adopted the same policies as the Australians (Philips et al. 2000). Not all importers of U.K. beef products adopted outright bans, with Japan, Morocco, Canada, and South Africa only requiring imports of live animals to be from herds certified to be free of BSE. In 1991 however, complete bans of all U.K. beef products were put into place by Algeria, Bahrain, Brazil, China, Iran, Iraq, Jordan, Morocco, Saudi Arabia, Syria, Tunisia, Turkey, the United Arab Emirates, the USSR, Egypt, and Canada. Concerning the

U.S., a ban on the import of all ruminants and MBM from the U.K. was adopted in 1989, extending to a restriction of all beef imports determined to be high-risk from nations confirmed to have cases of BSE (Kamisato 2005). Nations that did not fully remove U.K. beef from their domestic markets, but adopted age related import restrictions include Cyprus, Hong Kong, the Ivory Coast, Mexico, and Malta. Egypt and Brazil resumed imports in 1993, however at a significantly lower volume than before (Philips et al. 2000).

Upon the 1996 announcement, the U.K. lost the entirety of their export market. The European Union subsequently lifted the ban in 1999, and in 2000, cases of both BSE and vCJD were announced within France, Spain, and Germany, while cases of BSE alone were discovered in Italy and Denmark the following year. As a result, global bans on beef products from 30 nations within the EU were enacted, crippling the EU beef industry (Pickelsimer and Wahl 2002). Domestic consumption within the U.K. decreased immediately by 40 percent, and costs to taxpayers were approximately \$650 million. From 1975 until 1993, U.K. exports of bovine meat fluctuated between 100 thousand and 200 thousand tons per year, growing to 272,499 tons in 1994. The 1996 announcement caused total beef exports to decrease from 281,641 tons in 1995 to 69,502 tons in 1996, a 75 percent decrease. Total exports reached the lowest level of 9,456 tons in 1998, and have increased nearly every year since. The ban from the EU imposed what was essentially a complete export ban on British farmers, with net exports of beef, roughly 39,000 calves and 23,000 tons of fresh and frozen carcasses per month, ending as a result of EU policy (Lloyd et al 2003). U.K. beef exports before and after the 1996 discovery are almost completely restricted to nations within the European Union.

Exports of bovine meat from the United States had been continuously growing since 1990, and U.S. foreign sales were not impacted by the discovery within the U.K. and EU, increasing by 12 percent from 1996-1997. In the same time frame, Australian exports of bovine meat increased 11 percent; Canadian exports increased 22 percent, Brazilian exports decreased 3 percent and Argentine exports decreased by 9 percent. The variation in exports from the largest global suppliers of bovine meat suggests

the U.K. situation did not have a uniform impact upon global beef trade, unlike the discovery within the U.S. Upon the announcement of the disease reaching Japan in 2001, consumer demand for beef was further stressed, leading governments to take drastic measures to protect the food supply, prompting the severe restrictions on U.S. beef once the Washington case was declared in 2003.

2.3 BSE within the United States and Trade Policy

While an argument could be made that the initial reaction of nations to the discovery of BSE within the U.S. was not unwarranted as there was uncertainty as to the magnitude of the presence of the disease, the long term continuance of these policies 13 years later is simply not supported by science. Complete bans of all U.S. beef and beef products, along with unnecessary partial border closures in the present day are highly distortionary, and provide no additional measures of safety to nations who would otherwise source their beef from the U.S. Aside from being ineffective in safeguarding food supplies, these extreme reactionary measures have provided incentives for producers to withhold information about any potential cases of BSE from regulators, impeding the ability of created safeguards and protocols to control any potential spread, putting consumers at a greater level of risk (Kerr et al. 2007). The enhanced regulations put into place by the U.S. in the years following the 2003 discovery have ensured the safety of the American meat supply and should have provided importing nations with enough certainty that imports from the U.S. posed no significant risk to their consumers.

Among the initial bans implemented by countries on U.S. beef and beef products were the markets of Brazil, Canada, the Cayman Islands, Chile, China and Taiwan, Colombia, Costa Rica, Cuba, the Dominican Republic, Egypt, Guatemala, Hong Kong, Indonesia, Japan, South Korea, Kuwait, Malaysia, Mexico, Nicaragua, Peru, the Republic of South Africa, Russia, Singapore, Thailand, Ukraine, Uruguay, Venezuela, and Vietnam (Mathews 2008). The restrictions were not limited to these nations, however these markets were some of the largest pre-BSE destinations for U.S. beef, and their policies had the most devastating impact upon U.S. producers. The close political nature of the U.S. with its largest

trading partners, Canada and Mexico, allowed for the swift reintroduction of trade between the three nations, which was overwhelmingly not the BSE policy norm. Even prior to the December 2003 case within the U.S., the members of NAFTA submitted a proposal to the OIE requesting a science-based, international set of standards in response to the potential spread of BSE. The day after the U.S. case was announced, December 24 2003; Canada implemented interim import restrictions, but permitted the import of boneless beef from cattle less than 30 months of age, live cattle set to be immediately slaughtered, dairy products, semen, embryos, and protein-free tallow. As previously mentioned, Mexico reintroduced U.S. beef in March of 2004, allowing boneless beef to be imported, again with the restriction that the meat originated from cattle less than 30 months of age. In April of 2004, the U.S. removed restrictions on the import of Canadian ground beef, bone-in cuts of beef and offal from animals less than 30 months; however, restrictions on live animals were still in place, not to be removed until July of 2005 (U.S. Congress 2006). In June of 2006, Canada permitted all classes of U.S. cattle to be imported, regardless of age. In 2007, the OIE announced the classification of both Canada and the U.S. as controlled BSE risk countries.⁴ Further detail concerning the removal or lack thereof of beef restrictions by nation will be provided within the Trade Diversion and Creation sections of this paper. It should be noted, that despite the 2007 announcement by the OIE, nations that initially restricted U.S. exports have not been uniform in their decisions concerning the removal of barriers to trade. As stated previously, large markets such as Russia remain closed, while other nations lifted restrictions years later, most recently Peru and China in 2016.⁵

⁴ Nations are identified as negligible risk after demonstrating compliance with internationally recognized safeguards and if there has never been a BSE case within the nation, or if there have not been any infected domestic animals in the previous 11 years. While both the U.S. and Canada were compliant with the recommended safeguards, the presence of BSE within their domestic supplies categorized them as controlled risk.

⁵ U.S. beef exports to Peru have been increasing since the 2009 signing of the U.S.-Peru Trade Promotion Agreement. The 2016 announcement concerned the removal of a costly export verification program, granting full access to the Peruvian market for U.S. exporters. China announced the removal of their 13-year ban in September of 2016.

International regulatory authorities identify different beef products by their level of risk when imposing import ban measures, which provided different impacts to different sectors of the U.S. bovine industry. As previously mentioned, the two largest categories of beef exports by volume at the HS four-digit level are “fresh or chilled beef”, and “frozen boneless beef”. Coffey et al. (2005) estimated that these two categories accounted for 60 percent of total U.S. exports in 2003 with a combined value of \$2.4 billion. Coffey et al. also evaluated costs associated with new regulations that arose as a result of BSE to U.S. producers, estimated to be \$200 million, and estimated losses in 2004 caused by decreased export volume to range from \$3.2 billion to \$4.7 billion. The reopening of Canadian and Mexican borders shortly after the discovery of BSE did not soften the blow, as total U.S. beef exports decreased 82 percent from 2003 levels. As of 2016, the U.S. has still not regained full access to two of its previously largest export destinations, Japan and South Korea. Mattson and Koo (2007) also evaluated the financial implications of the BSE discovery, specifically estimating the effects of the removal of trade restrictions on U.S. cattle and beef prices. They noted that the removal of bans from smaller importers such as Taiwan, or entering new markets as a result of the restrictions by the largest traditional importers would prompt small but positive impacts on prices, but would be insignificant in comparison to the regaining of the largest markets (Japan, South Korea, Mexico, and Canada).

Brooks et al. (2014) examined the U.S. beef industry attempts at regaining the previously lost market share, noting that since 2004, total beef exports have grown nearly tenfold, reaching \$5 billion in 2013, which overall, has exceeded pre-BSE levels. After the opening of Japanese borders, trade between the United States and Japan rose from \$5 million in 2005 to \$903 million in 2013. Additionally, in 2013, Japan removed restrictions on the import of live cattle 30 months of age and younger.

Despite steps taken to reduce or eliminate the risk posed by importing potentially infected animals, the spread of both BSE and vCJD has not been completely quelled. As of 2014, 229 patients from 12 countries have reported to be infected with vCJD, with 77 percent of those cases originating from

the U.K., and 4 individual cases occurring within the U.S. (Food and Drug Administration 2016).⁶ The initial outbreak was unable to be contained, as seen by the spread across the EU, to Japan, and eventually to Canada and the U.S. However, strategies adopted by producers and regulators have been relatively successful at reducing the number of BSE cases and subsequently the number of humans infected with vCJD. The OIE documented a total of 7 cases of BSE in 2015 worldwide, in comparison to 1,389 in 2003.⁷ Most recently, France announced a case of BSE within the northeastern region of the country on March 24 of 2016, resulting in the OIE reinstating France to “controlled BSE risk” status from their previous status of “negligible BSE risk” on March 25 of 2016. Global beef imports from France are expected to fall as a result of the discovery.

⁶ The 2016 rulemaking by the FDA listed 4 cases of vCJD; however, the Center for Disease Control lists only 3 within the United States. This is due to the location of each individual when they were exposed to the disease. All four persons with vCJD were likely exposed to the infectious agent before moving to the U.S.

⁷ In 2015 the United Kingdom reported 2 cases of BSE, with Canada, Ireland, Norway, Slovenia, and Spain all reporting a single case.

Chapter 3: Analysis and Market Developments Related to the U.S. BSE Case

3.1 Market Share and Revealed Comparative Advantage Equations

Multiple tools are available to perform ex-post international trade analysis and to evaluate individual nation product specialization. Within this section we provide market share analysis complemented by description of U.S. export values and revealed comparative advantage (RCA) indices on global beef exports from 2001-2014, and compare the results. Performing market share analysis allows us to see what percentage of total global beef exports the U.S. represented in the years prior to the BSE announcement, during the initial years of the outbreak, and in the years following. This examination is one of the more simplistic types of analyses used for evaluating international trade patterns, with market share percentages being estimated by the following:

$$MarketShare_t^i = (X_t^i/X_t) * 100$$

Where X_t^i represents country i 's export values of a specific HS code in year t , and X_t is the summation of total global export values of that same commodity. The percentages obtained provide useful information such as whether U.S. market share is growing or shrinking in relation to total global exports, but it provides no insight as to why. Comparing market shares between nations who produce relatively similar products, such as U.S. and Australian beef, reveals greater detail about the level of global competition. The analysis provided exposes which nations were able to capture market share away from the U.S. after the 2003 BSE detection, and how much of the total market the U.S. has been able to recapture in the years since.

Evaluating historical trade patterns and individual country comparative advantage indicates what commodities countries produce and trade, and is helpful in performing trade balance simulations. The RCA index, introduced by Balassa (1965) calculates the ratio of a product in one country's exports to its share in world trade, indicating if a nation is more efficient in the production of a certain good. RCA

indices and other factors provide researchers with the ability to analyze the direction of international trade (Laursen 2015). Formally, RCA is calculated as:

$$RCA_k^i = (X_k^i/X^i)/(X_k/X)$$

Where X_k^i is country i's export value of good k, $X^i = \sum_k X_k^i$, its total export value, $X_k = \sum_i X_k^i$ being world export value of good k, and $X = \sum_i \sum_k X_k^i$ representing total world export value. An RCA value of one means that for that nation and that particular commodity, the percentage share of that sector is the same as the world average. An RCA value above one indicates that nation is relatively specialized in that commodity, and less than one is indicative of under-specialization. Criticism has been made on the use of the RCA index, due to it being unbounded in sectors that have a revealed comparative advantage, but having a zero lower bound when no advantage is present. Normalization of the index was proposed by Laursen (2015) and is calculated as follows:

$$NRCA_k^i = (RCA_k^i - 1)/(RCA_k^i + 1)$$

Where the interpretation of the normalized revealed comparative advantage (NRCA) is similar, however NRCA's critical value of share being the same as the world average is zero, with symmetric upper (1) and lower (-1) bounds. When using either RCA or NRCA, the per-year and commodity specific rankings are the same, and thus for this specific analysis and our use of the RCA for ranking measures, NRCA provides little additional insight on the classification of commodity specific competitiveness. However for clarity, both RCA and NRCA values will be provided within the Tables accompanying the RCA Results portion of this paper.

3.2 U.S. Market Share Results

The previously mentioned largest beef export HS codes for the evaluated time period 2001-2014, HS 0201, meat of bovine animals, fresh or chilled, and HS 0202, meat of bovine animals, frozen, had combined world exports totaling \$398 billion within that time frame. HS 0206, while not an exclusive

beef HS code, will also be analyzed due to its place as the third-largest traded HS category that contains beef, with 2001-2014 exports totaling \$62 million.⁸ HS 0206 is ambiguous when it comes to species, including four six-digit bovine categories, as well as three six-digit swine categories, and two six-digit categories that combine sheep, goats, asses, mules or hinnies offal. Beef exclusive categories account for over 50 percent of total exports within the time frame for HS 0206, and thus were included within the analysis. When necessary, HS 0206 will be evaluated down to the HS six-digit level, whereas HS 0201 and HS 0202 will only be analyzed at the four-digit level. Data used for the composition of this analysis was obtained from the International Trade Centre (ITC), a joint agency of the World Trade Organization and the United Nations.

For the largest beef exclusive category, HS 0201, Table 1 provides the top 25 exporters and their respective global market shares from 2001-2014. Prior to the 2003 discovery, U.S. domination was evident, holding 20.9 percent market share in 2001, with the second largest competitor, Canada, maintaining a 16.3 percent share. In the year of the U.S. BSE discovery, 2003, the U.S. was responsible for 17 percent of total global exports, followed by the Netherlands with 12.9 percent, and Australia, Ireland, and Germany representing roughly 10 percent each. Canada had dropped to 9 percent due to the early 2003 discovery of BSE within their borders. This is largely due to import restrictions similar to those placed on the U.S., with Canadian global market share dropping as low as 3.9 percent in 2013 and 5.1 percent in 2014. After the discovery of BSE in the state of Washington, U.S. market share declined to 3.9 percent in 2004, eventually returning to 10.4 percent in 2010, and as of 2014, had climbed back to 13.6 percent, still well below pre-BSE levels.

⁸ HS 0206 is comprised of the following six-digit HS codes: 020610, bovine edible offal, fresh or chilled, 020621, bovine tongues, edible offal, frozen, 020622, bovine livers, edible offal, frozen, 020629, bovine edible offal, frozen nes, 020630, swine edible offal, fresh or chilled, 020641 swine livers, edible offal, frozen, 020649, swine edible offal, frozen nes, 020680, sheep goats, asses, mules or hinnies, edible offal, fresh or chilled, and 020690, sheep, goats, asses, mules or hinnies edible offal, frozen.

For the second largest category, HS 0202, Table 2 provides the top 25 exporters and their respective market shares from 2001-2014. Australia held the largest market share in 2003 at 20.9 percent, followed closely by the United States at 20.8 percent. In 2004, U.S. market share declined to 1.1 percent, while Australian share increased by 4.2 percentage points. Brazil, India, New Zealand, Uruguay, and Paraguay were a few of several nations that experienced gains in market share from 2003-2004, largely at the expense of U.S. producers. It took 7 years for the U.S. to regain 10 percent of the market, fluctuating by little more than a percentage point in the years since. As of 2014, U.S. market share stood at 11.9 percent, providing further evidence that the negative consequences of widely-adopted, highly restrictive trade policies extended well beyond their removal.

The BSE discovery had a significant, but smaller impact on global market shares for HS 0206 than the previously diagnosed HS categories. This is likely due to the inclusion of non-beef categories present within HS 0206, and analysis at the six-digit level will be provided within later sections. Table 3 provides the top 25 exporters and their respective market shares, detailing the relatively smaller reduction in market share in comparison, but again showing the inability of producers to recover pre-BSE share. From 2003 to 2004, U.S. share in total market composition decreased by 13.7 percentage points, while in the same time frame, Australia, New Zealand, Germany, Brazil, and several other nations experienced increases in market shares. However, U.S. share grew from 12.8 percent in 2004 to 14.7 percent in 2005. As of 2014, U.S. global market share is 17.2 percent, roughly 60 percent of the pre-BSE level.

The results for all three categories illustrate that even with the removal of most restrictions on U.S. beef and beef products, producers have not been able to reestablish the dominance experienced prior to the outbreak. Market share levels for each category have not been fully regained to pre-BSE years, for multiple potential reasons. Some key markets either remain completely closed or still have restrictions on U.S. beef. In addition, this change in composition has not been fueled by only the BSE discovery and the slow process of the removal of import restrictions, but also by the emergence of new producers and new export destinations. The increased competition on the global beef market was in part spurred by the

restrictions on U.S. beef by many of the largest beef importers, allowing new suppliers to enter, and allowing other competing exporters to grow their share of these markets. In order to determine if there was expansion of U.S. beef to markets that either did not implement all-encompassing bans, or put into place highly restrictive policies in the year when the outbreak occurred but rescinded these policies fairly quickly, exports for each commodity code by the U.S. and then also by other exporters are evaluated within the following sections to both traditional and non-traditional specific markets to see where decreases occurred, and if there were any significant increases in 2004 and subsequent years.

3.3 U.S. Export Values to Traditional Markets

To complement the market shares shown in Tables 1-3, the total monetary nominal values of U.S. beef exports to traditional markets of the same HS codes are provided within Tables 4-6. Within Tables 4-6 real trade values are also reported for the world total value of U.S. exports. Real values are scaled using the U.S. GDP deflator, with 2014 as the base year, thus reporting annual exports in 2014 dollars.⁹ Quantities of beef exports as reported by the ITC were also evaluated, and for the most part, the quantity changes have general correspondence regarding annual increases and decreases with our reported nominal values in the immediate and near-term aftermath of the 2003 discovery of the BSE case. For the remainder of this chapter, in order to maintain consistency with frequently reported nominal values and due to general low inflation over the evaluated time frame, we will report and rely on nominal data, as presented in corresponding-year U.S. dollars by the ITC. However for clarity, total annual U.S. beef export values in both real and nominal terms, along with quantities, are provided within Table 7. It should again be noted, that annual changes in both real and nominal export values, along with exported quantities, generally matched before, during, and in the immediate years after 2003, however a divergence took place after prices increased in 2009. This price increase will be evident in the discussion of export values from 2008-2014, and when necessary, quantities will be provided to clarify changes in exports.

⁹ GDP Deflator values were obtained from the World Bank, defined as the ratio of GDP in current local currency to GDP in constant local currency.

Figure 3 illustrates the implied prices for all three HS codes, showing how the largest increase in prices was limited to HS 0201 and HS 0202, again beef exclusive categories, while the inclusion of pork products within HS 0206 excluded the overall category from increasing in a similar fashion.¹⁰ Table 8 presents the implied prices for each HS category, along with annual U.S. inflation rates obtained from the World Bank, providing evidence that the reliance on nominal values is appropriate for the evaluation of the 2003 impact of BSE on the global beef market. Figures 4, 5, and 6, presented within the following sections, detail total U.S. export values in both real and nominal terms, along with respective quantities in order to illustrate the previously mentioned divergence in recovery dependent upon the unit of measurement.¹¹ These figures and tables provide quick reference to see how each HS category responded to the implementation of restrictions, the subsequent removal of most policies by the largest importers, and the general increase in prices post-2009.

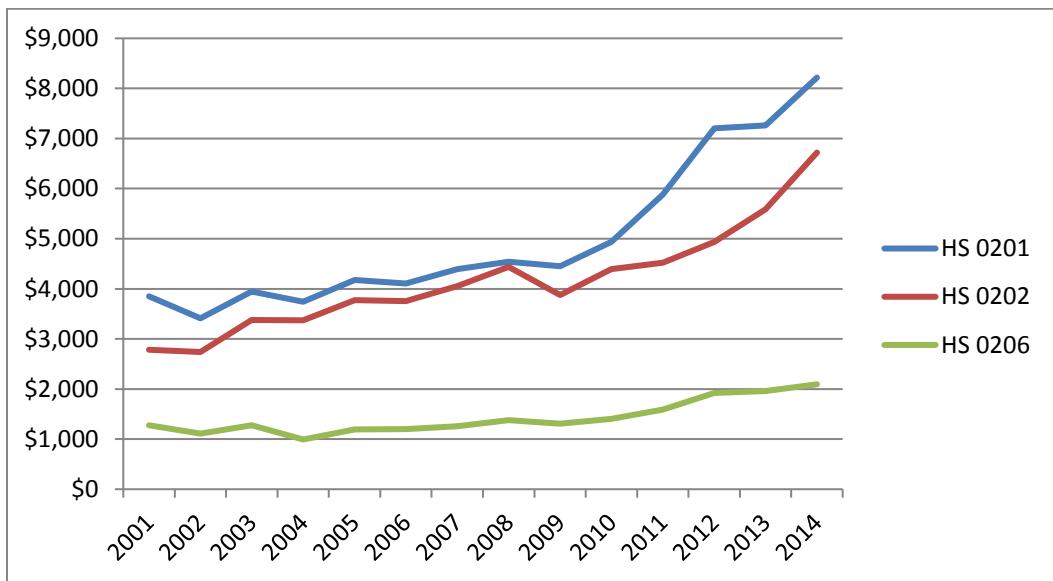


Figure 3: Implied Prices of U.S. Beef Exports: 2001-2014

¹⁰ Implied prices are obtained by dividing total exported value by total exported quantity annually.

¹¹ The ITC reports lists several reasons for divergence between traded volume and value, including price increases, demand shifts for higher priced goods or more value-added goods within the HS code, and variation in transportation and insurance costs.

In order to determine the main or traditional markets for U.S. beef, selection of nations was composed by the summation of annual beef imports from the U.S. from 2001-2014, and only nations where that value exceeded \$10 million during the 14 years were included within the evaluation. Due to this nation selection parameter, potential trade diversion to smaller non-traditional markets has been included within later sections of this paper; however, mention of certain nations where 2003-2004 imports from the U.S. increased will be included here. This further evaluation of export value to the top destinations provides a closer look at the time frame required by the U.S. to recapture traditional markets and how severely the imposed restrictions altered traditional trade flows.

Prior to the evaluation of U.S. exports by individual HS codes, it should be noted that total global domestic beef consumption, shown for comparative purposes at the bottom of Tables 4-6, increased annually from 2001-2006, with varying percentage changes each year. Domestic consumption data was retrieved from the USDA's Foreign Agricultural Service's Production, Supply, and Distribution Database, (PSD) and is measured in 1000 metric ton (MT) carcass weight equivalent (CWE).¹² The largest annual growth in total domestic consumption for the evaluated time frame was within 2001-2002, with global consumption increasing by 2.86 percent. From 2003-2004 global consumption increased at a smaller rate of 1.56 percent, dropping to a growth of 0.94 percent from 2004-2005. This suggests that the BSE discovery in the U.S. and Canada and subsequent trade restrictions may have slowed the growth rate of total global beef consumption, but did not cause total consumption to decrease from the previous year. From 2005-2006 global consumption increased by 2.21 percent, and grew again the following year by 2 percent. A reduction in global consumption volume did not occur until 2007-2008, at a decrease of 0.42 percent.

For HS 0201, total exports by the U.S. were greatly reduced from 2003-2004, a drop in value from \$1.7 billion to \$444.7 million (see Table 4). Mexico, Canada, South Korea, and Taiwan all imported

¹² Domestic consumption volumes from the USDA are not measured by specific HS codes, but by commodity title: Meat, Beef and Veal, being comprised of HS 0201, HS 0202, HS 021020 and HS 160250.

a smaller value in 2004 than in 2003, with the largest loss coming from Japan at a decrease of \$717 million. The damage from the announcement of BSE in Washington was not limited to the United States largest trading partners, as Hong Kong, Chile, Russia, the United Arab Emirates, Singapore, Kuwait, Jamaica, China, Belgium, Honduras, and many other small volume importers purchased less of HS 0201 in 2004 than in 2003. The decline in export values and quantities for HS 0201 can be seen within Figure 4. As previously stated, certain nations imported a larger amount between the two years; however, value levels are important when analyzing these changes to evaluate their significance. The Netherlands imported \$689 thousand of HS 0201 in 2003 from the U.S., increasing to \$1.2 million in 2004. The change alone may suggest trade diversion; however, the low volume suggests this change could be easily attributed to either reporting errors or other factors, in which case the increase should not be attributed to the restriction of U.S. beef by other nations. German imports of HS 0201 increased from \$1.9 million in 2003 to \$2.9 million in 2004, a larger increase than seen in the Netherlands, but in comparison to import values seen by South Korea and Japan in 2003, \$123 million and \$717 million respectively, this increase is small. Export levels from the U.S. to Mexico, Canada, Japan (slightly), and Taiwan grew from 2004-2005.

As restrictions were eased or completely lifted, total U.S. export value of HS 0201 has increased annually, with the exception of the 2008-2009 time period, likely due to the 2008 global financial crisis. Exports to Mexico and Canada exceeded pre-BSE levels in value by 2006, and have on average increased every year. In 2014 U.S. exports to both countries were the highest seen within the evaluated period, at a value of \$857 million to Mexico and \$772 million to Canada. For the largest traditional importers besides NAFTA members, specifically Japan, Taiwan, and South Korea, export values were slower to recover, however in 2014 each nation imported over \$100 million of fresh or chilled beef from the U.S. For both South Korea and Taiwan, this 2014 value is significantly higher than pre-BSE levels; however Japanese purchases in 2001 were larger than the value seen in 2014, at values of \$770 million and \$761 million respectively. Total world exports (not shown in the table) increased every year from 2001-2008, with the

smallest annual increase occurring in the 2003-2004 time period, at 10 percent. From 2001-2002 global export value increased 13 percent, and 15 percent growth was seen from 2002-2003. Despite the recovery in U.S. exported value, total exported quantity has only recently begun to reach the same level as seen in the pre-BSE period, which can be seen within Figure 4.

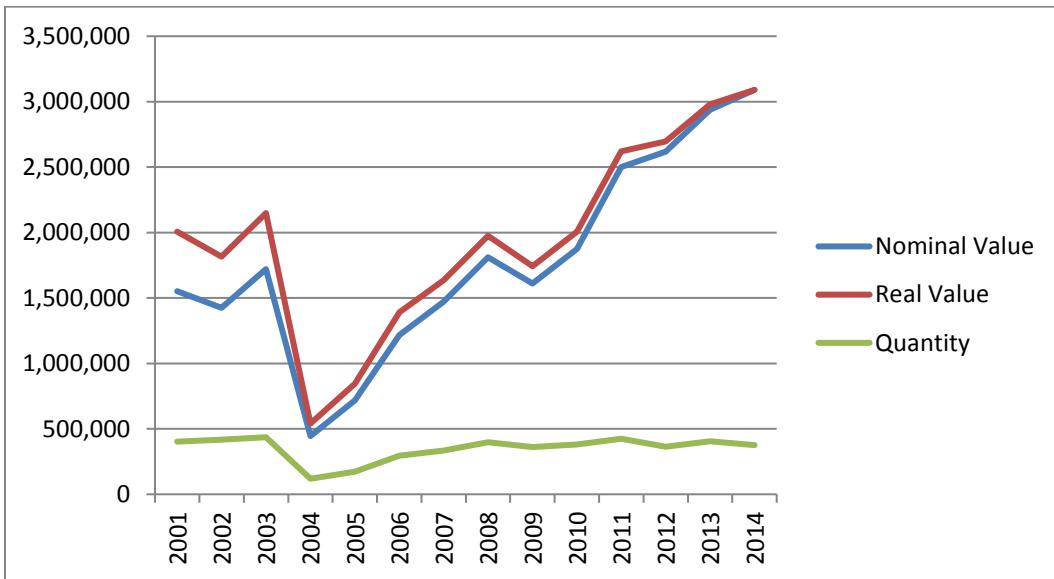


Figure 4: U.S. HS 0201 Exports 2001-2014

The total value exported by the U.S. for HS 0202 suffered similar negative changes, decreasing from \$1.3 billion to \$83 million from 2003-2004, as can be seen within Table 5. There are 20 more nations that satisfied the parameters previously mentioned for evaluation, as shown in Table 5 compared to Table 4. The top export destinations of South Korea, Japan, Hong Kong, Vietnam, Taiwan, Mexico, Egypt, Russia, Canada, and the Philippines all greatly reduced their purchases of HS 0202 from the U.S. Again due to the transportation limits on fresh beef and the larger number of importers, the size of the decline in export value and quantity for HS 0202, frozen beef, was significantly more pronounced and can be seen within Figure 5. The greatest loss was within the Korean market, with exports declining by \$617

million, followed closely by Japan with a loss of \$438 million, reinforcing again how important the Japanese and Korean markets are to U.S. beef exporters. The next largest losses in export value were Hong Kong and Taiwan at \$57 million and \$43 million. The Bahamas, the Dutch Caribbean region, Honduras, Antigua and Barbuda, Romania, Poland, and Bangladesh (mostly not shown in the table due to selection parameters) all had increases of HS 0202 imports from 2003-2004, with the largest increase being seen in Romania, increasing from purchases of \$108 thousand in 2003 to \$591 thousand in 2004, levels not considered significant. It wasn't until 2006-2007 that the largest U.S. trading partners began to increase their imports at any level of significance.

Again, the removal of complete restrictions by traditional importers began in the 2006-2007 period, in which U.S. exports to its largest trading partners began to rebound. A larger variation of recovery exists within HS 0202 in comparison to HS 0201. The large number of traditional importers for frozen beef that caused the decline in U.S. HS 0202 exports to be significantly greater was also the reason for the slower recovery. While the largest destinations for chilled beef, Canada and Mexico, reopened borders quickly, the largest destinations for frozen beef were slower to do so. This slower recovery by comparison can be seen within Figure 5. South Korea and Japan have only recently imported similar values to 2003, with Korean purchases in 2014 standing at \$700 million, in comparison to the 2003 value of \$617 million. Similarly, Japanese 2014 import value was \$566 million, whereas 2003 had a reported value of \$438 million. Within this region, Hong Kong is now the largest destination for U.S. frozen beef exports, importing over \$1 billion in 2014. At a much lower 2014 import value of \$159 million, Taiwan has greatly increased purchases from pre-BSE levels, which stood at \$43 million in 2003. It should be noted, that despite lower traded value within NAFTA than in the Asian region, Mexican imports of HS 0202 from the U.S. are still lower than pre-BSE levels, however exports to Canada were recovered by 2007.

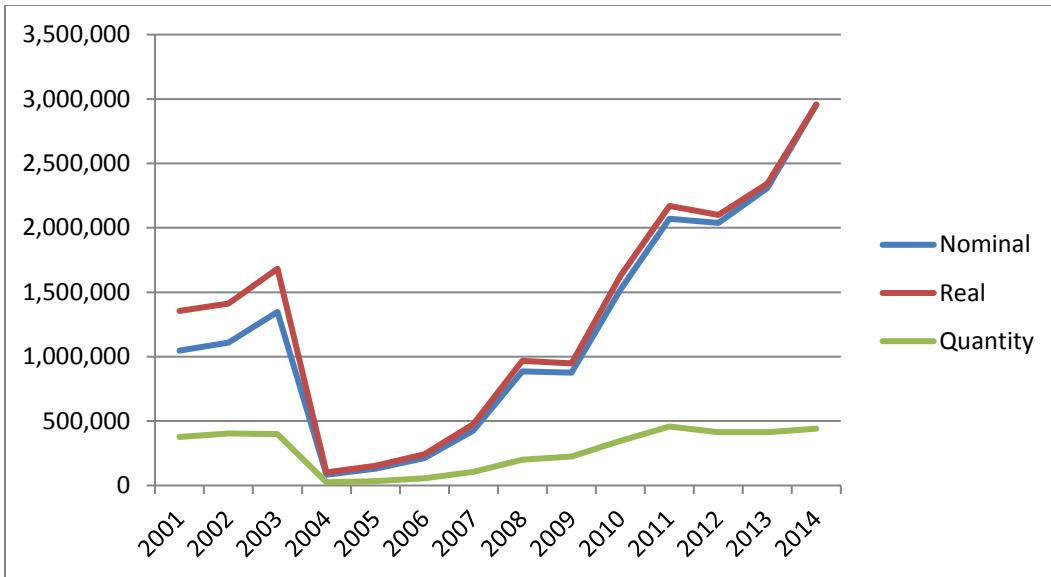


Figure 5: U.S. HS 0202 Exports 2001-2014

U.S. total global export value of HS 0206 stood at \$540 million in 2003, dropping to \$303 million in 2004, a much smaller absolute and percentage decrease than the two previously diagnosed HS codes. The structure of the loss attributed to the BSE discovery extends beyond the losses from traditional high-volume importers compared with the previously evaluated HS codes, with substantial losses occurring in Egypt, Hong Kong, Japan, Russia, Canada, South Korea, Jamaica, and Indonesia, which can all be seen within Table 6. The largest losses within the broad HS 0206 category were within Japan, South Korea, and Russia, almost exclusively in the bovine HS categories. Inspection at the six-digit level reveals that pork products within HS 0206 were not negatively impacted by the bans, with values from 2003-2004 actually increasing in all three nations. This increase alone could suggest consumers switched sources of protein as a result of the new policies, but is not definitive. The largest decrease in HS 0206 exports came from Japan, with a decrease of \$161 million from 2003-2004. Poland, Mexico, the Republic of Moldova, Germany, Belgium, China, the U.K., Turkey, Angola, Bulgaria, and Kazakhstan all saw imports of HS 0206 increase by a significant amount from 2003-2004. The largest expansion in purchases of HS 0206 in this time period came from Mexico, at an increased value of \$23 million, and Poland, with an increase of roughly \$12 million. However, U.S. exports of bovine products to Mexico decreased within the largest

six-digit category, HS 020629, bovine edible offal, frozen. The increase was largely caused by increases within swine categories, specifically HS 020649, swine edible offal, frozen, and HS 020630 swine edible offal, fresh or chilled. The increase in exports to Poland was exclusively within HS 020622, bovine livers, edible offal, frozen. This could potentially suggest trade diversion as a result of the bans by larger traditional importers; however, due to the specific category and relative small export value, this is not conclusive evidence. When evaluating HS 0206 at the four-digit level, U.S. exports have recovered in all markets as of 2014.

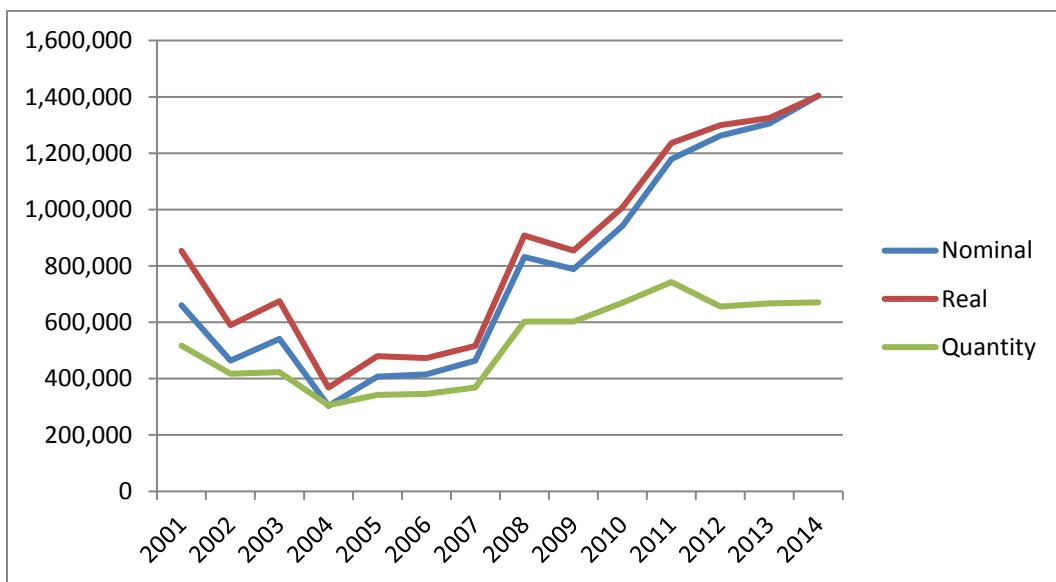


Figure 6: U.S. HS 0206 Exports 2001-2014

As previously stated, when looking at the longer-term trends in the values of U.S. beef exports, both price and quantity effects need to be evaluated. As shown in Tables 4-6 and Figures 4-6, comparing nominal and real total U.S. export values shows the cumulative effect of inflation. Real values rise less from the beginning of the 14 years than nominal values. Of equal importance is a sharp rise in prices of beef after 2007, illustrated previously within Figure 3. Total U.S. export quantity has had less fluctuation by year when compared to nominal or real values. As previously stated and shown within Figure 3, price increases from 2008-2014 spurred huge leaps in export value recovery from pre-BSE levels, which was

shown in Figures 4-6. Total quantity exports have recovered from the losses experienced in the years after the discovery, but have not grown as substantial as export values. For example, total export quantity of HS 0201 in 2014 was 376 thousand tons, whereas in 2003 total export quantity was 436 thousand tons. HS 0202 total export quantity reached its highest level in 2011, at 457 thousand tons, in comparison to a 2003 exported quantity of 398 thousand tons. HS 0206 has recovered the greatest in terms of quantity, likely due to the swine categories and increased demand for pork globally. 2003 total exported quantity was 423 thousand tons, growing to 670 thousand tons by 2014. A large part of the recovery to the U.S. beef sector again can be attributed to the increase in prices post-2008, with a corresponding increase in value exported. Exported quantity however, has only recently begun to approach pre-BSE levels.

3.4 Revealed Comparative Advantage Results

Evaluating and ranking the RCA indices provides a measure of when the United States was an efficient and competitive producer of certain beef products over the evaluated time frame, and where emphasis should be placed when addressing policies restricting U.S. beef imports. Table 9 illustrates both RCA and NRCA indices, U.S. HS 0201 export values, U.S. total export values, global HS 0201 export values, and global total export values from 2001-2014.¹³ Tables 10 and 11 provide the same information for HS 0202 and HS 0206, respectively.

Using the RCA formula, the United States had a revealed comparative advantage in the largest globally traded beef HS code, 0201 in the years prior to the emergence of BSE, 2001-2003, with RCA values of 1.75, 1.54, and 1.76, respectively. RCA values dropped sharply below 1 from 2004 until 2006 due to the large decrease in the volume of U.S. beef exported as a result of the import restrictions. It wasn't until 2007 when the RCA value again exceeded 1, however after restrictions were lifted, specifically by Canada and Mexico, the RCA value increased each year after the 2002-2003 drop. The

¹³ All export values again obtained from the International Trade Centre.

highest level experienced in 2003, 1.75, has not been recovered as of 2014, but is fairly close at a value of 1.57.

The second largest globally traded HS code, 0202, followed a similar pattern to HS 0201. From 2001 until 2003, RCA values were 1.65, 1.80, and 2.15, showing a high level of specialization in 2003. The drop from 2003-2004 was significantly larger for HS 0202 than for HS 0201, a decrease from 2.15 to 0.13, again due to the larger number of traditional importers to which the U.S. is able to export frozen beef. However, with HS 0202, RCA values did not exceed 1 again until 2010, long after most restrictions were lifted, showing the lasting impacts of severe policy reactions on U.S. beef industry competitiveness. Additionally, the U.S. revealed comparative advantage for HS 0202 has not regained the level experienced in 2003, standing at 1.36 in 2014.

For the third largest traded HS code that includes beef, HS 0206, the U.S. had revealed comparative advantage for the entire evaluated time frame, with its largest value occurring in 2001, a value of 2.90. Again, this is largely due to the swine HS codes contained within HS 0206 and average increases in exports of U.S. pork over the specified time frame. RCA value declined from 2.73 in 2003 to 1.43 in 2004, never regaining pre-BSE levels of specialization. The value exceeded 2 in 2010, but has declined to 1.99 as of 2014. As previously stated, the composition of HS 0206, specifically the inclusion of non-beef commodities, is likely the largest factor in the relatively diminutive response to the BSE outbreak.

The stable RCA values for HS 0201 and HS 0206 in 2001-2003, along with the relative growth in HS 0202, provides evidence that U.S. beef competitiveness was substantial and increasing prior to the years of the outbreak. This shows that the damage of BSE discovery was not restricted to only decreased export value and quantity, but it also prompted a reduction in any potential expansion of U.S. beef competitiveness on a global scale. Due to this fact, policy related to food safety should address that

unnecessary non-tariff barriers to trade are not only disruptive to simply trade volumes, but can have long term effects on the ability of producers and nations to remain competitive on a global scale.

3.5 Trade Diversion and Creation as a Result of BSE to Individual Traditional Markets

Within this section, evaluation and analysis will be provided for the largest global importers of beef again using the HS four-digit categorization to further examine what the short and long run trade value fluctuations were from 2001-2014. Determining what nations were responsible for increasing beef exports to these markets once the U.S. lost access is one of the previously stated objectives of this paper. Discovering the ability or lack thereof of these countries to retain that acquired market share and increased export value as restrictions on U.S. beef were lifted can provide a useful reference should a threat to U.S. food safety emerge in the future. Domestic consumption for each individual nation is also documented within the respective tables to determine if there was significant consumer reaction within these nations to the presence of BSE within the U.S. Individual nation domestic consumption data was again retrieved from the USDA's PSD database. U.S. exports to each country were previously provided within Tables 4-6. What is added here are exports to each specific market by competing exporters. We utilize import data for each country as opposed to export data from the U.S shown in the earlier tables.¹⁴ Selection of the top destinations was performed by summing total imports from all exporters in the specified time frame and evaluating only the nations where that value exceeded \$100 million. For HS 0201, meat of bovine animals, fresh or chilled, the top importers are Mexico, Canada, Japan, South Korea, and Taiwan. For HS 0202, meat of bovine animals, frozen, the top importers are South Korea, Japan, Hong Kong, Vietnam, Taiwan, Mexico, Egypt, and Russia. For HS 0206, edible offal of red meat,

¹⁴ While there is general correspondence in levels, the import values for each country do not always match U.S. export values listed in Tables 4-6 for multiple potential reasons. The main causes behind differences in values are the differences in trade systems used by nations, time lag, country confidentiality, re-exports taken into account or a lack thereof. The ITC reports that transportation and insurance costs are reflected in the reported import value, but are not included within the reported export value. The values presented in the previous section for the U.S. are the reported export values, whereas in this section for the destination markets, import values are presented.

the largest importers are Mexico, Egypt, China, Hong Kong, Japan, Russia, Canada, and South Korea. Again analysis of HS 0206 down to the six-digit level will be presented when necessary, however as with prior sections, this data will not be provided within the tables. Prior to the BSE discovery in Washington, Japan, Mexico, South Korea, and Canada represented 90 percent of U.S. beef exports based on value. The following evaluation will determine what happened to U.S. beef exports since the discovery, and how important each individual market was, and now is. The tables show import values from key exporters where export values were significant over the evaluated time frame to each country and total (world) imports by the country, so values or shares of the market can easily be evaluated.

Mexico

As a member of NAFTA and one of the largest trading partners with the U.S., Mexico represents a critical destination for U.S. beef exporters, and sources each of the three evaluated HS codes overwhelmingly from the U.S. (see Table 12). Mexico's import of HS 0201 comes almost completely from both the United States and Canada, with 99 percent of all imports coming from the two nations in the evaluated time period. A minor amount is sourced from Chile and Nicaragua, however not at levels high enough to be considered competition to either the U.S. or Canada. In 2003, the United States supplied Mexico with 90 percent of total purchases. In 2004 the U.S. portion of Mexico's total market decreased from \$720 million in 2003 to \$415 million, while in the same year, Mexican purchases from Canada increased by \$174 million, showing Mexican imports diverted significantly away from the U.S. towards Canada despite Canada's BSE cases, and total imports fell. To further provide evidence of Mexico shifting purchases away from the U.S. to Canada, we can show total imports of HS 0201 by Mexico from 2003-2004 decreasing by 18 percent, while domestic beef consumption decreased by only 6 percent. Furthermore, imports from the U.S. declined by 73 percent whereas imports from Canada increased 70 percent. Mexican purchases of HS 0201 also increased from a value of 0 in 2003 to \$4.3 million in 2004 from Chile, along with a much smaller increase, \$329 thousand, from Nicaragua. Imports from Chile grew to the largest value of \$13 million in 2005, but dropped significantly in the following

years as U.S. export values to Mexico have significantly grown. The increase in imports from Nicaragua followed a similar pattern. 2005 saw the U.S. recapture a significant portion of the market within Mexico, and has maintained in the years since on average above 80 percent of the total Mexican market. In 2014, the U.S. supplied Mexico with \$794 million out of total imports of \$912 million, roughly 87 percent of the Mexican market.

For HS 0202, imported values are significantly lower than HS 0201, and Mexican imports are obtained from a larger group of partners. In 2001, the United States represented 33.8 percent of total Mexican imports, a value of \$20 million, followed by Canada, New Zealand, and Australia. From 2003 to 2004 Mexican imports of U.S. HS 0202 dropped by 84 percent, a corresponding loss of \$14.9 million. Imports from Canada increased 63 percent, with decreases in imports from both New Zealand and Australia occurring during the same time frame. After 2004, and the removal of restrictions, the U.S. has slowly grown their market share annually, and as of 2014, the United States represents 68.2 percent of total Mexican imports for HS 0202 at a value of \$28 million, indicating no long term impacts from BSE. The U.S. has not only recaptured market share in this specific category, but has exceeded pre-BSE levels in value.

Trade between Mexico and its largest trading partners for HS 0206 was not significantly impacted by the discovery of BSE when looking only at the four-digit level. However, imports from the U.S. varied when evaluating this code at the six-digit level. For example, imports of HS 020629, bovine edible offal, frozen, decreased from 2003 to 2004, with imports of HS 020621, bovine tongues, edible, frozen, increasing within the same time frame. Mexican HS 0206 imports from Canada largely increased within HS 020649, swine edible offal, frozen, and slightly within HS 020629, bovine edible offal, frozen, HS 020621, bovine tongues, edible offal, frozen, HS 020610, bovine edible offal, fresh or chilled, and HS 020622 bovine livers, edible offal, frozen. Thus, for each of the evaluated four-digit HS codes, and within several six-digit codes, evidence is present that Mexican imports of beef were diverted away from the U.S. in the wake of the 2003 case in favor of Canadian imports, again despite the number of BSE cases

within the nation. Domestic beef consumption in Mexico, despite the previously noted 2003-2004 decrease, shows no significant long term effects that can be attributed specifically to the U.S. discovery. However, consumption of beef and veal meat has declined and is overall lower recently than pre-BSE levels.

Canada

Similar to Mexico and largely due to NAFTA, the decrease in Canadian imports from the United States in 2004 promptly rebounded by 2005 as pressure by the U.S. was placed on both nations to reestablish trade, with Canada being granted a special dispensation concerning their exports to the U.S. (Kerr et al. 2007). The overall decrease was also likely compounded due to the oversupply in their own market as a result of new trade restrictions on Canadian exports from other nations, defined as trade depression, a phenomenon which will be further explored within the econometric analysis section of this paper. Canadian imports of each HS code, along with domestic consumption values are provided within Table 13. Canadian total imports of HS 0201 decreased by \$190 million from 2003-2004, and while domestic consumption within the same time frame decreased, the minute change along with large variability in the following years does not provide evidence that the 2003-2004 decrease in Canadian beef consumption can be attributed to the presence of BSE either within the U.S. or Canada. The only nation that saw an increase in 2004 exports to Canada was Uruguay, at an increase of \$3.4 million from a 2003 value of \$8.7 million, and a 2002 value of 0. Again, imports from what could be considered a non-traditional market declined in the years following, with Uruguay exporting \$333 thousand to Canada in 2013, and nothing in 2014. Canadian imports from the U.S. grew to \$114 million in 2005, increased beyond pre-BSE levels in 2006, and have grown to comprise 94 percent of total imports since 2007. As of 2014, the U.S. supplied Canada with 97.2 percent of HS 0201 imports, a corresponding value of \$752 million.

For HS 0202, summing total Canadian imports from 2001-2014 shows the United States being the 4th largest supplier, behind New Zealand, Australia, and Uruguay. As with HS 0201, there was a significant decrease in Canadian purchases from the U.S. in 2004, a total loss of \$15.2 million. As opposed to HS 0201, no nation experienced an increase of HS 0202 exports to Canada and again, the U.S. has slowly recaptured market share, but still exports less than the other 3 primary suppliers mentioned. As of 2014 the United States supplies 11.9 percent of total Canadian imports, a value of \$38 million, almost double the nominal export value in 2003.

The United States is the overwhelmingly largest supplier of HS 0206 to Canada, providing over 95 percent of imports for the entire evaluated time frame, with little changes to trade patterns as a result of BSE. Evaluation of HS 0206 at the six-digit level reveals that trade of pork was not impacted by BSE cases in both nations, keeping U.S. HS 0206 market share values high. Canadian imports of swine products from the U.S. increased in every category from 2003 to 2004, while imports of bovine products within the same category decreased. It should be noted that from 2012-2014, Australia has exceeded \$1 million in annual exports of HS 0206 to Canada, as the total value of U.S. exports have decreased each year in the same time frame. However, this increase in Canadian purchases from Australia is within HS 020629, bovine edible offal, frozen, where in this category imports from the U.S. have also been increasing, as high as \$20.4 million in 2014. The largest decreases in Canadian HS 0206 purchases from the U.S. have been contained to HS 020690, sheep, goats, asses, mules or hinnies edible offal, frozen.

Japan

Japan was one of the largest destinations for multiple categories of U.S. beef in the years leading up to BSE, and the decreases in Japanese imports from the U.S., along with decreased market shares have been documented above. Unlike many of the other large importers for beef, but similar to Canada, Japan also suffered their own unique setbacks due to the 2001 discovery of BSE within their beef supply. However, Japan is not a large net exporter of beef or beef products, primarily producing for the domestic

market. Due to the high costs of beef production within Japan, they are unable to compete with imported beef on price, and rely on high levels of support by the Japanese Government, allowing the domestic industry to survive.¹⁵ As previously stated, Japanese consumers were much more reactive to BSE fears than Americans or Canadians, with domestic consumption of beef decreasing in wake of consumers switching to other sources of protein. Japanese annual domestic consumption of bovine meat and veal is detailed within Table 14, along with total imports from all traditional suppliers. Japanese consumption of beef and veal had been relatively stable prior to the more recent emergence of BSE, increasing on average annually during the 1990s. The 2001 Japanese case caused domestic consumption to decrease by 164 thousand metric tons from 2000 to 2001 (not shown in Tables), and to decrease again the following year by 95 thousand metric tons. Once the U.S. case was announced, Japanese domestic consumption was reduced to its lowest level in over a decade, roughly 1.16 million metric tons in 2004. Japan has slowly eased their restrictions on U.S. imports, allowing beef from cattle less than 21 months of age in 2005, and further eased restrictions to cattle less than 30 months of age in 2013.

In 2001 the U.S. supplied Japan with 50.9 percent of their HS 0201 total market share, representing \$753.8 million, followed by Australia at 45.8 percent and a value of \$678.2 million, and New Zealand at 1.2 percent and \$17.6 million. Immediately after the implemented bans, U.S. exports in 2004 to Japan dropped to zero, a decrease of \$650.6 million from the previous year. In 2004 the Australian share of the Japanese market surged to 97.4 percent, representing an increase to \$1.1 billion. Australia was able to maintain export levels of over \$1 billion annually from 2004-2007, when the Japanese government began to relax the largest restrictions on U.S. imports. Japanese purchases from 2003-2004 also increased from New Zealand by \$9.2 million and Mexico by nearly \$5 million. Imports from Canada also dropped to zero from 2004 to 2005 as the Japanese implemented similar restrictions on Canadian beef. As previously mentioned, the Japanese lifted certain restrictions on U.S. beef in 2005, and

¹⁵ The Japanese government assists the domestic beef industry through high tariffs, direct payments, grants, and loan/insurance subsidies. These programs are financed by taxes and proceeds of the beef tariff (Obara 2010).

U.S. market share increased to a meager 2.6 percent in 2006, growing to 8.6 percent in 2007, and increasing gradually to 41.9 percent in 2014, a value of \$669 million. In comparison to Australian import value standing at \$845 million in the same year with a 53 percent market share, evidence is provided as to the ability of a nation who was unable to compete with the U.S. pre-BSE having maintained the advantage gained by unwarranted import bans. As U.S. market share grows, the Australian share has been decreasing at a similar rate. The ban implemented in 2003 has restricted the U.S. share of the Japanese market 12 years into the future, and the U.S. beef industry has not regained market share levels experienced prior to the discovery, in spite of overall export values being greater. It should be noted that despite the annual decreases in Japanese domestic consumption, Australia, New Zealand, and Mexico were surprisingly able to increase their exports to Japan, showing that despite consumer awareness and strong Japanese reaction to the risk, competitors were able to capitalize on the sudden absence of U.S. beef. Had the Japanese consumers not been so risk-averse to BSE and the potential transmission of vCJD, these nations may have been able to expand their exports at even greater levels and potentially retain an even larger market share than currently held.

For HS 0202, the impact was even more pronounced due to greater levels in total share of the Japanese market held by the U.S. pre-BSE; however, traded values of the two categories were similar in most years. In 2001, the United States supplied Japan with 60 percent of total imports, valued at \$490 million, dropping to 0.8 percent in 2004 with a corresponding value of \$5.2 million, 0 percent in 2005, and began to increase in volume gradually as of 2006, when exports increased to \$10.8 million. As of 2014 the U.S. has only grown its market share to 37.3 percent, less than two-thirds of what it experienced in 2001; however, the 2014 exported value to Japan stands at \$48.4 million. This is due to overall imports by Japan being significantly larger in 2014 than in 2001, with total purchases growing from \$817 million to \$1.29 billion. Again Australia was the largest competitor, realizing their market share in 2003 of 35 percent grow to 81.9 percent in 2004, or an increase of \$258 million. Japanese imports of HS 0202 also grew from New Zealand, Mexico, and Chile. Mexico has been able to retain a small by comparison, but

significant portion of the market after the restrictions on Canada and the U.S. were removed. Pre-BSE annual Mexican exports to Japan never exceeded \$40 thousand, but have been greater than \$7 million in each year beginning in 2004, peaking in 2012 with a total of \$86 million. Again it should be noted that despite lower current overall domestic beef consumption, overall imports of frozen beef have greatly increased.

HS 0206 saw significant damage to Japanese imports from the United States, not unlike total Japanese purchases, which decreased by \$277.4 million. In 2001 the U.S. supplied Japan with 80.3 percent of total imports, \$581.9 million out of total Japanese purchases of \$724.2 million. U.S. share dropped to 5 percent in 2004, 3.9 percent in 2005, and has been steadily increasing every year since. Imports from the U.S. for every beef six-digit HS code within HS 0206 decreased from 2003 to 2004, with swine imports increasing in the same year. As of 2014, the U.S. represents 63.6 percent, or \$414.4 million of total Japanese imports, significantly lower than pre-BSE levels, but has regained the largest market share within the nation. This is due to the strong growth contained within this specific HS code for both beef and pork products. HS 020610, bovine edible offal, fresh or chilled, along with HS 020621, bovine tongues, edible offal, frozen, make up the largest portion of the larger HS 0206 code, with export values from the U.S. to Japan being \$220.2 million and \$151.7 million in 2003. Both of these codes fell to zero as a result of the Japanese ban, however HS 020610 has exceeded pre-BSE levels, reaching \$240.4 million in 2014. HS 020621 has not regained the previous levels, but is still substantial at a 2014 value of \$94.2 million. U.S. exports of the third largest six-digit code, HS 020649, swine edible offal, frozen nes, has steadily increased every year, again showing no impact on pork demand as a result of BSE. Australia supplied Japan with only 8.4 percent of total HS 0206 imports in 2003, increasing to 68.4 percent in 2005, hitting a peak of 66.9 percent in 2005, and gradually decreasing every year since. As of 2014, Australia supplied Japan with 22.8 percent of total imports, a value of \$414.4 million. Australia exports almost no pork products within HS 0206 to Japan, and thus their growth and decline for this category is nearly completely contained to beef. As previously detailed, Australia, New Zealand, Mexico, and Chile were

the largest nations tasked with filling the void left by U.S. beef. The Netherlands, Spain, and Nicaragua also contributed in the years where U.S. beef was restricted, but have also lost market share as the U.S. has reestablished dominance.

South Korea

Korean imports of all edible meat (HS 02) are almost completely exclusive to both the United States and Australia, with combined market share for total meat purchases in 2001 being 68.3 percent, growing to 77.9 percent in 2003. Table 15 illustrates South Korea's beef imports from its largest suppliers for HS 0201, HS 0202, and HS 0206, along with domestic consumption. Demand for beef was increasing prior to 2003, with Korean domestic consumption fluctuating around 600 thousand MT annually. After the BSE discovery and subsequent ban, U.S. market share for HS 0201 decreased from 71 percent in 2003 to 1.1 percent in 2004, a loss of \$41.8 million, and stagnated at 0 percent in both 2005 and 2006. Domestic consumption within South Korea dropped from 618 thousand MT in 2003 to 470 thousand MT in 2004, a 31.4 percent decline. 2005 saw domestic consumption decline even further, to 443 thousand MT, however growth has occurred in every year since. Despite the decreases reported in domestic consumption, imports from Australia and New Zealand grew from 2003-2004, at values of \$41.7 million and \$2.3 million respectively. The 2001-2003 exported values from Australia do not qualify them as a non-traditional supplier for South Korea, however minuscule imports from New Zealand in that same time period provide evidence that nations who suddenly restrict imports from their traditionally largest suppliers will indeed switch to non-traditional suppliers to fill the lost supply for specific commodity categories. U.S. export values were not again significant within South Korea until 2007, when the U.S. market share stood at 5.6 percent, an increase of \$13.9 million from the previous year, rising to 15 percent and \$27.2 million in 2009, and slowly growing to 27.8 percent in 2014, a value of \$111.5 million. Again this is caused by the overall growth of total beef imports in South Korea, from \$24.4 million in 2001 to \$401.7 million in 2014. The Australian share of the market has remained strong, comprising over 90

percent of total Korean imports in 2007 and 2008, and similar to what has occurred within Japan, has lost share as the U.S. rebuilds, standing at 71.4 percent as of 2014.

HS 0202 warrants a closer evaluation than HS 0201, due to the significantly larger value of imports by South Korea from the U.S., Australia, New Zealand, and Mexico. In 2001 South Korea imported \$24.4 million of HS 0201 and in the same year, imported \$462.8 million of HS 0202. Of that total HS 0202 volume, the U.S. provided \$303.2 million, and Australia provided \$115 million, a 65.5 percent and 24.9 percent market share respectively. As opposed to HS 0201, South Korea historically sourced HS 0202 from nations other than strictly the U.S. and Australia, specifically New Zealand and Canada. However, it wasn't until the discovery of BSE within the U.S. that South Korea imported any significant volume from New Zealand, as Canada again faced similar restrictions on their exports. Once BSE was discovered in 2003, U.S. market share went from 76.5 percent to 20.2 percent in 2004, a drop from \$728.1 million to \$94.3 million, while Australian market share increased from 15 percent in 2003 to 51.8 percent in 2004, and New Zealand increased from 6.8 percent to 27.4 percent. Both New Zealand and Australian share of the Korean market increased during the years of the ban on U.S. beef, peaking for New Zealand in 2005 at 30.4 percent and in 2006 for Australia, at 72.9 percent. The lowest level for the United States was in 2006 with a 0 percent market share. Once the ban was lifted in 2008, a familiar situation happened in relation to U.S. beef exports regaining market share as New Zealand's has steadily decreased. However, Australia has remained competitive with the United States for this specific category and export destination. In 2009, U.S. market share rebounded to 40 percent and value of \$246 million with Australia holding 46.7 percent of the market, or \$287.3 million. In the years since, both nations have fluctuated around comprising 45 percent of total market share. Mexico was distinctly a non-traditional supplier to South Korea for HS 0202, with export values of 0 in 2001, 2002, and 2003. In 2004 purchases from Mexico were nearly \$2 million, and peaked at \$17.5 million in 2005. The subsequent years saw Korean purchases of HS 0202 greatly divert away from Mexico back to the United States. In 2014, export

value from Mexico to South Korea stood at \$515 thousand, while Korean imports from the U.S. were valued at \$594.8 million.

HS 0206 is traded at a much larger volume than HS 0201, but at a slightly smaller volume than HS 0202. Again, South Korea sourced imports of this category from primarily the United States and Australia pre-BSE, but also sourced a minor amount from Canada. After 2003, South Korea increased HS 0206 imports from Australia, New Zealand, Spain, France, Mexico, Poland, Germany, Denmark, and Chile, however it is necessary to evaluate down to the HS six-digit level in order to determine in what type of product these increases occurred. In 2003, Australia supplied South Korea with 20.6 percent, with the U.S. representing 68.8 percent, a value of \$74 million. In 2004 U.S. share decreased to 15.3 percent, and 4.7 percent in the following year, again these decreases were all contained to bovine categories within HS 0206. Within Korean HS 0206 imports from the U.S., a swine category is the second largest, behind HS 020629, bovine edible offal, frozen nes, which has not recovered pre-BSE levels. Again, pork products were not impacted by the BSE case. Imports from Australia grew 14.6 percent in the same 2003-2004 time frame, with the largest increases occurring in HS 020629 and HS 020610, both bovine categories. The United States did not recapture any significant market share until 2009 when it held 24.3 percent of the market, \$19 million, with Australia supplying South Korea with over half of their total imports, a value of \$42 million. As of 2014, the U.S. has 38.2 percent of the market with \$86 million, with Australia standing at 42.2 percent, and New Zealand with 7.7 percent. For both the Australian and New Zealand beef suppliers, the implemented ban on U.S. beef by South Korea has been largely beneficial, as export increases within HS 0206 for both nations has been almost exclusively contained within beef categories at the six-digit level. As previously mentioned, the nations of Spain, France, Mexico, Poland, Germany, Denmark and Chile would be considered non-traditional suppliers, due to negligible imports by South Korea pre-2003, but for the majority, with the exception of Denmark, have on average maintained a significant level (over \$1 million annually) of exports after the restrictions have been removed on the U.S. A quick glance at the four-digit HS 0206 level suggests these nations benefited

from the U.S. BSE case, however for Spain, France, Poland, Germany, Denmark, and Chile, almost all of the increases and fluctuations within HS 0206 are in HS 020649, a swine category. None of these nations export significant values, if at all, of beef to South Korea. Mexico however, increased exports of HS 020629, bovine edible offal, to South Korea from a value of 0 in 2001-2003 to \$232 thousand in 2004, \$1.5 million in 2005, \$3.8 million in 2006, and \$3.7 million in 2007, before beginning to decline, standing at \$54 thousand in 2014. Due to the nonexistent export values for this beef category to South Korea from Mexico pre-BSE and the subsequent large increases, evidence exists for the idea that South Korea sourced imports from a non-traditional supplier due to the U.S. BSE case.

Taiwan

Taiwan was the fourth largest global importer of HS 0201, the fifth largest importer of HS 0202, and the tenth largest importer of HS 0206 in 2003, representing a critical export destination for U.S. beef. Imported values of all three categories decreased by significant margins as the Council of Agriculture in Taiwan banned the import of beef and lamb products from the U.S., and can be seen in Table 16, along with annual domestic consumption. Unlike Japan and South Korea, domestic consumption of beef was minimally impacted by the BSE case. A slight decrease in consumption levels from 2003-2004 was nearly recovered by 2005 and exceeded in 2006.

In 2003, the United States exported \$23 million of HS 0201 to Taiwan, representing 58.1 percent of the total market. In 2004, market share dropped to 1.4 percent, while imports from both Australia and New Zealand increased considerably. In 2004, these two nations accounted for 98 percent of total imports by Taiwan, an increase from 40 percent in 2003. The growth in U.S. market share for Taiwan and HS 0201 after the removal of the bans outpaces most other nations and categories. Market share was almost evenly split between the U.S., Australia, and New Zealand in 2005, with the U.S. reclaiming over 50 percent in 2006, peaking in 2010 at 78.9 percent and \$84 million, and standing at 69.6 percent in 2014.

Again, total export values from the U.S. have increased well beyond pre-BSE levels, with exports dropping from \$23 million in 2003 to \$533 thousand in 2004, increasing up to \$146 million in 2014.

Trade between the United States and Taiwan is much larger for HS 0202 than HS 0201; however, Australia and New Zealand held a larger portion of the market within Taiwan pre-BSE. In 2003 Australian market share stood at 39.9 percent, New Zealand at 29.7 percent, and the U.S. with 26.3 percent. U.S. exports to Taiwan decreased from \$54 million in 2003 to \$2.5 million in 2004. Again, exports rose quickly once the ban was lifted, increasing to \$71 million as early as 2006. Australia has preserved their dominance over the Taiwanese market for the entire time period, and as of 2014 holds 38.4 percent and \$184 million in comparison to the United States 30.7 percent with \$147 million. Imports of HS 0202 by Taiwan from New Zealand grew in 2004 and 2005, but have been steadily decreasing each year since. Nicaraguan exports to Taiwan, which did not exist in 2001 or 2002 have been continuously growing each year after 2003, with a relatively small market share of 4.6 percent in 2014. Panamanian exports to Taiwan were also potentially spurred by the 2003 discovery, growing nearly every year since. However, Panama only holds roughly 2 percent of the market in 2014.

Overall import levels of HS 0206 from the U.S. by Taiwan were not impacted by the 2003 discovery. This is due to the composition of HS 0206 being largely contained within HS 020649, swine edible offal. Export values for HS 020629, bovine edible offal, were present pre-BSE, with the largest value occurring in 2003 at \$2.1 million. However, after 2004, export values have been zero or not significant. U.S. market share within Taiwan for this category has been declining overall as import sources are expanded, including from the Netherlands, Australia, Canada, New Zealand, Nicaragua, Denmark, and Hungary. However, the growth in imports of beef products by Taiwan is only from Australia, New Zealand, and Nicaragua, specifically within HS 020629, whereas the increases from the Netherlands, Canada, Denmark, and Hungary are within HS 020649.

Hong Kong

The territory of Hong Kong, when summing total exports of the three major HS categories, is the fourth largest export destination for HS 0201, the third largest destination for HS 0202, and the fifth largest destination for HS 0206, representing another critical market for U.S. producers. Similar to Japan and South Korea, the territory implemented an all-encompassing ban on all beef products from the United States following the 2003 discovery. In 2005, U.S. producers were granted partial access to the market via removal of restrictions on deboned beef from cattle aged 30 months or younger. Further access was granted in 2013 with the allowance of specific bone-in cuts again from cattle less than 30 months of age. In 2014 Hong Kong agreed to new terms allowing the import of all U.S. beef. Imports of HS 0201, HS 0202, and HS 0206 are provided within Table 17. Domestic consumption values are also provided, which did not seem to be significantly altered as a result of the U.S. BSE case.

The strict policies enacted by authorities in Hong Kong caused U.S. exports of HS 0201 to decline from nearly \$10 million in 2003, when the U.S. held 41.6 percent of the market, to \$168 thousand in 2004, dropping to 0 in 2005. Australian producers picked up the lost market share, exporting an additional \$10 million to Hong Kong in 2004 from their 2003 levels. The previously mentioned removal of certain bans caused U.S. exports to immediately return to a value of \$8 million in 2006, while Australian exports remained strong, standing at \$18 million in the same year. Australia's share of the market, while still significant, has again been declining as the U.S. has gained greater access. Imports from Canada also greatly increased from 2004 to 2005, moving from a value of \$314 thousand to \$5 million. Questions can be raised as to why Hong Kong, similar to Mexico, switched imports from the U.S. to Canadian producers, who experienced problems of BSE within their own country in the same year, and the origin of the animal found within the U.S. was Canadian. As of 2014, Australia maintains the largest share of the market with 37.9 percent, or \$40 million in exports, with the U.S. slightly behind at 33 percent with a corresponding value of \$35 million.

Similar to other nations evaluated, imports of HS 0202 are significantly larger than HS 0201, with total imports by Hong Kong in 2003 standing at \$140 million. This critical market is unique in comparison to previously diagnosed HS codes and nations, due to Hong Kong importing significant values from 13 individual countries. From 2001-2003 the largest competitor to the U.S. was Brazil, however the U.S. was dominant in 2003, holding 49.9 percent of the market at an exported value of \$70 million. The policies put into place diverted purchases of HS 0202 toward Brazil, whose market share increased from 22.3 percent in 2003 to 45.5 percent in 2004. Again, Canadian exports increased as well, growing from a 0.5 percent share in the 2003 market to 6.4 percent in 2004, 27.7 percent in 2005, and decreasing nearly every year since. Imports from China, Argentina, and the Netherlands also increased in the 2003-2004 time period. Once restrictions were removed, U.S. exports recovered quickly, exporting \$6 million of HS 0202 to Hong Kong in 2006, increasing from a value of 0 in 2005, and has exponentially increased each year since, reaching \$867 million by 2014, with a 42.1 percent market share. Brazil has benefited the greatest from the policy, holding a 44.2 percent market share, nearly double what the nation held pre-BSE.

Hong Kong sources significant imports of HS 0206 from 24 individual countries, and again, due to the non-beef categories present within this HS code, the reduction of import values from the U.S. was smaller than the other two codes. For brevity, only the top 3 exporters of this HS code to Hong Kong were provided within the table. The two largest six-digit categories imported from the U.S. are HS 020649, swine edible, which was not impacted by BSE, and HS 020629, bovine edible, which has recovered and nearly doubled the export value of \$28.3 million in 2003, reaching \$42.3 million in 2014. However, the U.S. has not been able to regain the overall market share experienced pre-BSE. In 2001 the U.S. held 22 percent of the market, a value of \$55 million, followed by Brazil at 19.7 percent and \$50 million. Increases of purchases by Hong Kong from 2003-2004 were found in Brazil, Germany, the Netherlands, Argentina, Denmark, the U.K., Belgium, Spain, New Zealand, Uruguay, France, Poland, Chile, China, Sweden, and Finland. However, with the exception of Brazil, Argentina, New Zealand, and

Uruguay, the top export category within HS 0206 for these nations was HS 020649, a swine category.

The loss of the market for U.S. beef caused exports of HS 020629 to drop to zero in 2005 as Taiwan increased imports from Brazil, Argentina, New Zealand, and Uruguay. As of 2014, Brazil holds 64.4 percent of this market, followed by Argentina at 10.5 percent, with the U.S. holding a 4.3 percent market share, down from the 2001 share of 25.1 percent. Throughout the entire time frame, Brazil has maintained the largest share of the Taiwan market.

Vietnam

Historically Vietnam has been a small market for U.S. beef, however with rising domestic consumption within the nation, U.S. producers should be able to capitalize in the near future on the regained market access. Vietnam restricted all beef products following the 2003 case, reopening their border to boneless beef cuts in 2005, and allowed for the import of bone-in cuts in 2006. Similar to other nations, all purchases were required to be from cattle less than 30 months of age. In early 2015, Vietnam removed all age restrictions on U.S. beef, granting full access to the growing market. As previously stated, Vietnamese imports are significantly smaller than other evaluated importers, and these values can be seen within Table 18, along with domestic consumption. However, these volumes have been increasing in each HS category significantly, and Vietnam should be a nation the U.S. focuses on for potential future growth within the Asian region.

From 2001-2003, Vietnamese imports of HS 0201 had been growing to match the increases in domestic consumption, both of which have increased nearly every year in the evaluated time period. Vietnam sourced HS 0201 primarily from Australia and New Zealand in the years leading up to 2003, but did source a minor amount from the U.S. Import values from Australia have been increasing at an exponential rate, climbing from \$190 thousand in 2001 to over \$5 million in 2014. The restrictions placed on U.S. beef did result in a temporary decrease in what were already minuscule exports, however the previously mentioned policy removal in 2005 allowed HS 0201 sales to regain momentum in the

Vietnamese market. As of 2014, Australia still has the dominance established well before 2003, holding 75 percent of the market, or \$5.9 million, while the U.S. stands at 10 percent, a value of \$836 thousand.

Import values of HS 0202 within Vietnam are significantly larger than HS 0201, with total imports in 2014 reaching \$84 million. Contrasted with 2001 imports being \$213 thousand, Vietnam's demand for frozen beef is likely to continue this sustained and explosive growth. Vietnam sourced imports of HS 0202 exclusively from the U.S., Australia, and New Zealand pre-BSE, but diverted to the non-traditional suppliers of India and Argentina post-BSE. Imports from both India and Argentina were non-existent from 2001-2003, but the restriction on U.S. beef created a new market for both nations, of which Indian producers have been able to capitalize on, increasing exports to Vietnam each year, reaching a record level of \$54 million in 2014. Imports from Argentina grew in the initial years of the ban, but have stagnated and declined in the years since. Once the restrictions on U.S. beef were slowly removed, exports have been gradually increasing, surpassing Australian market share as early as 2007. U.S. and Australian market share levels have fluctuated for second place in the subsequent years, however neither nation has been able to come close to the dominance established by Indian producers. As of 2014 India holds 64.9 percent of the market, a \$183 million value, with the U.S. standing at 19.2 percent and \$16 million, and the Australians holding 13.6 percent, an \$11 million value.

Vietnamese imports of HS 0206 from the United States were non-existent until 2006, when purchases stood at \$27 thousand, mostly within swine categories, obviously indicating there was no measurable impact of the 2003 BSE case on trade with the U.S. for this specific HS code. However, purchases by Vietnam have been growing, reaching record levels in 2014 with total imports being valued at \$15 million. Again, the majority of these purchases have been from Indian producers, and imports from the U.S. have largely been within the non-bovine six-digit categories that comprise the HS 0206 code. As of 2014, India holds 48.6 percent of the HS 0206 market within Vietnam, followed by Australia with 21.2 percent, Spain with 13.4 percent, France with 2.7 percent, Poland with 3.2 percent, and the U.S. with 2.2 percent, a value of \$330 thousand.

Egypt

Egypt is the seventh largest market for U.S. beef products, and the largest importer of beef liver. While domestic consumption values show relatively stable levels, import values for each HS code have increased greatly from 2001-2014, which can be seen within Table 19. Aside from BSE related restrictions, unique political unrest within the nation has contributed to fluctuations in imports. Similar to other countries, Egypt completely closed its borders in 2003 after the BSE discovery. In 2005, Egypt began lifting restrictions prompted by BSE, accepting imports of boneless U.S. beef obtained from cattle less than 30 months of age.

Import values of HS 0201 by Egypt from any nation were virtually non-existent until 2010, when purchases began largely from Australia at a value of \$23 million, with Denmark, Brazil, Germany, the U.K., and the U.S. exporting much smaller values. Due to the lack of imports by Egypt from the U.S., there was no discernible impact of BSE on this specific HS code. The largest exported value by the U.S. into Egypt for HS 0201 occurred in 2011 at a value of \$146 thousand. In 2014, the U.S. had zero exports of HS 0201 to Egypt, with purchases from Sudan surpassing \$2 million in the same year.

Egyptian purchases of HS 0202 are sourced from 22 nations, most notably from Brazil, India, the U.S., Argentina, Australia, New Zealand, China, Uruguay, Paraguay and Colombia. The U.S. has struggled to capture market share from the two largest suppliers to the African nation, as Brazil and India overall hold roughly 80 percent of the total market. The U.S. exported \$1.8 million to Egypt in 2003 prior to the ban, dropping to \$12 thousand in 2004, and greatly increasing in the subsequent years. Ireland was the only nation that saw a significant increase in imports from 2003-2004 when the ban was implemented, growing from a value of 0 in 2003 to \$1.1 million in 2004, dropping back down to \$274 thousand in 2005. Imports of HS 0202 from the U.S. by Egypt reached an all-time high of \$62 million in 2012. As of 2014, 49.6 percent of Egyptian imports are sourced from Brazil, 44.4 percent from India, and 3.6 percent from the U.S., at a value of \$43 thousand.

The U.S. is dominant in the Egyptian market for HS 0206, despite the 2003 ban. Egyptian imports from the U.S. within HS 0206 are almost exclusively contained to HS 020629, bovine edible offal, frozen, and HS 020622, bovine livers, edible offal, frozen. U.S. market share from 2001-2003 exceeded 99 percent, dropping to 20.1 percent in 2004, and rebounded to 67.6 percent in 2005 as restrictions were gradually removed. This is largely due to the Egyptian consumer preferences for bovine livers, a trend not seen in Western nations. When BSE was discovered within the U.S., Egypt halted almost all purchases of livers, and significantly switched to imports from Brazil. The associated reduction in HS 020622 rebounded quickly, exceeding 2003 levels as early as 2005. Despite the initial move to Brazilian suppliers, the U.S. has maintained the largest market share in every year besides 2004. BSE did not have any long term impacts on U.S. trade with Egypt for HS 0206. In 2014 the U.S. held 85.4 percent of the market, a value of \$218 million.

Russia

When summing imports of HS 02, meat and edible meat offal, from 2001-2014, Russia ranks as the fourth largest export destination for the U.S., behind Japan, Mexico, and Canada. The nation is a significant market for the world's largest beef exporters, sourcing their imports from a much larger number of suppliers than previously evaluated countries, which are provided within Table 20. Beef purchases from the U.S. by Russia increased in the early 1990s as a result of the dissolution of the Soviet Union; however, Russia adopted the same policies as South Korea and Japan by banning all imports due to the 2003 BSE case. It was not until 2007 that Russian policies related to U.S. beef began to allow certain imports under the restriction that the beef product originated from an animal under thirty months of age. Again in 2013 Russia halted the imports of U.S. beef, this time including all pork, turkey, and other meat products, due to the use of beta agonists in production. In 2014 Russia further tightened its borders by suspending imports of food products from the U.S., Canada, Australia, Norway, and the EU in response to sanctions imposed due to Russian involvement in the Ukrainian conflict. As a result of the

political unrest and the resulting sanctions, U.S. producers still do not have access to one of the largest markets for beef.

Exports from the U.S. for HS 0201 were negligible from 2001-2003, at values of \$15 thousand, \$51 thousand, and \$72 thousand respectively. Export values dropped to zero from 2004-2007 as a result of the bans, but were able to increase dramatically as restrictions were eased. From 2008-2012 U.S. exports to Russia soared, peaking at over \$16 million in 2012. The previously mentioned 2013 ban on U.S. meat imports caused 2013 and 2014 values to be minimal. Prior to the U.S. BSE case, Russian imports of HS 0201 were primarily sourced from Germany and Denmark, however smaller purchase levels are also present from Ukraine, Australia, and Poland. Germany held 91.7 percent of the Russian market within 2003, the largest total annual market share any one nation experienced in the evaluated time frame. The 2003 removal of U.S. beef from the Russian market caused increases to occur dramatically from Lithuania, increasing from 2003 purchases of \$14 thousand to over \$3 million, as Lithuanian market share rose to over 54 percent in 2007. German sales to Russia also increased in the same period, however subsequent fluctuations in sales values suggest the increase was potentially due to factors other than the U.S. BSE case. Australian producers increased exports during the outbreak period, increasing from \$111 thousand in 2003 to \$41 million in 2013, but were also subject to Russian restrictive trade policies, and saw their 2014 exports decline to \$9 million.

As with other evaluated nations, Russian trade values of HS 0202 are substantially larger. 2003 total imports by Russia were valued at \$606 million, while only \$1.2 million was purchased from the U.S. The value of U.S. exports to Russia dropped sharply in 2004 to \$117 thousand, and 0 from 2005 until 2007. The lifting of certain restrictions gave U.S. producers a short window of opportunity, increasing sales in 2008 to \$71 million, and reaching the highest level in 2012 of \$221 million before new restrictions closed the Russian market. Brazil, Paraguay, Argentina, Uruguay, and Ukraine are the top suppliers of HS 0202 to Russia, with total 2001-2014 summed export values for each nation exceeding \$1 billion, and in Brazil's case, exceeding \$10 billion. Increases greatly occurred from Brazil, where sales to

Russia from 2003-2004 nearly doubled. Brazil has had the opportunity to grow within Russia as a result of the 2003 discovery, increasing exports nearly each subsequent year. In 2007 the South American nation held 63.3 percent of the market, a corresponding value of over \$1 billion. As of 2014, Brazil still holds the largest market share at 58 percent and a value of \$1.3 billion, followed by Paraguay at 24.8 percent, a value of \$557 million.

The market for HS 0206 within Russia is highly competitive, with significant import values coming from 22 nations. The two largest import categories for Russia from the U.S. within HS 0206 are HS 020649, swine edible offal, frozen, and HS 020622, bovine livers, edible offal, frozen. Again the swine category was not impacted by BSE, however bovine liver imports from the U.S. decreased to zero in 2005, from the largest value of \$5.2 million in 2003. The U.S. was by far the largest HS 0206 provider in 2001, 2002, and 2003, with export values of \$31 million, \$48 million, and \$47 million respectively. Once the U.S. was restricted from the Russian market, imports increased from every alternative supplier, with the exception of Ireland and Hungary. Germany, Brazil, France, Australia, Netherlands, Spain, Belgium, Canada, Italy, and Austria all had increases of over \$1 million from 2003-2004, with German sales increasing by \$14 million. The largest value imported by Russia from the U.S. was in 2008 at \$74 million, dropping to slightly over \$1 million in 2013. As of 2014, Argentina has the largest market share within Russia, at 35.6 percent, a value of \$94 million, followed by Paraguay at 12.7 percent market share, representing \$33 million.

China

Along with the other nations within the Asian region, China banned all imports of U.S. beef in 2003, however unlike Japan, Taiwan, and South Korea, the border was not reopened until 2016. Despite the 2013 OIE declaration of the U.S. being categorized as “negligible risk” for BSE in comparison to Canada’s designation as “controlled risk”, Canada was able to reenter the massive and continuously growing market in 2012. China imports beef and beef products from two nations defined at a higher level

of risk than the U.S., Canada and Spain. These import values, along with imports from all major exporters to China can be seen within Table 21. As China's demand for beef increases, beneficiaries of the ban on the U.S. again included Australia, New Zealand, and Uruguay. The increasing population within China, the world's largest agricultural importer, combined with the expanding economy poses serious potential for U.S. exporters, but strained relations between China and the U.S. has delayed the ability of U.S. beef producers to reenter the market (Morrison 2009). A partial reopening of Chinese borders occurred on June 30, 2006, however a lack of a firm science-based trading protocol within China kept U.S. beef out of the market until September of 2016 when China's premier announced a reopening of the border to U.S. producers.

The potential of China to become a large export destination for U.S. beef producers is a fairly recent hypothesis, with beef imports reaching significant levels only within the past decade. Chinese total imports of HS 0201 did not exceed \$1 million until 2003, standing at \$677 thousand in 2001 and \$766 thousand in 2002. The U.S. was not completely shut out of the market before 2003, supplying China with \$77 thousand in 2001, \$122 thousand in 2002, and \$116 thousand in 2003. Despite these low levels, the U.S. held the second largest market share in these years, 11.4 percent, 15.9 percent, and 11 percent respectively. However, as the previously mentioned demand has increased, and despite the exclusion of U.S. beef products, imports of fresh beef have increased greatly, almost exclusively from Australia. Domestic consumption values within Table 21 show that with the exception of the 2010 to 2011 time frame, Chinese domestic consumption of beef and veal products has increased every year. The largest value of 7.2 million metric tons consumed in 2014 is over 3 times the next largest annual domestic consumption value for 2014 within all evaluated nations, in Russia, showing the potential posed by these two markets. As previously mentioned, Australia has been the largest beneficiary of the absence of U.S. HS 0201 exports, holding at least 94 percent of the Chinese market from 2004-2013, and reached a 100 percent market share in 2014, a value of \$20.9 million.

The impact of the 2003 BSE case on U.S. exports to China is more pronounced when evaluating HS 0202, again due to transportation restrictions on HS 0201. The U.S. had the largest share of the Chinese frozen beef market both in 2002 and 2003, values of \$8.6 million and \$6.3 million before declining to 0.7 percent in 2004 and 0 percent in every year since. Imports from Australia increased from \$3.7 million in 2003 to \$5.6 million in 2004, and in the subsequent years, the Chinese government has begun to source HS 0202 from Uruguay, New Zealand, Argentina, Canada and Brazil in significant volumes. The value of the Chinese market in 2014 stood at \$1.2 billion, with Australia holding 48.7 percent of the market. Australia, Uruguay, and New Zealand all exported over \$100 million of HS 0202 to China in 2014, with Argentina, Canada, and Costa Rica supplying the remainder of total imports.

The composition of HS 0206 has allowed the U.S. to remain competitive within this specific category, despite the decrease associated with the ban on U.S. beef. In 2002 the U.S. held 70.4 percent of the Chinese HS 0206 market, a corresponding value of \$55 million. However, 58 percent of that value was within HS 020649, swine edible offal, with 40 percent being contained within HS 020629, bovine edible offal, which declined to a value of \$469 in 2004 and zero in the following years. Chinese imports of HS 020649 have on average increased every year since, showing no impact of the beef ban on pork imports. Chinese total imports of HS 0206 in 2014 stood at \$1.48 billion, of which the U.S. holds 35.5 percent of the market, completely within swine HS six-digit categories.

Conclusion for Traditional Markets

Within this section, analysis of imports by the largest global markets for beef was provided in order to determine the magnitude of the loss U.S. beef producers faced during and in the years following the 2003 BSE case. We also explored the ability of both traditional and non-traditional exporters to enter these newly vacant markets, and how these suppliers were able to retain market share in subsequent years. As previously stated, nations that are deemed risk-free from specific diseases stand to benefit the most when large traditionally high-volume importers place severe restrictions on their largest suppliers, as was

frequently seen throughout this section. For a majority of the evaluated nations, Australia was successful at capturing the lost U.S. market share. However, other emerging competitors, such as Brazil, India, and Argentina were able to increase their presence within nations where the U.S. had historically been the largest provider, or within nations that have only recently begun to import significant values, such as Vietnam. Evidence was provided that variables other than the desire to protect domestic food supplies drives trade values and policy, as was seen with the 70 percent decline in Mexican HS 0201 imports from the U.S. the year after BSE was discovered in Washington, with a corresponding 73 percent increase from Canada, who at the time had a larger number of BSE cases. Similarly, Hong Kong imported \$5.64 million of HS 0201 from Canada in 2005, up from a value of \$314 thousand in 2004, a time span in which imports from the U.S. were negligible or non-existent because of BSE restrictions. Imports from Canada by Hong Kong of HS 0202 increased from \$667 thousand in 2003 to \$6.87 million in 2004 as well. Furthermore, the 2012 decision by the Chinese government to allow the import of Canadian beef while only recently opening the border to U.S. producers further suggests these decisions are not based solely on potential risks to food safety.

Variables impacting trade values are not reflected simply by looking at the values themselves or even trade policy. For example, the 2003-2004 increase in Canadian HS 0201 imports from Uruguay could be attributed to the BSE cases; however, it would be inaccurate to state BSE was the definitive cause for this increase, or potentially for any of the aforementioned changes in imports and exports. Evidence was also presented that nations will switch to non-traditional importers, as was seen in Korean purchases of HS 0201 from New Zealand. Prior to the 2003 case, these imports were non-existent, grew during the years in which U.S. beef was restricted, and declined as these barriers were lifted. However, trade values between the two countries existed for HS 0202 before 2003, so using the term, “non-traditional” supplier, may not be completely accurate once expanding analysis beyond a single HS code. The strongest evidence provided for traditional importers switching to non-traditional exporters was seen within Korean purchases from Mexico. For all three of the evaluated HS codes, South Korea did not

import any value from Mexico from 2001-2003. In 2004, imports by South Korea from Mexico for HS 0202 increased to \$1.97 million, grew to \$9.99 million the following year, and \$17.5 million in 2006. HS 0206 values, almost completely within HS 020629, bovine edible offal, increased to \$235 thousand in 2004, \$1.76 million in 2005, and \$4.09 million in 2006. For each of these codes, imports from Mexico have been decreasing as the restrictions on the U.S. are lifted. Again, analysis of export values and market shares does not fully explain the reasons behind fluctuations, but creates questions concerning the policies implemented by nations attempting to reduce risk associated with threats to food safety.

3.6 Trade Diversion and Creation as a Result of BSE to Non-Traditional U.S. Markets

One of the primary objectives of this paper is to determine if exports of U.S. beef products to non-traditional markets increased significantly as a result of the restrictions imposed by the largest traditional importers. In this section we will use data taken again from the ITC in order to evaluate if any potential new non-traditional markets were discovered by the U.S., and evaluate if exports to these markets was sustained as restrictions on U.S. beef were gradually removed. Again the top three HS codes that include beef were used as parameters to select what we can define as a non-traditional beef market, and again, evaluation down to the six-digit HS level for HS 0206 will be provided in order to determine if value changes were within beef or pork codes. Determining trade diversion within this section relies only on export and import values, omitting any other potential variables that impact global beef trade, which will be addressed within Chapter 4. The following analysis will be divided into two sections; initially evaluating non-traditional markets defined as nations where summed 2001-2014 total imports from all exporters of each HS code are less than \$100 million, and where 2003-2004 increases were over \$1 million. These parameters provide evaluation into certain smaller nations not addressed within the preceding traditional markets portion of the paper. The second section expands the number of countries evaluated, by including nations where summed 2001-2014 total imports from all exporters were less than

\$1 billion, and again where 2003-2004 increases were over \$1 million. From this second expansion, there are a few countries covered in the previous section and here.

2001-2014 Total Imports less than \$100 Million

In evaluating selected nations using the first set of parameters listed above, for HS 0201, 2003-2004 reported import increases over \$1 million occurred within Tunisia, Belarus, Honduras, Australia, and Uruguay. For Tunisia, the increases came exclusively from Germany and Ireland, and there have been no imports from the U.S. for HS 0201 throughout the entire 2001-2014 time frame. The increases in Belarus were restricted to Lithuania, Russia, and Poland. The only year displaying any U.S. exports to Belarus occurred within 2011 at a value of \$7 thousand. Honduran increased imports were almost exclusively from Nicaragua; however, purchases from the U.S. within Honduras did occur during what was described as the U.S. BSE crisis. In 2002 Honduras imported \$23 thousand worth of HS 0201 from the U.S., increasing to \$59 thousand in 2003, decreasing to \$39 thousand in 2004, and reached \$149 thousand in 2005. Fluctuations in the following years suggest no definitive evidence that trade diversion occurred within Honduras as a result of the 2003-2004 policy changes. It should be noted that Honduran purchases from the U.S. have increased substantially in recent years, climbing from \$479 thousand in 2012 to \$4.5 million in 2013 and \$2.1 million in 2014. The increase in Australian HS 0201 imports were limited to New Zealand and Vanuatu, as Australia was one of the nations that completely banned all U.S. beef and beef products. Uruguay sources their imports of HS 0201 only from Brazil and Argentina, and has not imported any volumes from the U.S. in the evaluated time frame.

HS 0202 had a much larger group of nations that experienced increases in import volumes from 2003-2004, however as with HS 0201, there were not significant increases in imports from the U.S. Swaziland, Albania, Estonia, Belarus, Barbados, Equatorial Guinea, Colombia, Latvia, Macedonia, and Comoros were the nations that satisfied the previously identified requirements to be labeled non-traditional markets who purchased more of HS 0202 in 2004 than in 2003. Of these nations, only Albania,

Estonia, Belarus, Barbados, Equatorial Guinea, Colombia, and Macedonia sourced any volume of U.S. HS 0202 from 2001-2014. Swaziland imports are primarily sourced from South Africa, Botswana, and Australia. The nations with greater levels of competition for market share who do not import from the U.S. include Latvia, who imports from Poland, while Estonia, Lithuania, Germany, Hungary, Sweden, and Comoros all import exclusively from France, Brazil, Ireland, and Germany.

Albanian imports of HS 0202 are largely sourced from Italy, Paraguay, and Brazil, however exports from the U.S. have been present for all evaluated years. Imports from the U.S. increased from \$111 thousand to \$382 thousand from 2003-2004, however decreased to \$53 thousand in 2005, and soared to \$1.3 million in 2006. Again this fluctuation does not provide substantial evidence of trade diversion to Albania as a result of traditional nations placing new import restrictions on U.S. beef. While Estonia qualified for evaluation due to the increased 2003-2004 purchase of HS 0202, the nation did not begin importing any value from the U.S. until 2011. Similar to Estonia, Belarus's increased imports satisfied requirements for evaluation, but imports from the U.S. were not significant until 2011.

Evaluation of Barbados simply at the value level does not explain what took place from 2003-2004. In 2003 the U.S. exported \$1.43 million of HS 0202 to Barbados, slightly increasing to \$1.48 million in 2004, while in the same time frame, the U.S. market share declined from 42.6 percent to 28.1 percent. Uruguay captured 10 percent of the market within that same year; New Zealand's share increased by 3.7 percentage points, Canada's increased by 8.4 percentage points, while Australia, who was typically seen as the nation responsible for capturing lost U.S. market share, also saw their share of the Barbados market decline by 9.2 percentage points. The fluctuation seen in the market share evaluation provides little evidence of trade diversion as a result of BSE, and the relatively stable level of U.S. exports to Barbados from 2001-2014 provide further evidence to that notion.

Equatorial Guinea's total imports of HS 0202 grew from a value of \$927 thousand in 2003 to \$2.5 million in 2004, with increases coming from Brazil, Paraguay, Argentina, Belgium, France, the

Netherlands, and India.¹⁶ Imports from the U.S. stood at \$520 thousand in 2003, decreasing to \$351 thousand in 2004, and similar to other nations, the relative stability of U.S. exports to Equatorial Guinea from 2002-2014 provides little evidence that trade diversion took place. Colombia's imports tell the same story, with total global imports decreasing from \$2.26 million in 2002 to \$31 thousand in 2003, climbing to \$1.56 million in 2004. U.S. exports to Colombia declined from \$30 thousand in 2003 to \$8 thousand in 2004, increasing to \$60 thousand in 2005, dropping to a value of 0 in 2006 and 2007, climbing back up to \$30 thousand in 2008, and peaking at \$3.77 million in 2014. The 2003-2004 increase in Colombian imports was completely from Argentina, a growth of \$1.56 million. Macedonia's imports grew from \$4.83 million in 2003 to \$6.14 million in 2004, however imports from the United States dropped from a value of \$32 thousand in 2003 to zero in 2004, peaking at \$41 thousand in 2005. Since that year, the U.S. has not exported any volume of HS 0202 to Macedonia. The increase in Macedonian imports was primarily from Brazil and Argentina.

Only two nations satisfied the first parameter for evaluation of potential trade diversion of HS 0206, Ireland and Belarus. However, Ireland only imported HS 0206 from the U.S. in 2005 and 2011, with values of \$2 thousand and \$1 thousand, respectively. The 2003-2004 increase came primarily from the U.K., France, and Denmark. Belarus imported \$3.22 million of HS 0206 in 2003, increasing to \$5.35 million in 2004, with the increased purchases coming from a wide variety of nations, particularly Hungary, Germany, Poland, Denmark, and Spain. U.S. exports dropped from a value of \$457 thousand in 2003 to 0 in 2004. Imports by Belarus from the U.S. were restricted to HS 020641, swine livers, edible offal, frozen, and HS 020622, bovine livers, edible offal, frozen. After 2004, U.S. exports of HS 0206 to Belarus are non-existent.

¹⁶ The ITC reports Equatorial Guinea's imports as mirror data, which is used when nations do not report trade data to the United Nations. ITC then uses partner country data, which is constructed on the basis of data reported by partner countries. The mirror data provided when looking at Equatorial Guinea's imports matches exactly with export information reported by each of the nations evaluated.

2001-2014 Total Imports less than \$1 Billion

As a result of the lack of evidence of trade diversion revealed by the initial parameters, expansion of the criteria was performed to look at a much larger number of nations who experienced increases in 2003-2004 purchases of the three largest HS codes. As previously stated, nations were included here if their 2001-2014 summed imports were less than \$1 billion. This expansion grew the list of HS 0201 importing nations evaluated to 28, up from 5 in the previous section. For HS 0202, the previous section evaluated 10 importers, this one will evaluate 47. Finally, for HS 0206, the previous section provided trade data for only Ireland and Belarus, whereas we will analyze 30 importers here. Due to the large number of nations that satisfy the criteria of summed 2001-2014 imports being less than \$1 billion and a corresponding 2003-2004 increase in imported beef value being over \$1 million, detailed analysis will only be provided where significant fluctuations in U.S. imports, particularly increases, was evident in the years of the crisis. For example, nations such as the Slovenia satisfied the above criteria; however, imports from the U.S. for HS 0201 did not begin until 2009, and thus Slovenian imports are unable to provide evidence of trade diversion due to the 2003 BSE case. Also, as may be intuitive, nations that were evaluated within the previous sections will be omitted within this section.

Of the 28 nations that imported more of HS 0201 in 2004 than in 2003, only the Bahamas sourced their increased imports from the U.S. However, from 2001-2011, over 98 percent of total Bahamian purchases came exclusively from the U.S. In 2001 the U.S. supplied \$3.46 million of HS 0201 to the Bahamas, increasing to \$3.48 million in 2002, \$3.99 million in 2003, \$5.03 million in 2004, \$8.28 million in 2005, and \$14 million in 2006. Despite steady increasing levels of U.S. exports to the Bahamas, there is potential evidence to the idea of trade diversion. Percentage growth values for the same years reveals the 2002-2003 increase to be 14 percent, 2003-2004 growth of 25 percent, 2004-2005 growth of 65 percent, and a remarkable 75 percent increase between 2005-2006. Once the restrictions by many U.S. traditional importers were lifted in the 2006-2009 time frame, annual growth rates began a decline, at negative 4 percent from 2006-2007, negative 5 percent from 2007-2008, and again negative 5 percent

from 2008-2009. Evaluation of the six-digit HS codes contained within HS 0201 reveal that the largest increases of trade value between the U.S. and the Bahamas were within HS 020130, bovine cuts boneless, fresh or chilled, with minor increases also occurring in HS 020110, bovine carcasses and half carcasses, fresh or chilled. This sudden increase and subsequent decrease of U.S. export values to the Bahamas that correspond with the policies implemented by the larger traditional markets, suggests that based on the data alone, trade diversion of U.S. exports of HS 0201 to the Bahamas was potentially caused by the 2003 BSE case.

Out of the 47 nations that had increased 2003-2004 purchases of HS 0202, only 8 warrant closer evaluations, as previously stated, due to interesting fluctuations in total purchases, or due to increasing volume imported from the U.S. from 2003 to 2004. In order to determine exactly where these increases occurred, this section will provide evaluation of HS codes down to the six-digit level within HS 0202 when necessary. Increases in overall four digit codes provide a general consensus of trade volumes, but can be deceiving when those codes are ambiguous. Overall market share composition was provided within previous sections for HS 0202 only at the four-digit level, but when attempting to determine if the hypothesized trade diversion took place, greater detail is warranted.

Certain nations have relatively minor changes to their import volumes, but require evaluation in order to determine if any evidence is present of trade diversion. South African import values from the U.S. stood at 0 from 2001-2003, increasing to \$27 thousand in 2004. Imports from the U.S. were not present for the next two years, reaching \$48 thousand in 2007 and \$35 thousand in 2008. In comparison to U.S. global export value of HS 0202 being \$83 million in 2004, these exports to South Africa are not significant enough to warrant the title of trade diversion. Furthermore, South African imports of HS 0202 in 2004 were valued at \$19.74 million, with the U.S. representing 0.1 percent of total imports, a negligible amount. Hungarian total imports of HS 0202 increased from \$6 million in 2003 to \$15.5 million in 2004; however, the U.S. provided only \$14 thousand of that increase, within HS 020230, bovine cuts boneless, frozen. Values of zero for U.S. HS 0202 exports to Hungary for all years with the exception of 2004, may

alone suggest trade diversion, but again the values are not significant enough to come to a definitive conclusion. French Polynesia imports of HS 0202 increased from \$12.7 million to \$16.5 million from 2003 to 2004, while U.S. exports to the nation within the same time frame increased by \$49 thousand, this is another insignificant value increase that does not provide enough evidence that the increase in exports was a direct result of the loss of traditional markets by the U.S.

Armenia had one of the largest 2003-2004 increases in imports, growing from a value of \$8.42 million in 2003 to \$12 million in 2004. India was responsible for \$1.3 million of that increase, while the United Arab Emirates increased their 2003-2004 exports by \$1.95 million, with U.S. exports increasing by \$350 thousand. Even with a low values associated with the 2003-2005 shipments by the U.S. to Armenia, the lack of exports pre-2003 and post-2005 suggests this temporary trade could have been a result of the restrictions placed on the U.S.

The country of Georgia is also unique, as imports of HS 0202 from the U.S. increased from a value of 0 in 2001 to \$72 thousand in 2002, over \$1 million in 2003, and \$962 thousand in 2004, before dropping back down to 0 for the next 7 years. The exports to Georgia closely follow the policies implemented and removed by the largest traditional U.S. beef importers. The increase in imports was almost completely within HS 020220, bovine cuts bone in, frozen, with minor increases also occurring within HS 020230, bovine cuts boneless, frozen. However, when comparing to the U.S. total exports within these years, Georgia still represents an extremely small export destination.

Along with HS 0201, the Bahamas source an overwhelming amount of total HS 0202 imports from the U.S. What is significantly different for Bahamas-U.S. beef trade for HS 0202 are the growth values. While there was significant expansion of HS 0201 exports from the U.S. during the years of the BSE crisis, the 2003-2004 percentage increase for HS 0202 was only 6 percent, and 2004-2005 percentage change was negative 15 percent, suggesting no evidence for trade diversion.

Out of the 30 nations that had an increase in imports of HS 0206 from 2003-2004, only 8 warrant evaluation for potential trade diversion, but again, nations that have been evaluated previously within the paper will be omitted to avoid unnecessary repetition. HS 0206 with the current parameters requires a greater level of scrutiny than HS 0201 or HS 0202 again due to the fact that it contains non-beef HS codes. The nations that will be evaluated within this section will again contain information down to the HS six-digit level to see if beef restrictions had any impact on non-beef categories within the broader HS 0206, edible offal of red meat.

Saudi Arabia imported a significantly larger volume of HS 0206 in 2004 than in 2003, a growth of over \$7 million; however, a majority of the increase came from New Zealand, India, and Brazil. U.S. exports to the country increased from \$537 thousand in 2003 to \$858 thousand in 2004, however the majority of the increase was within HS 020690, sheep, goats, asses, mules or hinnies edible offal, frozen. Despite the ban implemented by the Saudi regulators on certain beef products, imports of HS 020649, bovine livers, edible offal, frozen, increased from a value of 0 in 2002 to \$21 thousand in 2003, \$65 thousand in 2004, and peaking at \$496 thousand in 2007 before dropping to zero again in the subsequent two years.

While data for the nation of Gabon is sparse, imports from the U.S. for HS 0206 were reported in 2001 at a value of \$1.3 million, a 32.6 percent share of the African nation's market. In that same year the U.S. competed primarily with Argentina, where in the following year, both the U.S. and Argentine market share dropped to zero, while France's increased to 48 percent. The reasoning behind this dramatic shift is unclear, but the following years are informative in determining if trade diversion potentially took place. U.S. exports of HS 0206 increased from the 2002 value of zero in 2002 to \$391 thousand in 2003, \$1.4 million in 2004, and peaked at \$3.3 million in 2008.¹⁷ Almost all of the increased value in U.S. exports to

¹⁷ 2009 is the latest available data for imports of HS 0206 by Gabon.

Gabon was contained within HS 020629, bovine edible offal, frozen nes. This sudden spike in exports may suggest that trade diversion took place.

Malaysian total HS 0206 imports increased by \$3.69 million from 2003 to 2004, with the U.S. increasing exports by \$95 thousand and New Zealand being responsible for \$3.56 million of the overall increase. Again the increase seen within the U.S. was almost completely restricted to a swine HS code, HS 020649, comprising 93 percent of the total increase, negating any possibility of beef trade diversion. The Philippines have had increased import volumes of HS 0206 on average every year since 2001, with 2003 total imports standing at \$12 million, growing to \$14.3 million in 2004. The U.S. is not responsible for a majority of these increases, exporting only \$132 thousand in 2003 and \$749 thousand in 2004. A large percentage of this growth was again contained within non-bovine related HS six-digit codes, however from 2001-2003 the U.S. did not export any of HS 020621, bovine tongues, but began exporting in 2004 at a value of \$72 thousand, growing to \$135 thousand in 2005. This alone may suggest trade diversion, but U.S. total exports of this HS code in 2003 were \$105 million, showing exports to the Philippines to be almost completely insignificant by comparison. Increases in HS 0206 imports by the Philippines from the U.S. were largely contained within HS 020649, swine edible offal, frozen nes.

Colombian imports of HS 0206 increased by nearly \$2 million from 2003-2004, with close to \$1 million of that total increasing coming from the U.S. As previously seen for multiple nations, the increase in exports was not caused by increases in beef or beef products. HS 020649 again was the primary reason for the increase in the four-digit HS code, growing from \$793 thousand in 2003 to nearly \$2.5 million in 2004. Bulgaria also had increases of HS 0206, but once again was limited to only swine related HS codes. The minute increase in imports by the Congo were similarly restricted to HS 020622, bovine livers, at a 2004 value of \$9 thousand, up from a value of 0 in 2002.

Conclusion for Non-Traditional Markets

The two parameters set forth on the evaluation of potential trade diversion based on export values and market share composition provided a comprehensive analysis on nations not considered traditional markets for beef and beef products. While the first set of parameters did not reveal any evidence of significantly altered trade flows to larger nations by the U.S., it provided insight as to whether or not nations are able to quickly divert exports of a commodity restricted by their traditional markets to larger destinations where their exports previously were not substantial. Long term value fluctuations in imports for many nations, along with declining market share despite increased import values, as seen within Barbados, further failed to provide comprehensive evidence that the U.S. was able to substantially redirect exports to other nations. The second set of parameters initially suggests that the U.S. was able to redirect a portion of beef exports to the Bahamas, however existing levels of trade between the two countries should be taken into account when using the term trade diversion. Furthermore, the high correlation of growth and subsequent decline of exports with the policies implemented by the previously large export destinations, such as Japan and South Korea, suggest value changes to the Bahamas were potentially influenced by these policy decisions, but it is not conclusive. As previously mentioned, the nation of Georgia did not source any beef from the U.S. in 2001, however a large increase occurred within 2003, with over \$1 million imported from the U.S. in that year, before decreasing to 0 in 2005. Similar to Georgia, U.S. exports to Gabon increased considerably during the years of the outbreak. When using trade values alone, leaving out any other potentially influencing variables, these increases may suggest trade diversion took place as a result of the restrictive policies. Small or minute increases to non-traditional markets, such as South Africa, Hungary, Armenia, and Saudi Arabia, do not provide confident and conclusive evidence that the increases were a result of these policies. Again annual fluctuations, as seen within Honduras and Albania, are also unable to provide conclusive evidence as to the impact of the 2003 BSE case on their imports.

3.7 Overall Conclusions from the Data

Evaluation of import and export quantities and values, along with market share composition and the presentation of RCA indices, have shown what the initial and long term impacts of the 2003 discovery of BSE within the United States was on the global market for beef and beef products. Large variation was shown to exist within individual markets on specific beef HS codes, with frozen beef products traditionally destined for the Asian market taking longer to recover than chilled beef products, largely as a result of transportation restrictions and the time frame in which certain importers removed policies restricting U.S. beef. The largest trading partners of the U.S., Canada and Mexico, quickly reopened borders, and current market shares are similar or greater than they were pre-BSE. The largest traded beef HS code for the U.S., Canada, and Mexico is HS 0201, and export values along with U.S. market share in the two nations are provided within Table 22, detailing the long term trends of U.S. exports within the NAFTA region.

U.S. export values and market share to traditional Asian importers who sourced a large volume of beef and beef products from the U.S. prior to 2003 and have removed most restrictions include Japan, South Korea, Hong Kong, and Taiwan. The U.S. has slowly expanded exports, and has exceeded pre-2003 values in each nation, however has not been able to regain the pre-BSE market share within Japan and Korea, the two overwhelmingly largest importers out of the four. These two nations remain highly competitive for beef exporting nations, and should the 2007-2014 trend of increasing U.S. exports continue, pre-BSE levels of market share by the U.S. should be attained within the next few years. The largest exported beef HS code by the U.S. to these importers is HS 0202, and U.S. export values along with market shares can be seen within Table 23.

Out of the nations evaluated within the previous traditional markets portion of the paper, Russia still completely restricts the imports of any type of U.S. beef, with China only removing restrictions in September of 2016. Measured by domestic consumption, these two nations pose the greatest potential for

a future significant expansion of U.S. beef exports, pending the successful reopening of their borders. As previously stated, South American nations are primarily responsible for beef exports to Russia, where 2014 total import value of frozen beef stood at \$2.2 billion. China primarily sources from Australia, who in 2014 exported \$617 million out of a total HS 202 import value of \$1.2 billion. Despite Vietnam and Egypt not having similar restrictions, U.S. presence within these two nations is minimal. All four of these countries, even with overall imports by Egypt and Vietnam being significantly less than Russia and China, should be focused on for potential expansion of U.S. beef exports in the future. The largest exported beef HS code from the U.S. for Russia, China, Egypt, and Vietnam, again is HS 0202, and export values and market shares are presented within Table 24.

Our hypothesis of potential trade diversion by the U.S. into non-traditional markets was not significantly evident, with small increases occurring within the Bahamas, Georgia, and Gabon. However, evidence exists that the increases in exports during certain years to certain nations is related to the policies of larger traditional markets. We also hypothesized that non-traditional suppliers may attempt to gain new access to markets once the U.S. presence was completely or partially removed, and in certain regions, that proved to be true. The bulk of the supply was provided by what we can consider traditional suppliers such as Australia and New Zealand; however emerging competitors have begun to increase their presence in global beef trade. This is particularly evident when evaluating the global market for frozen beef. There has been a steady decline of market share by the largest historical exporters of frozen beef, the U.S., Australia, and New Zealand, while Brazil, India, Uruguay, and Paraguay have been steadily increasing their shares. The emergence of new competitors and continuous market share shifting has occurred with the presence of BSE effects; however other factors are likely contributing to the change in market share composition. The following econometric evaluation will provide further evidence of our trade phenomena by controlling for factors influencing traded values.

Chapter 4: Econometric Analysis

As was apparent in the previous chapter, there was not much evidence that the U.S. was able to reroute beef exports to non-traditional markets as a result of the restrictions imposed as a result of the 2003 case of BSE. However, it was overwhelmingly evident that traditional competitors in the global beef market were quickly able to increase their levels of exports to nations where the U.S. had been shut out, and that these policies had a longer lasting impact on the U.S. beef export industry than only in the years in which they were strictly enforced. Furthermore, emerging competitors have begun to increase their market shares within the largest beef importing nations, at the expense of countries who can be considered traditional exporters, including the U.S.

Therefore, in order to quantify the magnitude in which U.S. beef exports were depressed, along with testing the ability of competitors to quickly increase their export volumes, a panel data gravity model of bilateral beef trade is developed to examine fluctuations in traded values as a result of BSE policies following the U.S. outbreak. The gravity model, first introduced by Tinbergen (1963), relates bilateral trade between countries to GDP, distance between nations, populations, and other factors. The model is a well-known tool within existing literature and has been shown to be very useful when evaluating the impacts of policies on trade, taking into account first that trade is driven positively by income (GDP), and negatively driven by factors such as transportation cost. The gravity model derives its name due to the fact that the larger a nation is, the higher its levels of trade are likely to be, and that as distance between nations grow, the less likely they are to exchange goods and services. Baier and Bergstrand (2003) noted that the gravity model has been empirically successful in explaining trade flows for more than 40 years, referring to it as the “workhorse for cross-country empirical analyses of international trade flows.”

A vast number of studies have used this model to perform *ex-post* analysis on the impact of barriers and policy on trade. Notably, Anderson and van Wincoop (2003), who while evaluating the problem of omitted variable bias in previous studies involving the gravity model, and subsequent biased estimates, provided evidence that trade between nations was not only dependent on economic size and

trade costs, but largely upon what they called multilateral resistance. In their seminal paper, they estimated by controlling for these resistance terms, the impact of national borders on trade flows. Moving to several applications to agriculture relevant to this study, Grant and Lambert (2008) adopted a similar structure set forth by Anderson and van Wincoop (2003) to look at the impact of RTAs specifically. They found that the evaluation of the impact trade agreements have on bilateral trade is largely dependent upon evaluation of agricultural vs. non-agricultural sectors, specific individual agreements, and the duration of phase-in periods. Grant, Peterson, and Ramniceanu (2015), in a more recent paper, developed a product line gravity model to assess the restrictiveness of SPS regulations on U.S. exports of fresh fruits and vegetables. While these regulations are well known to be a barrier to trade, with further evidence to this notion being presented in the paper, the authors were able to show that the negative impact on trade values associated specifically with SPS regulations diminishes with time. That is, as the experience and knowledge of exporters about country-specific import regulations grows, the depressive nature of these regulations decrease, and is completely gone within two to three years.

We here will use a similar model, modified in order to capture the effects of BSE policy on global beef trade after discovery of the case of BSE in the U.S. in 2003.

4.1 The Gravity Model

The standard log-linear gravity model specified as an OLS regression, regressing the log of the value of imports on continuous and dummy variables influencing the direction and level of trade is as follows:

$$(1) \ln(X_{ijt}) = \beta_0 + \beta_1 \ln(GDP_{it}) + \beta_2 \ln(Pop_{it}) + \beta_3 \ln(GDP_{jt}) + \beta_4 \ln(Pop_{jt}) + \beta_5 \ln(Dist_{ij}) + \delta_1(ComLang_{ij}) + \delta_2(Contig_{ij}) + \delta_3(RTA_{ijt}) + \varphi_1(Z_{ijt}) + \varepsilon_{ijt}$$

Equation (1) is the benchmark specification which we will modify to capture effects on beef trade related to BSE events. Here X_{ijt} represents the value of imports by country j from exporting source country i in year t ; followed by GDP for both exporting and importing nations, along with populations, all of which control for country-specific fluctuations that have been shown to have an impact on export and import values. It should be noted that while we define X_{ijt} here as the value of imports, we will also modify our model to also define X_{ijt} in quantities. Other frequently used variables anticipated to affect trade levels are included, such as $Dist$, a continuous value representing the distance between trading partners, dummy variables for $ComLang$, which is unity if nations share a common language and zero otherwise, $Contig$, which is unity if the nations share a contiguous border, and RTA , which indicates if countries i and j participate in a regional trade agreement, which might result in lower trade barriers than otherwise for their bilateral trade. The variable(s) Z represent other factors hypothesized to affect trade within our study, in our case these variables will be importers' policies related to the BSE case.

The first six variables are well known in existing trade literature to control for standard fluctuations in traded values. If beef is a normal good, we expect that as both GDP and population within a nation increases, demand for beef imports should increase, and as such the coefficients on these variables should be positive for the importing country. It is possible that as GDP and population grows within an exporting nation, such as the U.S., producers may find markets for their product domestically, reducing the volume exported, thus resulting in a negative coefficient. Variables that have historically influenced trade such as whether or not nations share a common language or contiguous border, along with the presence or lack of

having an RTA in effect, have commonly been included in gravity models in order to control for potential significance. In particular, we would intuitively expect the coefficient on *RTA* to be positive and significant, although the proliferation of these agreements in the years preceding the years within our study could potentially dampen observation of significant effects. Table 25 below provides further descriptions of certain variables, along with their respective summary statistics.¹⁸

¹⁸ While tables 1-24 containing descriptive statistics on trade are organized into an Appendix for convenience of the reader, the tables related to the econometric modeling are included within this chapter. The variable *RelativePrice*, while included within the Summary Statistics table, is introduced within the following section again for convenience.

Table 25: Variable Definitions and Summary Statistics

VARIABLES	Variable Description	Mean	St. Dev.	Min.	Max.
$\ln ValueImported_{ijt}$	Annual value of beef imports by country j from country i in logarithm	5.87	7.10	0	25.73
$\ln QuantityImported_{ijt}$	Annual quantity of beef imports by country j from country i in logarithm	5.18	6.53	0	24.41
$\ln GDP_{it}$	Nominal GDP of exporting country i in logarithm	13.16	1.92	8.75	16.75
$\ln Population_{it}$	Population of exporting country i in logarithm	3.92	1.71	-.77	7.21
$\ln GDP_{jt}$	Nominal GDP of importing country j in logarithm	12.92	1.77	8.75	16.75
$\ln Population_{jt}$	Population of importing country j in logarithm	4.03	1.55	-.77	7.21
$\ln Relativeprice_{ijt}$	Relative price of beef from exporting country i into importing country j .	3.77	3.90	-9.73	15.56
Observations		21,437	21,437	21,437	21,437

4.2 Hypotheses and Estimating Equations

The three phenomena that will be evaluated for their economic and statistical significance are:

- 1) *Trade destruction*, defined as the magnitude to which total or U.S. beef exports to traditional markets declined in the years in which BSE-related beef import restricting policies were in place,
- 2) *Trade creation*, defined as the magnitude to which the largest competitors were able to enter the traditional U.S. markets in the years of the BSE-related policies, and
- 3) *NAFTA Trade depression*, defined as beef trade within NAFTA members potentially declining as a result of an oversupply of beef due to deteriorating export opportunities collectively for these countries due to BSE-related restricting policies. An alternative hypothesis is that close regulatory cooperation among these countries after BSE was discovered in Canada and Mexico, together with limitations on their other trade opportunities, stimulated increased beef trade among the NAFTA countries.

The descriptive data in Chapter 3 give initial evidence of these three phenomena, but without econometric controls for other factors affecting trade or tests of statistical significance of effects due to BSE policies. The decline in U.S. beef exports, trade destruction, is evident in specific markets and in total once BSE was discovered, as are the increased exports, trade creation, from competitors (see Tables 4-7, 12-24). In addition, as previously noted, both the Canadian and Mexican borders quickly reopened in comparison to the Asian market. Thus, any decline or lack of significant change in NAFTA traded values is more likely to be attributed to the phenomena of trade depression than the brief policies directly restricting U.S. and Canadian imports.

We define three periods to quantify the changes in beef trade as a result of the 2003 U.S. case: 1) Pre-BSE, which will encompass the years 1998-2003; 2) BSE, which will reflect the years 2004-2007, immediately following the detection of the U.S. BSE case; and 3) Post-BSE, 2008-2014. While the discovery of BSE in the U.S. was within 2003, it wasn't until December, and thus the largest reductions

in imports weren't realized until 2004. The most impactful bans, those by the largest Asian importers, were removed in 2007, with few exceptions, which allowed U.S. exports to slowly regain market share lost during the BSE period. Each of the time frames is distinguished in the gravity model.

Three refinements to the traditional logarithmic gravity model are also applied in our analysis. The first is a frequently used adjustment of adding a small constant (one) to the value of imports so that the logarithmic transformation is defined for the cases where zero trade is observed. It has been noted in the literature that omission of observations where trade value is zero causes biased estimates, and due to the large values typically associated with beef trade, we do not expect adding a value of one to all observations to significantly bias our results.

Second, we control for each country's overall price levels – or multilateral resistance as coined by Anderson and van Wincoop (2003) – with all of their trading partners using a comprehensive set of time-invariant country-by-period fixed effects. While time-invariant country-by-period fixed dummies may not fully capture changing overall resistance or openness to trade over time, given the inclusion of explicit time-varying BSE policy variables in the model for many of the country-pairs that implemented policy restrictions, we do not expect this to bias the results. In order to verify our use of fixed effects over also frequently used random effects, a Hausman test was performed. The Hausman test is used to determine the efficiency of these two specifications in panel data, with the null hypothesis being that random effects is the preferred estimator, or that there is no correlation between the error term (ε_{ijt}) and the regressors. When performing this test on our base model, we were able to significantly reject the null hypothesis of random effects being the more efficient specification, and thus proceed with the use of fixed effects.¹⁹

The inclusion of BSE policy dummy variables will be the key factor for determining year and country specific changes to beef trade. It should be noted that in order to circumvent the “natural trading partner” bias that is a result of residual trade factors that are time-invariant, the use of fixed effects, as suggested by Baldwin and Taglioni (2006), removes the variables *Dist*, *ComLang*, and *Contig*, and

¹⁹ The Hausman test performed returned a p-value of 0.0048.

controls for any other potentially omitted variables. However, we will provide results with these variables included as well as with the fixed effects for the first set of models reported.

Third, we add relative unit value prices to the model when evaluating shifts in traded quantities in order to control for possible price effects that may be responsible for shifting beef market shares. Relative prices were omitted from the modeling when evaluating changes in traded values as the presence of unit values in both our dependent and independent variables would lead to the possibility of simultaneity bias. In order to compute relative unit value prices, we summed the values and quantities for each importer for all of its partners with the exception of the partner the importer is trading with in the current observation, then divided value by quantity to get the unit value price of all other competing suppliers in the importer's market. This computation provided the exporting nation's relative price to all other suppliers of a specific market for a given commodity and specific year.

Our first specifications of the model are provided below, and were used to test the average difference in global beef trade between the two periods BSE (2004-2007) and post-BSE (2008-2014) compared to the pre-BSE (1998-2003) period. As previously mentioned, we tested the effect of BSE policies on both traded values and quantities, in order to further examine any significant deviations between the two. Again, our computed relative price variable was included within models where quantity was the dependent variable, shown in equation (2), but omitted when evaluating traded values, here equation (3).

The global quantity model is:

$$(2) \quad \ln(X_{ijt}) = \alpha_{ik} + \alpha_{jk} + \beta_1 \ln(GDP_{it}) + \beta_2 \ln(Pop_{it}) + \beta_3 \ln(GDP_{jt}) + \beta_4 \ln(Pop_{jt}) + \gamma_1 \ln(RelativePrice_{ijt}) + \delta_1(RTA_{ijt}) + \varphi_1(BSE) + \varphi_2(postBSE) + \varepsilon_{ijt}$$

The global value mode is:

$$(3) \quad \ln(X_{ijt}) = \alpha_{ik} + \alpha_{jk} + \beta_1 \ln(GDP_{it}) + \beta_2 \ln(Pop_{it}) + \beta_3 \ln(GDP_{jt}) + \beta_4 \ln(Pop_{jt}) + \delta_1(RTA_{ijt}) + \varphi_1(BSE) + \varphi_2(postBSE) + \varepsilon_{ijt}$$

The coefficients of interest, φ_1 and φ_2 will estimate the extent to which BSE policies raised or lowered global beef trade on average in each of the respective periods compared to the pre-BSE period. Within equation (2), γ_1 is also of interest, to see how large a role relative prices play in the level of quantity imported.

After evaluation of the global impact of BSE within the two time frames, we estimate a model with separate BSE dummy variables affecting the fluctuations in imports and exports by certain specific countries, which can be seen in equation (4).

Third, to increase the level of statistical significance, we specify a model where certain “similar country” aggregated groups were created, and can be seen within equation (5). To capture the effect of BSE policies, we rely on the information found within Chapter 3 to create these country groups. Three were created, with the first being comprised of the United States and Canada, denoted with the subscript *West*, the second containing Japan, Korea, Hong Kong, and Taiwan, denoted by subscript *Asia*, and the last having Australia and New Zealand, denoted by subscript *AustNZ*. These eight nations were the principal participants in the events surrounding the discovery of BSE within Canada and the United States, and thus equation (5) will provide us with a closer look than the aggregate period specific estimation (2) and (3), but a broader look than the multi country-detail of equation (4).

These models allow us to test two of our previously stated hypotheses. *Trade Destruction* would be revealed by any negative statistically significant coefficients for the global model or the two nations targeted by BSE policies, notably the United States and Canada, for the BSE period compared to the pre-BSE period, and also with negative coefficients associated with traditional importers. *Trade Creation* would be evident by economically large and statistically significant coefficients associated with the competitors revealed within Chapter 3 that increased exports to the Asian region, specifically Australia and New Zealand, in the BSE period. For certain countries, the trade values for the pre-BSE and post-BSE periods may be similar as they, for the most part, omit the significant impacts upon the beef market associated with the BSE period and instead reflect recovery of trade over a longer time period.

The country detail equation is:

$$(4) \ln(X_{ijt}) = \alpha_{ik} + \alpha_{jk} + \beta_1 \ln(GDP_{it}) + \beta_2 \ln(Pop_{it}) + \beta_3 \ln(GDP_{jt}) + \beta_4 \ln(Pop_{jt}) + \delta_1(RTA_{ijt}) + \varphi_1(BSE_{it}) + \varphi_2(postBSE_{it}) + \varphi_3(BSE_{jt}) + \varphi_4(postBSE_{jt}) + \varepsilon_{ijt}$$

The equation including country groups-by-period dummy variables, is as follows:

$$(5) \ln(X_{ijt}) = \alpha_{ik} + \alpha_{jk} + \beta_1 \ln(GDP_{it}) + \beta_2 \ln(Pop_{it}) + \beta_3 \ln(GDP_{jt}) + \beta_4 \ln(Pop_{jt}) + \delta_1(RTA_{ijt}) + \varphi_1(BSE_{West}) + \varphi_2(PostBSE_{West}) + \varphi_3(BSE_{Asia}) + \varphi_4(PostBSE_{Asia}) + \varphi_5(BSE_{AustNZ}) + \varphi_6(PostBSE_{AustNZ}) + \varepsilon_{ikjt}$$

Finally, *Trade Depression* will be examined through the use of dummy variables that represent trade between NAFTA members, the U.S., Canada, and Mexico. For the BSE and post-BSE periods, coefficients again represent the difference in the previously defined years to the pre-BSE period. It should be noted that within this model, we only included year dummies as opposed to the previously specified country-period dummies, as their inclusion would absorb at least one of the NAFTA countries' BSE effect. The model specified to capture any potential decreases in beef trade within NAFTA as a result of the restrictions by Asian importers prompting an oversupply within NAFTA members is as follows:

$$(6) \ln(X_{ijt}) = \alpha_{it} + \alpha_{jt} + \beta_1 \ln(GDP_{it}) + \beta_2 \ln(Pop_{it}) + \beta_3 \ln(GDP_{jt}) + \beta_4 \ln(Pop_{jt}) + \delta_1(RTA_{ijt}) + \varphi_1(BSE_{NAFTA}) + \varphi_2(PostBSE_{NAFTA}) + \varepsilon_{ikjt}$$

Collectively, these models, including regressions where value and quantity of imported beef are the dependent variables, are hypothesized to allow us to see the impact of the BSE policies on both importers and exporters during the BSE and post-BSE periods, our previously stated objectives.

4.3 Data

A novel bilateral trade database (X_{ijt}) of beef import values in U.S. dollars and quantities in tons, specifically for the previously mentioned HS codes 0201, 0202, and 0206, spanning the years 1998-2014, was developed to test the stated hypotheses. Unlike in the descriptive data tables in Chapter 3, for

the econometric analysis we omit any observations within HS 0206 that were not exclusively bovine commodity codes. The trade data were retrieved from the United Nations Commodity Trade Statistics Database (COMTRADE), and to maintain consistency with the results of Chapter 3, nominal values were used. A total of 76 nations were included in the analysis as beef importers and exporters. Included countries accounted for over 95% of global beef trade in the evaluated time frame, thus providing nearly complete coverage of the global market for the evaluation of the impact of the U.S. BSE case. However, before any analysis was undertaken, due to low trade values within certain years for certain countries, and in order to eliminate noisy data associated with very small trade flows between some countries, aggregate country groups were formed among the 76 countries for all regressions. For example, we aggregated all nations within the European Union into a single country group, along with specific regions such as the Middle East, South America, and Eastern Europe. A complete listing of nations included along with each region aggregation is given in Table 26. Our aggregation resulted in 26 individual countries being included, along with 6 country groups, providing a total of 32 individual countries and regions as the set of exporters and importers.

Table 26: Nations included within Econometric Analysis and Country Mappings:

Country	Map	Country	Map	Country	Map
USA	USA	ITA	European Union	KWT	Middle East
CAN	CAN	DEU	European Union	LBN	Middle East
MEX	MEX	NLD	European Union	ISR	Middle East
JPN	JPN	IRL	European Union	ARE	Middle East
KOR	KOR	GBR	European Union	JOR	Middle East
TWN	TWN	LUX	European Union	TUR	Middle East
HKG	HKG	MLT	European Union	GAB	Africa
VNM	VNM	FRA	European Union	BWA	Africa
RUS	RUS	ESP	European Union	COG	Africa
CHN	CHN	POL	European Union	ARM	Eastern Europe
BRA	BRA	SVN	European Union	UKR	Eastern Europe
ARG	ARG	SVK	European Union	MDA	Eastern Europe
CHL	CHL	FIN	European Union	BLR	Eastern Europe
IND	IND	LTU	European Union	COL	South America
AUS	AUS	LVA	European Union	VEN	South America
NZL	NZL	HUN	European Union	BOL	South America
EGY	EGY	DNK	European Union	TTO	South America
SAU	SAU	CZE	European Union	NIC	Central America
PRY	PRY	EST	European Union	CRI	Central America
URY	URY	GRC	European Union	HND	Central America
PHL	PHL	CYP	European Union	PAN	Central America
SGP	SGP	PRT	European Union	ATG	Caribbean
MYS	MYS	SWE	European Union	BHS	Caribbean
IDN	IDN	BEL	European Union	BMU	Caribbean
THA	THA	AUT	European Union	CYM	Caribbean

Finally, it should be noted that before we aggregated to the 32 countries and regions in the model, we dropped country-pair observations from the database in cases where the country-pair did not trade the specific HS code at least twice in the years evaluated, roughly 10 percent of the time. This filtered out nations where there was little potential to participate in the trade of beef products. Prior to our specifications, there were 49,152 observations (32 importers x 32 exporters x 3 commodities x 16 years). As a result of our modifications, our final database had 21,437 unique observations, of which 12,265 had imported value of 0, and correspondingly 12,600 observations had an imported quantity of 0. Any omission of observations due to imported quantities or values being 0 does not affect our results.

GDP data (all in millions, nominal U.S. dollars) was taken from the World Bank Development Indicators Database. When missing, GDP data was obtained from the International Monetary Fund's (IMF) *Financial Statistics Yearbook*. Values for population, distance, contiguity, and common language were obtained from the *Centre d'Etudes Prospectives et d'Informations Internationales* (CEPII) database.²⁰ The great circle formula is used by CEPII to calculate geographic distances between countries, referenced by latitudes and longitudes of the largest urban agglomerations in terms of population. Finally, Regional Trade Agreement data was obtained from the World Trade Organization's Regional Trade Agreements Information System database.

4.4 Empirical Results

The econometric results are organized according to the previously mentioned models. We will initially test the global impact of BSE related policies in the BSE and Post-BSE period with no fixed effects to show the impacts of mentioned traditionally included variables, then rely on our models with the fixed effects specification and variables of interest for the remainder of the paper. Second, we test the previously mentioned country-by-period specification, followed by our country group specification, and finally test for potential significance of beef trade depression within NAFTA. Each of these sections and specifications will allow us to test our stated hypotheses for evidence of previously described trade phenomena. Both effects on traded values and quantities are provided in the results tables.

Our initial results, based on equations (2) and (3), allowed us to test what the impact of the 2003 discovery of BSE and the subsequent restrictions on U.S. and Canadian beef imports had on the global beef market, and results are presented within Table 27. The initial regression without the use of fixed effects returned low R^2 values when testing both traded quantities and values. However, the results are presented in the table for reference. Upon applying our fixed effects specification, controlling for

²⁰ CEPII is a research institute focusing on the global economy, located in Paris. Data sets are available from www.cepii.com

unobserved heterogeneity, the models performance improved considerably and provided more intuitive coefficients.

In the case of the *GDP* and *Population* variables, we do not get a fully consistent set of results across importers and exporters for the value and quantity equations. Membership in an RTA has the expected positive sign and is statistically significant, however while statistically significant, our *RelativePrice* variable did not return economically intuitive results, having an unexpected positive sign. This could be evidence of higher quality exports being sent to larger, wealthier and more developed nations, and is an area for potential future research.

Concerning quantities, our results indicate that global beef trade was 19 percent ($(\exp(-0.215)-1) \times 100$) lower in our BSE period than the pre-BSE period. The second regression indicates that globally traded beef value was 28 percent ($(\exp(-0.336)-1) \times 100$) lower than the pre-BSE period. Both of these results are statistically significant, at the 10 percent and 1 percent level, respectively. This initial outcome, while expected, is evidence of trade destruction attributed to BSE. As detailed in previous chapters, U.S. exports declined considerably, and as previously stated, prior to 2003, the U.S. was the largest global exporter of beef. What is shown here is that the sudden restriction of imports globally resulted in a significant depression of globally traded beef. We were unable to pick up any statistical significance for the post-BSE period in comparison to the pre-BSE period. This suggests the traded values in the post-BSE period were relatively similar to the pre-BSE period, showing the recovery in global beef exports realized in these years. Chapter 3 provided detail about the post-BSE period, and the increases in global exports after the policies were removed was highly evident.

Table 27: Log-Level Gravity Equation Period Results with Panel Data, Global Impact, 1998-2014.

VARIABLES	(1) Quantity	(2) Value	(3) Quantity FE	(4) Value FE
GDP_{it}	0.737*** (0.0372)	1.068*** (0.0397)	0.124 (0.136)	0.463*** (0.126)
Pop_{it}	-0.766*** (0.0407)	-1.049*** (0.0435)	5.762*** (0.918)	6.908*** (0.852)
GDP_{jt}	0.695*** (0.0369)	1.038*** (0.0380)	0.205 (0.135)	0.300** (0.126)
Pop_{jt}	-0.437*** (0.0393)	-0.654*** (0.0421)	-2.206*** (0.720)	-2.517*** (0.668)
$Dist_{ij}$	0.0847 (0.0647)	0.844*** (0.0693)		
$ComLang_{ij}$	0.749*** (0.0967)	0.806*** (0.104)		
$Contig_{ij}$	2.429*** (0.176)	3.705*** (0.188)		
$RelativePrice_{ijt}$	0.148*** (0.0121)		0.0439*** (0.0138)	
RTA_{ijt}	0.872*** (0.111)	1.022*** (0.119)	0.295* (0.171)	0.659*** (0.158)
BSE	-0.562*** (0.117)	-0.659*** (0.125)	-0.215* (0.112)	-0.336*** (0.104)
$PostBSE$	-0.667*** (0.110)	-0.673*** (0.118)	0.0918 (0.176)	0.0267 (0.164)
$Intercept$	-10.40*** (0.740)	-22.74*** (0.791)		
Observations	21,437	21,437	21,437	21,437
R-squared	0.075	0.102	0.555	0.676

Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

For our second specification, equation (4), the results can be seen within Table 28. Only the RTA and relative price variable and BSE and post-BSE dummy variables for the eight key nations of interest, previously stated, are included within the table for brevity, however all nations were included in the modeling. Again, the models with fixed effects performed relatively well, returning R^2 values of .58 and .70 for quantity and value of trade, respectively. The coefficient for relative price is again positive and highly statistically significant, at the 1 percent level, however is not necessarily economically significant.

Table 28: Log-Level Gravity Equation Period Results with Panel Data, Individual Nations, 1998-2014.

VARIABLES	(1) Quantity	(2) Value
<i>RelativePrice_{ijt}</i>	0.0627*** (0.0148)	
<i>RTA_{ijt}</i>	0.326* (0.185)	0.818*** (0.169)
<i>HongKong_{BSE}</i>	-0.125 (0.949)	-0.378 (0.865)
<i>Japan_{BSE}</i>	-1.123 (0.999)	-0.755 (0.910)
<i>Korea_{BSE}</i>	-0.927 (0.998)	-1.390 (0.910)
<i>Taiwan_{BSE}</i>	1.893* (1.060)	2.466** (0.966)
<i>Australia_{BSE}</i>	-1.364 (0.924)	0.00563 (0.842)
<i>Canada_{BSE}</i>	-2.340** (0.931)	-2.733*** (0.848)
<i>NewZealand_{BSE}</i>	-0.569 (0.923)	0.345 (0.841)
<i>USA_{BSE}</i>	-2.278** (0.922)	-2.895*** (0.840)
<i>HongKong_{PostBSE}</i>	1.541* (0.860)	2.689*** (0.782)
<i>Japan_{PostBSE}</i>	-0.366 (0.938)	0.310 (0.855)
<i>Korea_{PostBSE}</i>	-0.376 (0.889)	-0.366 (0.810)
<i>Taiwan_{PostBSE}</i>	2.661*** (0.974)	3.770*** (0.888)
<i>Australia_{PostBSE}</i>	0.587 (0.820)	2.362*** (0.747)
<i>Canada_{PostBSE}</i>	1.126 (0.826)	0.647 (0.753)
<i>NewZealand_{PostBSE}</i>	1.348 (0.820)	1.654** (0.747)
<i>USA_{PostBSE}</i>	1.616** (0.818)	0.998 (0.745)
Observations	21,437	21,437
R-squared	0.583	0.707

Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

For three of our importing nations of interest, Hong Kong, Japan, and Korea, we were unable to pick up any significant effects on beef imports quantities and for the most part, value, in the BSE period. However, due to the growing size of the Taiwan market, we are able to show that for imported values was 11 times ($\exp(2.466)$) higher than in the pre-BSE period, and quantities were 6 times ($\exp(1.893)$) higher. This is due to the growing demand in the region despite the case of BSE in the west, and as described in Chapter 3, the areas ability to quickly switch to both Australian and New Zealand suppliers. In the years after the bans were removed, our post-BSE period of 2008-2014, we are able to see significant growth within both Hong Kong and Taiwan in these years. For Hong Kong, the nations imported value was 4 times higher ($\exp(1.541)$) in the post-BSE period than in the pre-BSE years in terms of quantity, and 14 times higher ($\exp(2.689)$) in value. Similarly, Taiwan's imported quantity was 14 times ($\exp(2.661)$) larger, whereas imported value was 43 times ($\exp(3.770)$) greater. Unfortunately, we are unable to detail the recovery seen within Japan and Korea that was revealed in Chapter 3. Again this is comparing the difference in imported quantities and values between the pre and post-BSE time frames. Due to Japan and Korea being traditionally high volume importers, the values between these years are relatively similar, despite the variation in suppliers. Hong Kong and Taiwan were low value importers in the pre-BSE period, resulting in both highly statistical and economic significance assigned to their respective *PostBSE* variables. Overall, these results match the observations in Chapter 3, that nominal prices of beef and hence values of imports rose sharply in the most recent years, while quantities of beef exports increased to regained levels similar to the pre-BSE period.

When evaluating exporters in the BSE period, our results again reinforce what was reported in Chapter 3. Most notably, for the United States and Canada, we can see significant decreases associated with their respective *BSE* variables. Our modeling indicates that U.S. beef exports were 89 percent ($(\exp(-2.278)-1) \times 100$) lower in terms of quantity with a corresponding 94 percent ($(\exp(-2.895)-1) \times 100$) decrease in value. Canada also suffered greatly during this time frame, with a quantity decrease of 90 percent ($(\exp(-2.340)-1) \times 100$) and a 93 percent ($(\exp(-2.733)-1) \times 100$) drop in value. These results,

significant both economically and statistically, show the greatest evidence of trade destruction within individual nations. However, we were unable to obtain significance and evidence of trade creation for the largest competitors, Australia and New Zealand, even though the coefficients in the value regressions are of the correct sign. Similar to the results for traditional importers during the BSE period, traded quantities and values in the BSE period compared to pre-BSE were similar enough to prevent obtaining statistical significance. In the post-BSE period for the included exporters, results were mixed, showing U.S. exported quantity to be 5 times ($\exp(1.616)$) greater in the post-BSE period, with no statistical significance for exported value. The coefficients for both Australia and New Zealand are economically and statistically significant in the post-BSE time frame, reinforcing the ability of these nations to remain competitive in post-BSE global beef market.

Our country group aggregations, specified by equation (5), for which results can be seen within Table 29, were created in order to test for significant increases or decreases that were not able to be captured with the previous country-specific modeling. Again the model returned high R^2 values, which can also be seen in the Table, along with consistent positive signs on our *RTA* and *RelativePrice* variables. When combining the nations above into groups, we get many intuitive results on the BSE variables similar to the country model results. Specifically, we are able to quantify the decrease seen in exports for our country group *West*, again the U.S. and Canada, showing a 68 percent ($(\exp(-1.164)-1) \times 100$) decline in quantity and a corresponding drop of 91 percent ($(\exp(-2.475)-1) \times 100$) in value for the BSE period. As exported quantities have recently returned to pre-BSE levels, we were again prevented from obtaining significance in the post-BSE time frame for the U.S. and Canada for quantity, while the coefficient in the value model has an unexpected negative sign and is statistically significant. This result states that in comparison to the pre-BSE time frame, combined total exported value from the U.S. and Canada is lower than in the pre-BSE years. It should again be noted that this variable accounts for all U.S. and Canadian beef exports in the post-BSE years, suggesting that overall exports are .56 times $\exp(-0.576)$ lower from 2008-2014 than from 1998-2003 as predicted by the model. Similar to our *West*

grouping, the aggregation of our Asian market reinforced what was found in the previous section for the BSE period. Overall imported quantity was 40 percent ($(\exp(-0.518)-1) \times 100$) less, with a corresponding 50 percent ($(\exp(-0.713)-1) \times 100$) decrease in value. Again the lack of significance in the post-BSE time frame for the *Asia* group is due to similar import values and quantities to the pre-BSE period, and is evidence of a recovery in beef imports within the region. What is of note in this specification is that for value, when combining Australia and New Zealand, we see that exported value was 67 percent ($(\exp(0.515)-1) \times 100$) greater in the BSE period than in the pre-BSE time frame, providing further evidence of trade creation. This is also true when evaluating the *PostBSE* coefficient for these nations, revealing exported value to be 102 percent ($(\exp(0.705)-1) \times 100$) greater. This is likely due to the maintained presence of Australia in the Asian market, despite reported decreases in exports from New Zealand.

Table 29: Log-Level Gravity Equation Period Results with Panel Data, Country Groups, 1998-2014.

VARIABLES	(1) Quantity	(2) Value
<i>RelativePrice</i> _{<i>ijt</i>}	0.0510*** (0.0139)	
<i>RTA</i> _{<i>ijt</i>}	0.363** (0.172)	0.628*** (0.159)
<i>BSE</i> _{<i>West</i>}	-1.164*** (0.248)	-2.475*** (0.230)
<i>PostBSE</i> _{<i>West</i>}	0.0419 (0.221)	-0.576*** (0.204)
<i>BSE</i> _{<i>Asia</i>}	-0.518** (0.248)	-0.713*** (0.229)
<i>PostBSE</i> _{<i>Asia</i>}	-0.0104 (0.248)	0.0261 (0.229)
<i>BSE</i> _{<i>AustNZ</i>}	0.212 (0.248)	0.515** (0.229)
<i>PostBSE</i> _{<i>AustNZ</i>}	-0.250 (0.215)	0.705*** (0.199)
Observations	21,437	21,437
R-squared	0.7617	0.680

Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Our final specification, represented by equation (6), was intended to capture any possible decreases within the NAFTA region as a result of BSE and the results can be seen within Table 30. We do not find any evidence of trade depression in the BSE (or post-BSE) period. Quite the contrary, the regression results suggest a strong positive effect on NAFTA beef trade in both periods compared to the pre-BSE period. This is supportive of the alternative hypothesis we indicated above, that regulatory cooperation and reduced other export opportunities cemented beef trade relations among the NAFTA countries in the BSE period and that this has had lasting long-term effects. However, due to the empirical results of trade between the three nations detailed within Chapter 3, along with the suggestive coefficients in Table 30, this possibility deserves further investigation in future research.

Table 30: Log-Level Gravity Equation Period Results with Panel Data, NAFTA, 1998-2014.

VARIABLES	(1) Quantity	(2) Value
<i>RelativePrice</i> _{<i>i,j,t</i>}	0.145*** (0.0122)	
<i>RTA</i> _{<i>i,j,t</i>}	1.425*** (0.0989)	1.121*** (0.106)
<i>BSE</i> _{NAFTA}	4.116*** (0.640)	6.245*** (0.687)
<i>PostBSE</i> _{NAFTA}	4.081*** (0.475)	6.575*** (0.510)
Observations	21,437	21,437
R-squared	.6174	.7617

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

Chapter 5: Summary and Conclusion

The stated goal of this thesis was to evaluate the trade shocks imposed on the global beef market in the wake of the 2003 discovery of BSE within the United States. We evaluated the impact of these policies on total trade and individual nation export and import levels, for both traditional and non-traditional countries. The sudden restrictions put in place against the U.S. by the largest traditional markets for beef, specifically nations within Asia, were highly distortive and caused significant long term damage to the U.S. beef industry. Our stated argument was that the policies put into place on the U.K., when knowledge about risks associated with BSE was low, was not initially unwarranted. However, given what was known about BSE in 2003 and the minimal presence of the disease within the U.S., the reaction by several of the largest beef-importing nations was severe and apparently did little to protect food supplies. Thus, these trade-restrictive policies caused unnecessary disruption to markets.

As was shown in Chapter 3, while total U.S. export value has increased, market share within certain nations is still lower than during the pre-BSE period, and total U.S. exported quantities have only recently begun to recover. We also provided evidence as to how competing nations are able to enter newly vacant markets, and detailed their ability to retain or grow market share even after BSE policies were removed. International trade patterns and fluctuations in market share composition were evaluated to provide evidence that the removal of restrictive policies did not provide smooth reentry by traditional suppliers, specifically the United States. Furthermore, despite the dramatic steps taken by U.S. industry and regulators to ensure the safety of both domestically consumed and exported beef products, certain nations either remain completely closed, or still have policies in place restricting the import of certain type of U.S. beef. The continuation of these policies in the present day, 13 years after the initial discovery, continues to disrupt markets.

Nations using unnecessary non-tariff barriers to trade greatly disrupt what is otherwise an efficient global market which allows goods to flow from the most efficient producers to where they are

valued the most. With few exceptions, total annual global demand and consumption of beef is increasing, and has survived negative demand shocks such as the emergence of BSE within the world's largest beef producer, the U.S. The average increases in annual beef consumption, despite BSE, shown in descriptive statistics in Chapter 3, contributed to the manner in which competing nations were able to enter these newly vacated markets. Had domestic demand within each individual importing nation decreased, the ability of these nations to increase their exports likely would have been hampered—as shown in Chapter 4, beef trade did decline in the BSE period compared to pre-BSE, holding other variables constant.

A wealth of evidence within Chapters 3 and 4 was provided revealing that the primary nations responsible for supplying the markets where the U.S. had previously been dominant were Australia and New Zealand, and that in certain regions they have maintained high levels of market share and export values. We also provided extensive evidence that the U.S. was not able to immediately reenter these markets after the majority of complete bans on the import of U.S. beef was removed. As a result, should another threat to the safety of the U.S. food supply arise in the future, steps should be taken to ensure importing nations do not adopt similar policies unnecessarily. The hypothesized spread of BSE from the single infected animal within Washington did not materialize, and while there was confirmation of 3 cases of vCJD, each case resulted from exposure outside of the U.S. Despite the statement by the OIE that complete bans related to BSE are unnecessary, restrictions on specific regions such as the Pacific Northwest, as opposed to nation-wide bans, would have lessened the economic impact seen from the 2003 case. We also showed that nations will not only increase imports from traditional suppliers, but begin sourcing from nations where no prior trade existed for specific commodities. Thus, the most significant results from our evaluation included the delay of U.S. recovery within its traditional markets, the emergence of traditional and new suppliers within the global beef market (such as India and Argentina), and the variance in policy decisions made by those nations who traditionally sourced beef imports from the U.S.

Changes in import values by traditional large-volume importing nations was well documented, along with decreases in export values by the U.S. and Canada. While Chapter 3 showed these changes in export and import values, our econometric evaluation within Chapter 4 allowed us to statistically determine the impact BSE had on the global market of beef. While these results are somewhat mixed and some estimated effects on trade seem too large, in other ways the results in Chapter 4 reinforced what was revealed in Chapter 3. For example, Section 3.2 detailed the large presence the U.S. and Canada had on the global beef market, both fresh and frozen, in the years prior to the 2003 outbreak, and detailed the respective decline in the following years. The analysis performed within Chapter 4 further evaluated what the drop in export levels from these two nations had upon globally traded beef values as a whole. While the nature of our econometric modeling restricted our ability to evaluate the post-BSE period, the recovery for the U.S. was detailed within Chapter 3. Furthermore, our country-specific modeling, represented by equation (4), reinforced what was provided within Section 3.3 for declines in U.S. export quantity and value, and provided a closer look at what happened to total Canadian beef exports, which had not been completely explored within Chapter 3. Similarly, the country-specific modeling also reinforced the growth in import value that was initially detailed in Chapter 3 for Hong Kong and Taiwan.

Future research could pursue the trade relationship and results obtained for the NAFTA region, as the results obtained within the paper were not what was expected. Also, in the course of working with our specific models, we attempted to include country-by-commodity specifications, but due to low numbers of observations, were not able to obtain significant results. While we briefly evaluated products other than beef within Chapter 3, they were not included within the modeling of Chapter 4. Further evaluation of fluctuations in imported values when looking at specific commodities, including poultry and pork products, perhaps by further creation of country groupings, could potentially provide greater detail concerning the events surrounding the 2003 case of BSE.

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Appendix

Table 1: HS 0201 Global Market Shares. Unit: Percentage

Exporters	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
World	100	100	100	100	100	100	100	100	100	100	100	100	100	100
United States of America	20.9	16.6	17	3.9	5.5	8.3	8.8	9.5	9.2	10.4	11.6	12.5	13.6	13.6
Netherlands	9.2	11.4	12.9	13.8	13.3	13	13.7	13	13.6	12	13.1	13.2	13	12
Australia	12.6	10.1	9.9	13.5	12.7	11.6	10.3	9.6	8.7	9.4	9	9.4	9	10.2
Ireland	7	8.2	9.5	9.9	10	10.1	10	9.9	9.3	8.8	8.9	8.7	8.8	8.9
Germany	9.7	11.1	9.5	10.7	9.8	10.8	9	10	10	9.2	9.1	8.3	7.8	7
Canada	16.3	13.9	9	12	10.5	6.9	5.7	5	5	6	4.6	4	3.9	5.1
France	4.7	6.6	7.6	7.5	7.1	7.2	7	7	7.3	6.8	7	6.2	5.7	4.9
Poland	0.2	0.4	0.4	1.1	2.2	2.9	3	3.7	4	4.4	4.4	4.2	4.6	4
Brazil	3.2	3.1	4.2	5.2	4.8	4.5	4.7	1.5	2.1	2.7	3	3.9	4	3.7
Belgium	3.6	3.9	3.9	3.9	3.7	3.4	3.7	3.5	3.6	3.5	3.5	3.4	3.6	3.4
Mexico	0.2	0.1	0.2	0.3	0.5	0.6	0.6	0.5	0.7	1.2	1.5	2.4	2.4	3.4
Argentina	0.8	2.6	2.9	3.6	4.5	3.8	4.7	4.3	4.1	3.5	3.4	3.3	3	2.9
United Kingdom	0.3	0.2	0.3	0.2	0.3	1.1	1.3	1.8	2.1	2.5	3	2.5	2.3	2.3
Spain	2	2.2	2.7	2.6	2.9	2.6	2.3	2.8	2.3	2.1	2	2.3	2.4	2.2
Austria	1.5	1.7	1.8	1.9	2	2	1.9	2.2	2.5	2.3	2.2	2.2	2.2	2.1
Paraguay	0.8	0.6	0.2	0.5	0.7	0.9	0.9	1.2	1.6	2.8	1.6	0.5	1.1	2
Italy	0.6	0.8	0.9	1.3	1.4	1.8	1.9	1.8	1.8	2.1	2.1	2	1.9	1.9
Belarus	0	0	0.1	0	0.1	0.1	0.3	0.5	1	1.5	1.7	1.8	2	1.8
Uruguay	0.8	0.9	1.2	1.3	1.4	1.7	1.4	1.7	1.2	1.5	1.5	1.8	1.7	1.8
Denmark	2.1	2.2	2.2	2.4	2	1.8	1.8	1.9	2.2	2.1	1.9	1.9	1.8	1.7
New Zealand	1.1	0.9	1.1	1.2	1.1	1.1	1	0.9	0.9	1.1	0.9	1	1	1
Nicaragua	0.4	0.5	0.5	0.6	0.5	0.2	0.6	0.5	0.5	0.4	0.5	0.4	0.4	0.5
Lithuania	0.1	0	0.1	0.2	0.4	0.4	0.5	0.5	0.5	0.5	0.5	0.5	0.4	0.4
India	0.2	0.2	0.1	0	0	0.1	0.1	0	0.1	0.1	0.1	0.2	0.3	0.4

Table 2: HS 0202 Global Market Shares Unit: Percentage

Exporters	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
World	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Brazil	9.4	8.9	11.2	18.5	21.1	26.0	27.1	27.8	23.2	23.2	19.8	19.9	20.7	19.8
India	4.7	4.5	4.1	5.3	6.5	6.9	8.0	8.2	8.5	11.5	14.5	16.1	20.3	18.8
Australia	26.0	24.3	20.9	25.1	22.4	20.5	20.1	17.6	16.3	15.5	16.4	16.1	16.4	18.7
United States	19.7	19.4	20.8	1.1	1.5	2.2	4.3	6.6	7.6	10.4	11.7	11.1	10.6	11.8
New Zealand	12.4	12.4	12.8	15.1	13.3	10.6	9.9	8.8	8.5	8.1	8.0	8.0	6.9	7.3
Uruguay	2.7	3.0	3.8	6.2	6.6	7.1	5.7	6.6	6.4	5.7	5.5	5.5	4.3	4.1
Paraguay	0.4	0.3	0.4	1.2	1.7	2.8	1.9	2.7	2.4	2.6	2.1	3.6	3.5	3.3
Argentina	1.1	2.2	2.6	5.7	6.9	5.8	4.2	4.1	7.1	2.9	2.4	1.7	1.5	1.5
Nicaragua	0.7	0.7	0.5	0.6	0.6	0.6	0.8	0.8	1.2	1.6	1.8	2.0	1.3	1.3
Canada	2.1	2.1	1.1	1.0	1.1	0.9	0.9	1.4	1.1	1.3	1.2	1.2	1.2	1.3
Poland	0.4	0.9	0.5	0.4	0.5	0.5	0.5	0.7	0.8	1.0	1.0	1.1	1.2	1.1
Germany	5.2	3.7	2.6	1.9	2.3	2.0	1.7	1.7	1.9	1.8	1.5	1.3	1.1	1.0
Ireland	1.3	2.1	1.9	1.9	1.5	1.8	1.7	0.8	0.9	0.9	1.1	1.0	0.8	0.9
Netherlands	2.0	2.6	2.7	2.4	2.2	2.3	2.5	2.4	2.0	1.5	1.4	1.2	0.9	0.9
Italy	1.9	2.0	2.3	2.7	2.1	1.8	1.7	1.7	1.6	1.6	1.5	1.4	1.1	0.8
Hong Kong	0.2	0.3	0.3	0.1	0.1	0.1	0.3	0.3	0.9	0.6	0.5	0.5	0.7	0.6
Mexico	0.0	0.0	0.1	0.3	0.5	0.5	0.5	0.4	0.5	0.5	1.2	1.4	0.6	0.5
Spain	0.9	1.0	1.4	1.2	1.1	0.7	0.7	0.8	0.6	0.6	0.7	0.8	0.5	0.5
Belarus	0.5	0.6	0.7	1.2	1.3	1.7	1.2	1.0	1.7	1.3	0.7	0.8	0.9	0.5
Austria	0.4	0.3	0.2	0.4	0.3	0.3	0.4	0.4	0.4	0.4	0.4	0.4	0.5	0.4
United Kingdom	0.1	0.1	0.1	0.2	0.1	0.2	0.3	0.4	0.3	0.3	0.4	0.4	0.4	0.4
France	0.8	1.0	2.1	1.4	0.8	0.7	0.8	0.8	0.7	0.5	0.5	0.3	0.3	0.3
Belgium	0.4	0.5	0.5	0.6	0.5	0.5	0.5	0.5	0.6	0.6	0.5	0.4	0.3	0.3
Botswana	0.5	0.4	0.3	0.3	0.4	0.4	0.5	0.2	0.4	0.4	0.2	0.3	0.3	0.3

Table 3: HS 0206 Global Market Shares Unit: Percentage

Exporters	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
World	100	100	100	100	100	100	100	100	100	100	100	100	100	100
United States	34.7	27.2	26.5	12.8	14.7	14.4	13.4	15.6	15.6	17.3	17.4	17.6	17.6	17.2
Germany	5	7.4	6.2	9.1	11.3	10.9	9.1	11.3	11.4	10	11.5	12.1	11.5	10.4
Hong Kong	10.9	12.5	12.8	8.6	3	6.4	11.3	16	17	15.4	8.2	7.4	6.6	8.5
Australia	8.9	7.6	8.7	13.5	15.5	13.2	11.4	8.4	7.7	8.2	8.3	8.3	8.1	8.3
Netherlands	5.1	7.4	8.2	9.5	8.9	8.7	8.9	7.5	7	6.6	8.2	7.9	7.5	7.3
Brazil	1.8	2	2.8	3.5	3.1	4	4.4	4.3	5	4.7	5.2	5.3	6.1	6.5
Canada	10.1	9.7	6.8	6.2	7	6.8	7.1	6	5.3	5.2	5.5	5.5	5.2	5.3
Ireland	1.8	2.3	3.8	5.1	4.1	4.5	4	3.2	3.3	5.3	4.9	4.1	4.2	4.3
Denmark	5.4	5.9	5.1	6.1	5.6	5	4.7	4.6	4.7	4.7	5.4	5.2	5.1	4.2
Spain	1.9	2.2	2.7	3.6	3.6	3.6	3.8	3.7	3.4	2.9	3.7	4	3.6	4.1
France	2.4	3	3	3.8	3.6	3.6	3.7	3.4	3.3	3.2	3.3	3.2	3	3.1
New Zealand	2.9	2.8	3.3	5.6	6.2	3.9	3.3	2.4	2.1	2.4	2.3	2.2	2.2	2.1
United Kingdom	0.3	0.5	0.4	0.4	0.5	0.5	0.7	0.7	1	1.3	1.7	1.5	1.5	2.1
Argentina	0.9	0.8	1.3	1.9	1.7	2.7	2.9	2.5	3	2.4	2.5	2.4	2.3	2
Belgium	2.8	2.9	2.9	3.5	3.4	3.2	3.3	2.9	3	2.3	2.3	2.3	2.5	1.9
India	0	0	0.1	0	0	0	0.1	0.1	0.2	0.2	0.3	1.1	2.1	1.6
Poland	0.1	0.2	0.2	0.5	0.7	1	0.8	0.9	0.9	1.1	1.5	1.7	1.8	1.5
Italy	1	1	1	1.4	1.5	1.3	1.3	1.2	1.1	1.1	1.3	1.4	1.2	1.2
Austria	0.8	0.9	1.1	1	1	0.9	1	1.3	1	0.9	1.1	1.1	1.2	1.1
Uruguay	0.5	0.3	0.3	0.3	0.3	0.5	0.5	0.5	0.5	0.6	0.6	0.7	0.8	1
Paraguay	0.1	0.1	0	0.1	0.1	0.2	0.3	0.4	0.4	0.6	0.4	0.5	0.6	0.9
Singapore	0	0	0.1	0.1	0	0.2	0.2	0.1	0.1	0.1	0.2	0.2	0.4	0.7
Chile	0.4	0.3	0.3	0.6	0.9	0.8	0.7	0.5	0.4	0.5	0.5	0.6	0.7	0.6
Mexico	0.1	0.1	0.2	0.4	0.4	0.7	0.6	0.6	0.5	0.5	0.5	0.5	0.5	0.6
Hungary	0.2	0.2	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.4	0.4	0.5	0.4

Table 4: US HS 0201 Exports 2001-2014 Unit: US Dollar Thousand

Importers	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	Total
World	1,551,407	1,425,808	1,721,577	444,786	717,586	1,217,276	1,470,126	1,810,199	1,610,041	1,874,941	2,500,870	2,618,806	2,937,634	3,089,972	24,991,029
Real Values	2,005,911	1,815,643	2,149,419	540,462	844,761	1,390,296	1,635,558	1,975,154	1,743,516	2,005,878	2,621,396	2,696,606	2,980,495	3,089,972	27,495,067
Mexico	500,405	582,563	583,398	365,743	526,176	762,240	703,657	807,918	644,194	624,282	741,434	586,653	653,314	857,280	8,939,257
Canada	198,714	199,789	226,048	50,786	118,328	317,909	463,963	545,950	490,783	556,634	816,590	945,791	942,896	772,382	6,646,563
Japan	770,548	522,350	717,968	576	4,718	53,087	158,321	248,716	252,808	353,153	472,865	584,187	716,007	761,205	5,616,509
Taiwan	15,230	17,183	26,158	0	28,623	35,652	52,402	59,869	45,255	80,988	65,898	39,797	117,805	133,719	718,579
South Korea	27,543	56,585	123,936	56	0	288	17,542	15,774	36,175	41,328	67,744	65,620	79,554	114,064	646,209
Netherlands	375	447	689	1,251	1,501	1,887	14,058	33,510	35,472	55,822	99,517	103,436	111,917	122,491	582,373
Hong Kong	4,687	8,957	10,802	76	0	7,266	9,292	10,545	11,389	12,915	28,162	41,691	61,450	37,858	245,090
Italy	30	38	0	17	1,545	2,078	1,800	2,641	2,477	19,765	40,116	35,589	62,577	75,077	243,750
Chile	0	48	181	29	28	33	46	483	1,215	5,520	18,518	48,243	55,035	56,923	186,302
Switzerland	6,702	6,449	5,014	5,245	4,894	3,944	7,162	10,180	8,774	9,655	17,038	17,891	15,896	16,905	135,749
Germany	3,304	2,195	1,974	2,911	3,530	3,222	4,098	8,798	3,878	5,965	15,187	20,609	22,419	24,799	122,889
U.A.E	1,172	1,529	1,990	14	902	3,372	5,363	7,542	7,427	11,772	19,367	20,571	28,042	116,490	
Vietnam	53	14	21	0	1,857	650	315	8,141	20,959	34,578	11,749	6,622	1,016	301	86,276
Russia	1,038	1,751	1,710	303	117	0	0	4,298	2,000	10,016	27,383	32,942	868	216	82,642
Bermuda	4,163	5,097	5,837	7,076	6,898	6,232	6,563	4,864	3,594	3,627	4,592	5,201	6,341	6,343	76,428
Singapore	2,339	2,126	2,659	13	0	2,122	3,067	4,473	3,628	3,789	5,642	6,895	6,352	6,677	49,782
Cayman Islands	118	97	422	935	1,517	1,363	3,790	3,014	1,619	4,105	5,614	6,023	5,455	6,961	41,033
Bahamas	3,016	2,399	1,341	2,021	3,139	1,901	3,252	3,065	1,992	2,661	2,685	3,015	3,250	5,978	39,715
Netherlands Ant.	324	212	278	362	418	395	566	1,940	3,739	4,434	5,517	6,830	6,753	7,069	38,837
Kuwait	433	356	2,071	519	1,249	1,481	846	1,655	1,895	1,755	3,318	3,035	3,739	5,805	28,157
Belgium	2,508	1,876	1,458	583	416	445	2,288	4,120	5,665	2,094	1,200	995	1,654	1,708	27,010
Dom. Republic	475	378	421	223	548	599	731	1,908	2,443	2,207	2,740	4,348	4,466	4,398	25,885
Jamaica	763	800	347	0	421	956	950	2,980	3,158	1,879	620	715	6,462	6,562	24,793
Peru	21	96	81	0	0	287	353	486	769	1,582	1,642	2,203	4,968	4,922	17,410
Saudi Arabia	715	796	587	423	55	151	277	2,910	2,386	3,189	2,855	2,853	0	211	17,408
Qatar	96	130	12	0	0	18	43	272	1,574	1,765	2,299	2,886	4,373	3,902	17,370
Guatemala	238	186	90	69	266	143	386	508	488	1,195	3,439	2,951	2,385	3,692	16,036
Trin. & Tobago	14	78	108	588	846	1,173	1,624	1,983	1,082	1,776	1,218	1,596	1,733	886	14,705
Bahrain	46	0	174	202	78	300	164	676	1,312	1,769	1,793	2,668	2,477	2,479	14,138
Luxembourg	0	0	0	0	0	290	1,616	998	349	1,226	3,760	1,399	716	1,501	11,855
Barbados	318	283	177	111	924	1,100	512	1,133	751	774	1,405	1,313	1,485	1,494	11,780
Philippines	129	32	345	387	325	223	878	930	432	1,364	629	2,302	2,042	624	10,642
Total World Domestic Consumption (1000 MT CWE)	52,205	53,740	54,245	55,107	55,631	56,887	58,050	57,809	57,234	57,421	56,517	57,047	57,785	57,708	787,386

Table 5: US HS 0202 Exports 2001-2014 Unit: US Dollar Thousand

Importers	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	Total
World	1,048,274	1,108,835	1,347,327	83,705	129,947	211,898	427,237	886,663	874,871	1,521,952	2,069,345	2,038,788	2,309,332	2,956,973	17,015,147
Real Values	1,355,379	1,412,006	1,682,161	101,710	152,977	242,017	475,314	967,461	947,399	1,628,238	2,169,074	2,099,357	2,343,026	2,956,973	18,533,091
South Korea	333,035	551,093	617,819	664	0	160	99,778	269,246	171,871	453,364	581,086	474,793	479,816	700,314	4,733,039
Japan	472,479	310,170	438,812	402	477	11,114	71,518	105,689	158,870	192,680	286,649	319,738	466,153	566,886	3,401,637
Hong Kong	38,031	48,689	57,250	51	21	6,448	25,237	29,429	67,338	139,472	189,865	289,012	722,195	1,026,652	2,639,690
Taiwan	27,056	32,257	43,542	23	12,391	65,509	54,740	67,698	94,772	134,012	132,891	88,337	136,398	159,403	1,049,029
Vietnam	73	157	126	9	3,604	4,713	26,718	116,911	136,641	117,278	177,331	153,223	25,464	21,737	783,985
Russia	4,904	12,649	6,936	12	473	0	17	50,357	13,198	92,625	185,358	217,110	0	0	583,639
Mexico	78,712	53,086	47,316	25,005	30,105	17,793	14,510	28,093	21,206	20,312	19,630	23,048	45,599	38,149	462,564
Canada	19,818	18,752	20,566	4,821	13,778	17,267	21,325	35,770	26,846	40,547	49,422	43,959	34,923	39,730	387,524
Egypt	2,857	7,013	7,037	13	544	481	530	4,026	23,498	78,396	94,136	79,578	37,023	5,789	340,921
Philippines	2,290	2,523	3,383	4,070	3,816	5,867	9,360	16,759	16,247	19,069	29,422	32,877	43,830	50,987	240,500
Dom. Republic	1,208	1,644	2,974	1,108	4,918	9,225	14,614	16,991	14,123	19,808	25,570	27,786	29,450	50,082	219,501
U.A.E	3,189	7,543	6,564	2,265	3,982	5,710	7,840	12,994	11,552	19,255	26,281	29,741	36,026	33,916	206,858
Netherlands	1,383	615	619	409	1,043	1,505	5,354	17,711	15,264	21,615	22,680	32,416	32,405	27,268	180,287
Bahamas	6,857	7,356	9,343	10,912	10,720	13,981	9,696	8,827	12,453	16,396	15,313	17,830	15,642	15,376	170,702
Kuwait	2,385	1,944	23,495	2,612	6,162	4,991	7,419	6,910	6,493	10,281	15,591	16,195	21,554	21,150	147,182
Saudi Arabia	3,226	4,682	8,227	4,472	4,466	7,086	7,004	11,564	7,959	17,488	26,990	11,534	436	534	115,668
Indonesia	3,710	3,271	6,204	5,248	9,211	0	0	1,660	617	12,328	16,002	7,326	12,216	18,478	96,271
Italy	1,903	698	1,007	1,081	735	665	3,421	7,588	5,089	11,917	22,792	23,071	6,813	5,075	91,855
Guatemala	2,841	3,050	3,370	1,443	1,853	2,605	3,987	5,861	5,125	5,862	9,971	11,464	11,064	17,401	85,897
Jamaica	1,406	3,092	2,202	71	2,233	4,769	7,523	6,173	4,143	7,954	10,003	11,124	6,325	4,622	71,640
Singapore	2,459	2,624	3,151	82	0	598	1,055	1,238	1,776	8,177	9,310	7,295	10,960	10,777	59,502
Germany	630	914	392	356	345	641	1,424	2,264	2,083	7,325	6,448	12,205	12,610	10,322	57,959
Qatar	449	1,949	1,166	741	1,186	1,312	1,610	2,239	2,968	4,186	8,019	7,929	10,439	11,814	56,007
Angola	24	62	42	0	26	1,506	1,145	2,471	861	1,925	12,913	2,516	6,032	6,044	35,567
Netherlands Ant.	673	647	398	821	549	689	832	1,865	3,250	4,933	4,153	3,417	5,206	5,992	33,425
Spain	571	482	828	263	477	697	2,288	3,368	766	2,627	8,978	3,828	3,329	4,684	33,186
Trin. & Tobago	265	307	501	773	1,166	1,986	1,909	1,943	2,472	3,205	4,195	4,457	4,541	4,821	32,541
Peru	275	295	53	0	0	66	68	657	1,093	1,390	4,255	7,651	6,599	8,847	31,249
Jordan	177	128	1,095	0	88	497	996	1,274	2,150	3,156	5,077	5,936	5,420	4,661	30,655
Panama	777	178	59	18	34	3	195	527	1,312	1,677	2,855	4,469	6,515	9,430	28,049
Chile	297	248	117	40	59	176	564	856	716	592	3,802	6,895	7,529	5,934	27,825
Bermuda	1,601	1,187	1,265	1,253	1,433	1,742	1,836	3,006	2,953	3,240	3,005	2,427	443	1,978	27,369
Bahrain	2,907	2,237	351	315	856	1,002	1,635	1,835	1,169	2,045	2,147	3,070	4,145	3,136	26,850
Costa Rica	1,715	1,588	2,053	196	688	1,650	1,035	1,175	1,113	2,158	2,468	2,706	2,959	5,291	26,795
China	8,440	7,501	8,390	28	3	51	500	626	251	942	0	0	0	0	26,732
Barbados	590	346	754	685	1,244	1,332	1,955	1,896	2,905	2,652	2,802	2,953	2,189	3,013	25,316
Belgium	130	94	40	0	0	82	137	3,485	4,622	2,236	3,006	2,919	3,192	2,645	22,588
Aruba	186	209	305	886	769	1,326	1,324	1,914	2,002	1,554	2,156	3,117	2,448	3,306	21,502
Cayman Islands	596	1,528	1,427	544	551	871	904	1,882	3,842	1,916	1,155	1,436	2,073	2,394	21,119
Colombia	108	427	1,060	0	25	0	33	84	73	728	2,842	1,796	5,222	8,101	20,499
Honduras	216	190	105	677	481	833	983	845	630	1,017	2,292	3,025	3,671	2,787	17,752
Australia	91	237	198	68	434	71	169	363	481	185	2,801	4,115	4,064	3,241	16,518
Denmark	876	733	1,081	796	441	583	2,013	4,335	888	1,293	1,012	304	1,236	540	16,131
Turks & Caicos	266	685	1,062	450	346	557	679	670	722	1,382	1,766	2,076	2,205	2,784	15,650
France	350	142	158	229	136	219	481	1,140	6,854	4,400	234	219	315	173	15,050
Bulgaria	14	22	191	9	1,225	1,217	0	10,812	886	0	0	0	0	3	14,379
Thailand	1,892	2,231	2,300	0	0	556	820	437	116	401	772	1,218	1,513	1,864	14,120
Saint Lucia	391	153	506	273	504	544	293	523	831	1,994	1,438	2,203	1,994	2,222	13,869
Lebanon	173	167	547	0	857	606	227	988	1,815	1,890	1,816	1,432	1,594	12,339	
Uruguay	1,421	324	216	150	159	131	1,040	1,435	808	766	839	1,071	1,519	1,440	11,319
El Salvador	253	109	136	109	44	158	350	457	439	690	761	1,368	2,917	3,459	11,250
Macao, China	0	0	0	0	0	3,772	0	0	0	4,645	2,038	0	0	0	10,455
Total World Domestic Consumption (1000 MT CWE)	52,205	53,740	54,245	55,107	55,631	56,887	58,050	57,809	57,234	57,421	56,517	57,047	57,785	57,708	787,386

Table 6: US HS 0206 Exports 2001-2014 Unit: US Dollar Thousand

Importers	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	Total
World	660,206	463,489	540,711	303,187	407,389	414,600	463,574	831,619	788,972	941,647	1,179,402	1,262,511	1,305,228	1,404,130	10,966,665
Real Values	853,621	590,213	675,087	368,404	479,589	473,530	515,740	907,401	854,379	1,007,407	1,236,242	1,300,018	1,324,272	1,404,130	11,990,033
Mexico	151,523	134,490	132,293	155,430	182,180	176,971	197,477	265,042	262,459	296,214	351,312	335,893	337,821	400,519	3,379,624
Japan	306,658	148,440	179,539	18,157	19,535	10,859	22,898	66,982	88,622	132,096	139,327	190,442	235,856	275,403	1,834,814
China	12,805	13,548	21,107	14,385	23,883	15,244	34,098	32,729	24,386	64,929	163,058	250,523	296,766	162,559	1,130,020
Egypt	21,442	14,578	19,381	83	44,394	84,143	75,939	80,401	71,095	100,153	140,974	135,092	131,482	144,966	1,064,123
Hong Kong	34,182	20,012	25,453	9,974	10,410	15,932	19,603	90,884	124,075	107,641	105,636	75,485	78,774	194,045	912,106
South Korea	27,492	30,263	49,053	6,623	16,212	15,778	15,481	44,726	22,593	37,080	83,862	63,188	60,289	49,722	52,362
Russia	40,359	43,495	44,486	4,344	7,361	11,712	19,695	108,397	62,627	75,784	38,924	49,434	49	4,578	511,245
Canada	21,096	22,983	30,923	35,200	34,779	37,230	26,740	30,134	29,912	38,041	48,517	49,527	41,260	36,477	482,819
Taiwan	5,525	9,113	9,723	7,951	6,479	7,196	5,266	10,707	15,340	11,782	16,120	15,567	10,945	10,166	141,880
Philippines	679	351	418	595	1,324	2,368	3,481	5,450	15,674	13,372	7,658	10,131	19,564	12,377	93,442
Peru	874	671	1,902	131	236	1,041	1,843	4,865	4,354	7,801	12,644	18,120	14,628	9,779	78,889
Singapore	333	128	140	218	177	303	157	3,033	2,743	712	2,261	658	20,645	44,930	76,438
Indonesia	5,473	4,289	7,820	10,369	8,427	0	36	2,611	3,338	10,599	11,155	857	3,507	7,881	76,362
Angola	805	0	69	490	4,325	6,403	6,875	4,842	4,170	4,786	9,028	10,814	6,921	8,198	67,726
Jamaica	3,200	1,661	1,677	260	1,611	1,641	2,395	3,870	2,933	4,735	6,002	5,212	4,088	4,063	43,348
Poland	3,262	1,795	767	13,622	10,585	6,493	2,961	384	1,912	0	0	0	0	41,781	
Côte d'Ivoire	1,298	1,817	1,706	2,087	2,037	2,744	1,569	2,676	2,844	2,800	3,583	5,595	2,428	2,738	35,922
Vietnam	129	69	121	0	4,028	1,077	1,049	7,772	8,413	3,399	1,271	1,512	563	302	29,705
Colombia	821	2,487	1,277	674	871	242	1,777	5,745	1,250	1,378	1,070	3,124	2,663	3,765	27,144
Ukraine	0	26	0	132	0	102	853	15,922	3,717	1,463	1,080	873	1,853	259	26,280
Dom. Republic	863	636	962	1,068	1,485	1,057	2,056	6,187	3,844	1,903	1,719	1,582	229	797	24,388
Gabon	836	188	279	568	1,155	974	1,072	1,543	1,582	1,612	1,836	3,067	3,870	5,645	24,227
Haiti	284	858	431	1,442	2,958	2,412	1,774	1,743	2,515	1,917	1,252	1,219	2,005	1,384	22,194
Guatemala	687	413	442	486	180	474	1,770	2,337	1,813	1,709	2,786	4,323	2,208	2,426	22,054
Australia	25	19	71	0	727	574	1,675	4,788	6,322	2,066	1,078	444	1,041	965	19,795
Honduras	95	259	625	708	1,454	1,698	2,902	2,023	1,486	1,123	1,418	1,684	1,443	1,530	18,448
Saudi Arabia	920	0	425	954	1,007	1,415	1,436	1,812	1,881	1,985	1,865	1,490	901	446	16,537
Chile	100	3	12	5	118	119	430	840	954	96	3,308	3,983	4,455	2,031	16,454
Trin. & Tobago	4	57	83	673	510	862	1,281	1,223	1,195	1,918	1,769	1,471	1,697	1,268	14,011
United Kingdom	2,896	878	1,236	1,944	1,141	356	1,051	2,672	1,342	131	89	21	0	0	13,757
Moldova	14	48	0	1,492	1,827	0	0	987	908	775	2,398	2,817	1,660	384	13,310
Ecuador	92	89	19	5	526	271	316	1,102	785	1,007	2,000	2,368	2,015	1,318	11,913
Cuba	0	162	0	0	0	267	654	617	432	381	1,818	1,277	4,102	1,314	11,024
Total World Domestic Consumption (1000 MT CWE)	52,205	53,740	54,245	55,107	55,631	56,887	58,050	57,809	57,234	57,421	56,517	57,047	57,785	57,708	787,386

Table 7: U.S. Beef Exports 2001-2014 Unit: Real, Nominal, and Quantity

Product	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	Total
HS 0201 Real	2,005,911	1,815,643	2,149,419	540,462	844,761	1,390,296	1,635,558	1,975,154	1,743,516	2,005,878	2,621,396	2,696,606	2,980,495	3,089,972	27,495,067
HS 0201 Nominal	1,551,407	1,425,808	1,721,577	444,786	717,586	1,217,276	1,470,126	1,810,199	1,610,041	1,874,941	2,500,870	2,618,806	2,937,634	3,089,972	24,991,029
HS 0202 Quantity	402,786	417,980	436,023	118,848	171,814	296,308	334,503	398,963	361,825	380,048	424,974	363,611	404,414	376,040	4,888,137
HS 0202 Real	1,355,379	1,412,006	1,682,161	101,710	152,977	242,017	475,314	967,461	947,399	1,628,238	2,169,074	2,099,357	2,343,026	2,956,973	18,533,091
HS 0202 Nominal	1,048,274	1,108,835	1,347,327	83,705	129,947	211,898	427,237	886,663	874,871	1,521,952	2,069,345	2,038,788	2,309,332	2,956,973	17,015,147
HS 0202 Quantity	376,665	404,808	398,540	24,842	34,428	56,409	105,360	199,847	225,663	346,596	457,844	413,145	440,034	3,897,624	
HS 0206 Real	853,621	590,213	675,087	368,404	479,589	473,530	515,740	907,401	854,379	1,007,407	1,236,242	1,300,018	1,324,272	1,404,130	11,990,033
HS 0206 Nominal	660,206	463,489	540,711	303,187	407,389	414,600	463,574	831,619	788,972	941,647	1,179,402	1,262,511	1,305,228	1,404,130	10,966,665
HS 0206 Quantity	517,597	417,428	423,327	305,613	342,145	346,084	368,277	602,320	602,199	669,444	742,742	656,200	666,695	670,336	7,330,407

Table 8: Implied Prices and U.S. Inflation 2001-2014

Implied Prices	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
HS 0201	3,852	3,411	3,948	3,742	4,177	4,108	4,395	4,537	4,450	4,933	5,885	7,202	7,264	8,217
HS 0202	2,783	2,739	3,381	3,370	3,774	3,756	4,055	4,437	3,877	4,391	4,520	4,935	5,586	6,720
HS 0206	1,276	1,110	1,277	992	1,191	1,198	1,259	1,381	1,310	1,407	1,588	1,924	1,958	2,095
Inflation Rate	2.28	1.54	1.99	2.75	3.22	3.07	2.66	1.96	0.76	1.22	2.06	1.80	1.49	1.46

Table 9: US HS 0201 Revealed Comparative Advantage Unit: US Dollar Thousand

Year	RCA	NRCA	US 0201 Exports	US Total Exports	World 0201 Exports	World Total Exports
2001	1.75	0.27	1,551,407	731,005,998	7,422,103	6,114,492,134
2002	1.54	0.21	1,425,808	693,222,414	8,566,336	6,403,698,429
2003	1.76	0.27	1,721,577	723,608,648	10,113,530	7,463,277,048
2004	0.44	-0.39	444,786	817,905,572	11,326,637	9,101,298,802
2005	0.63	-0.23	717,586	904,339,487	13,044,306	10,367,581,282
2006	0.96	-0.02	1,217,276	1,037,029,245	14,724,037	11,986,437,555
2007	1.05	0.02	1,470,126	1,162,538,150	16,658,877	13,823,495,887
2008	1.16	0.08	1,810,199	1,299,898,877	19,131,802	15,977,916,880
2009	1.07	0.04	1,610,041	1,056,712,100	17,457,679	12,311,804,550
2010	1.22	0.10	1,874,941	1,278,099,187	18,033,400	15,052,525,130
2011	1.41	0.17	2,500,870	1,481,682,202	21,542,309	18,059,506,359
2012	1.47	0.19	2,618,806	1,544,932,014	20,846,349	18,091,943,586
2013	1.60	0.23	2,937,634	1,577,587,252	21,554,368	18,552,449,750
2014	1.57	0.22	3,089,972	1,619,742,864	22,762,594	18,685,583,537

Table 10: US HS 0202 Revealed Comparative Advantage Unit: US Dollar Thousand

Year	RCA	NRCA	US 0202 Exports	US Total Exports	World 0202 Exports	World Total Exports
2001	1.65	0.24	1,048,274	731,005,998	5,321,262	6,114,492,134
2002	1.80	0.28	1,108,835	693,222,414	5,701,653	6,403,698,429
2003	2.15	0.36	1,347,327	723,608,648	6,474,546	7,463,277,048
2004	0.13	-0.78	83,705	817,905,572	7,405,345	9,101,298,802
2005	0.18	-0.70	129,947	904,339,487	8,490,206	10,367,581,282
2006	0.26	-0.59	211,898	1,037,029,245	9,505,997	11,986,437,555
2007	0.51	-0.33	427,237	1,162,538,150	10,000,413	13,823,495,887
2008	0.82	-0.10	886,663	1,299,898,877	13,355,688	15,977,916,880
2009	0.89	-0.06	874,871	1,056,712,100	11,454,603	12,311,804,550
2010	1.23	0.10	1,521,952	1,278,099,187	14,578,155	15,052,525,130
2011	1.42	0.17	2,069,345	1,481,682,202	17,727,085	18,059,506,359
2012	1.30	0.13	2,038,788	1,544,932,014	18,421,832	18,091,943,586
2013	1.25	0.11	2,309,332	1,577,587,252	21,732,955	18,552,449,750
2014	1.36	0.15	2,956,973	1,619,742,864	25,035,691	18,685,583,537

Table 11: US HS 0206 Revealed Comparative Advantage Unit: US Dollar Thousand

Year	RCA	NRCA	US 0206 Exports	US Total Exports	World 0206 Exports	World Total Exports
2001	2.90	0.49	660,206	731,005,998	1,904,356	6,114,492,134
2002	2.51	0.43	463,489	693,222,414	1,703,360	6,403,698,429
2003	2.73	0.46	540,711	723,608,648	2,043,690	7,463,277,048
2004	1.43	0.18	303,187	817,905,572	2,364,991	9,101,298,802
2005	1.68	0.25	407,389	904,339,487	2,772,983	10,367,581,282
2006	1.67	0.25	414,600	1,037,029,245	2,870,982	11,986,437,555
2007	1.59	0.23	463,574	1,162,538,150	3,464,398	13,823,495,887
2008	1.92	0.32	831,619	1,299,898,877	5,319,944	15,977,916,880
2009	1.82	0.29	788,972	1,056,712,100	5,061,247	12,311,804,550
2010	2.04	0.34	941,647	1,278,099,187	5,445,626	15,052,525,130
2011	2.12	0.36	1,179,402	1,481,682,202	6,765,840	18,059,506,359
2012	2.07	0.35	1,262,511	1,544,932,014	7,159,070	18,091,943,586
2013	2.07	0.35	1,305,228	1,577,587,252	7,416,207	18,552,449,750
2014	1.99	0.33	1,404,130	1,619,742,864	8,154,329	18,685,583,537

Table 12: Mexico Beef Imports 2001-2014 Unit: US Dollar Thousand, Domestic Consumption

Exporters	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	Total
HS 0201															
World	831,681	953,316	794,644	670,616	820,134	930,989	1,026,485	1,121,615	808,133	850,714	904,057	802,156	864,484	912,840	12,291,864
United States	682,686	814,266	720,201	415,981	654,272	810,610	886,056	980,098	679,968	699,237	755,361	698,317	789,674	794,004	10,380,731
Canada	148,172	137,150	72,111	246,547	150,084	118,144	134,811	140,327	126,388	151,072	141,967	101,584	74,253	116,608	1,859,218
Chile	0	0	0	4,337	13,466	1,913	1,798	556	869	0	0	0	0	0	22,939
Nicaragua	99	130	1,979	2,308	1,314	148	360	0	0	0	6,164	1,271	0	914	14,687
HS 0202															
World	59,239	55,323	52,814	49,285	54,007	42,298	50,595	44,527	31,294	24,025	28,686	30,124	29,876	42,199	594,292
United States	20,009	14,577	17,858	2,868	5,183	12,317	11,768	24,728	15,930	14,236	19,238	22,460	19,693	28,769	229,634
Australia	9,668	15,374	12,057	7,560	8,068	5,841	6,554	3,020	3,282	4,514	3,556	2,947	5,573	7,455	95,469
New Zealand	10,756	7,002	12,716	11,345	13,697	9,828	5,660	2,771	2,101	2,070	1,893	2,858	2,736	3,241	88,674
Canada	13,922	14,019	5,842	15,952	5,542	1,958	4,724	5,542	3,045	1,960	772	1,697	1,669	2,174	78,818
Chile	0	0	0	5,904	17,160	7,497	4,741	1,509	565	51	188	27	109	13	37,764
Uruguay	1,042	61	0	0	0	1,424	12,459	2,966	2,198	164	76	30	0	0	20,420
Costa Rica	129	0	26	1,704	2,963	2,008	3,139	3,596	3,817	763	30	3	0	0	18,178
Nicaragua	2,692	1,700	1,939	2,130	720	770	865	362	355	73	2,859	103	96	547	15,211
Panama	1,021	2,448	2,323	1,821	674	655	684	32	0	192	0	0	1	1	9,852
HS 0206															
World	238,074	233,107	226,903	246,647	295,706	306,111	350,227	394,159	318,512	376,697	428,293	434,338	451,158	502,978	4,802,910
United States	190,098	186,279	191,133	185,193	246,587	260,032	301,240	343,469	278,870	325,083	373,611	373,410	385,196	412,082	4,052,283
Canada	34,690	35,488	27,053	51,318	40,100	34,805	38,123	41,535	35,321	47,706	49,721	54,587	57,388	79,629	627,464
Australia	5,748	3,672	4,231	4,326	3,364	3,719	3,518	3,306	2,060	1,585	2,054	3,032	4,212	4,989	49,816
Denmark	3,409	3,252	1,465	1,902	1,088	2,607	3,250	1,441	1,374	1,664	475	1,042	959	747	565
Chile	1,185	1,422	561	899	1,720	1,441	1,374	1,664	643	667	1,246	1,918	3,461	4,576	22,777
New Zealand	1,744	1,095	1,455	1,930	867	831	481	399	157	248	376	467	238	206	10,494
Domestic Consumption:															
1000 MT CWE	2,353	2,218	2,319	2,177	2,028	1,894	1,961	2,033	1,976	1,938	1,921	1,836	1,873	1,839	28,366

Table 13: Canada Beef Imports 2001-2014 Unit: US Dollar Thousand, Domestic Consumption

Exporters	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	Total
HS 0201															
World	244,057	249,795	275,979	85,812	138,843	335,451	473,446	547,988	491,749	555,340	807,690	937,321	933,370	774,243	6,851,084
United States	192,717	193,148	221,809	48,940	114,385	307,711	446,763	528,380	476,491	541,055	795,708	924,883	923,049	752,452	6,467,491
Australia	34,486	45,397	30,437	16,355	6,948	11,915	12,075	13,626	8,529	6,533	9,730	8,977	7,270	13,872	226,150
New Zealand	15,576	11,250	15,018	8,228	7,311	8,495	6,140	3,875	5,562	5,875	2,095	3,289	2,172	2,407	97,293
Uruguay	259	0	8,715	12,200	10,154	7,330	8,356	1,847	980	1,786	158	0	333	0	52,118
HS 0202															
World	252,131	252,353	229,119	141,864	157,337	120,339	182,599	137,046	170,164	167,156	198,260	229,736	207,527	320,491	2,766,122
New Zealand	92,584	93,372	84,656	70,245	78,208	66,235	71,873	64,401	83,338	70,831	96,155	86,545	58,866	66,999	1,084,308
Australia	80,465	140,698	61,683	15,856	21,249	23,285	30,345	26,328	29,164	24,850	29,773	55,391	65,910	136,418	741,415
Uruguay	53,512	98	62,701	50,833	44,636	14,149	59,777	12,210	31,126	32,299	24,164	45,585	48,986	77,916	557,992
United States	19,141	18,134	20,032	4,797	13,139	16,669	20,541	34,107	26,524	39,176	48,169	42,215	33,490	38,263	374,397
HS 0206															
World	21,557	23,035	31,075	35,665	34,766	37,040	29,052	32,393	31,815	38,005	48,168	50,106	41,833	38,985	493,495
United States	20,558	22,240	29,759	34,000	33,682	35,985	26,489	30,363	29,053	36,324	47,020	47,917	40,017	35,526	468,933
Australia	155	396	181	404	412	399	768	541	562	568	795	1,777	1,252	1,444	9,654
Denmark	43	195	757	983	297	331	1,364	398	27	0	0	0	0	0	4,395
New Zealand	203	204	322	278	283	219	413	46	255	318	341	395	532	459	4,268
Chile	0	0	0	0	92	85	18	1,045	1,853	740	0	0	0	0	3,833
Domestic Consumption:															
1000 MT CWE	966	981	1,079	1,027	1,026	1,023	1,067	1,051	1,003	1,003	996	1,019	1,024	999	14,264

Table 14: Japan Beef Imports 2001-2014 Unit: US Dollar Thousand, Domestic Consumption

Exporters	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	Total
HS 0201															
World	1,480,700	991,148	1,353,605	1,179,339	1,322,016	1,267,031	1,281,292	1,247,633	1,157,259	1,284,504	1,454,363	1,514,617	1,454,515	1,596,675	18,584,697
Real Values	1,440,802	979,628	1,361,214	1,202,228	1,364,749	1,322,821	1,350,278	1,331,655	1,241,405	1,408,386	1,624,704	1,707,919	1,649,191	1,596,675	19,581,653
Australia	678,262	507,811	674,912	1,148,979	1,269,973	1,168,097	1,104,825	979,830	885,790	912,772	934,119	881,835	751,147	845,802	12,744,154
United States	753,834	452,318	650,613	0	442	33,238	110,748	204,174	212,961	291,176	436,455	541,994	623,861	669,015	4,980,829
New Zealand	17,639	13,281	16,158	25,382	31,733	36,650	40,280	40,574	37,000	47,237	54,303	62,055	52,680	44,415	519,387
Mexico	0	9	0	4,978	19,703	17,409	12,235	10,131	6,366	7,236	8,096	10,844	15,193	22,871	135,071
Canada	30,775	17,566	11,921	0	68	11,598	13,137	12,876	15,143	26,083	21,390	17,884	10,102	13,171	201,714
HS 0202															
World	817,376	524,814	782,864	650,319	683,500	675,028	766,944	894,874	838,768	1,003,639	1,190,043	1,245,439	1,274,573	1,295,543	12,643,724
Real Values	795,351	518,714	787,265	662,941	705,594	704,751	808,237	955,139	899,756	1,100,433	1,329,425	1,404,387	1,445,165	1,295,543	13,412,701
Australia	256,793	171,487	274,007	532,562	530,899	529,983	561,744	655,510	543,611	638,270	748,730	712,172	634,729	629,059	7,419,556
United States	490,537	303,621	458,196	5,234	0	10,848	76,099	98,528	157,327	196,466	249,078	298,172	423,778	483,428	3,251,312
New Zealand	29,530	19,826	37,020	99,900	113,227	110,352	95,284	90,519	73,374	91,311	98,922	105,011	103,532	92,311	1,160,119
Mexico	11	40	2	7,682	25,467	17,655	23,460	34,632	37,546	43,676	64,035	86,421	67,905	38,098	446,630
Canada	39,237	29,057	12,350	0	0	1,670	5,293	11,678	25,786	32,455	26,649	40,821	42,050	49,591	316,637
Chile	0	19	4	3,515	11,236	1,956	2,067	777	315	152	250	705	297	559	21,852
Vanuatu	1,203	718	1,284	1,264	1,546	1,626	1,436	2,411	809	1,279	1,399	1,602	1,172	1,265	19,014
HS 0206															
World	724,287	349,177	549,033	271,597	417,008	288,277	350,155	391,222	333,668	374,082	458,617	499,600	587,557	651,764	6,246,044
Real Values	704,771	345,119	552,119	276,868	430,487	300,970	369,008	417,569	357,929	410,160	512,332	563,361	666,197	651,764	6,558,654
United States	581,918	290,263	481,118	13,639	16,350	25,272	81,454	110,333	125,403	155,248	204,676	242,698	356,516	414,453	3,099,341
Australia	68,263	22,957	46,009	185,731	278,844	181,525	184,147	183,770	138,197	141,599	163,172	165,480	148,575	148,760	2,057,029
Canada	48,334	25,573	10,130	4,268	6,604	9,671	13,803	18,834	23,043	24,370	28,176	27,750	30,115	33,039	303,710
New Zealand	19,470	4,254	10,174	51,115	78,496	41,489	39,472	42,986	25,167	28,097	34,184	30,769	26,992	29,555	462,220
Mexico	121	1,497	0	5,066	12,834	15,499	15,700	19,036	13,355	14,675	16,739	19,550	14,812	12,698	161,582
Chile	2,240	1,321	1,043	7,485	15,442	9,916	8,262	8,884	5,059	5,146	5,544	5,123	3,658	3,222	82,345
Netherlands	0	0	0	105	219	260	420	307	310	774	1,138	1,492	2,183	3,184	10,392
Spain	0	0	0	52	71	254	298	242	366	587	1,001	2,463	2,128	2,831	10,293
Nicaragua	443	36	2	1,207	2,429	1,084	1,660	1,733	1,052	1,658	2,477	2,304	1,220	1,336	18,641
Domestic Consumption:															
1000 MT CWE	1,399	1,304	1,348	1,169	1,188	1,159	1,182	1,173	1,211	1,225	1,237	1,255	1,232	1,226	17,308

Table 15: South Korea Beef Imports 2001-2014 Unit: US Dollar Thousand, Domestic Consumption

Exporters	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	Total
HS 0201															
World	24,435	61,726	119,969	78,092	136,299	198,802	248,421	233,435	182,064	271,703	361,964	316,629	329,708	401,755	2,965,002
Australia	7,196	22,457	32,588	74,323	131,138	191,675	225,650	216,140	152,084	215,308	285,981	251,510	251,533	286,963	2,344,546
United States	16,885	38,627	85,224	823	0	0	13,955	8,085	27,246	51,543	73,887	64,256	76,938	111,527	568,996
New Zealand	38	0	611	2,945	4,740	7,053	8,816	9,208	2,731	4,740	1,870	833	424	1,233	45,242
HS 0202															
World	462,858	786,444	951,359	466,178	533,720	593,669	690,979	726,557	615,042	808,700	1,160,036	943,477	1,065,976	1,271,560	11,076,555
Australia	115,076	162,966	142,559	241,612	357,668	432,628	457,380	395,038	287,345	356,034	483,649	424,136	506,432	560,102	4,922,625
United States	303,237	552,970	728,182	94,333	3,713	0	80,069	185,530	246,032	343,482	525,238	407,478	452,027	594,844	4,517,135
New Zealand	21,607	0	64,689	127,799	162,278	143,515	138,252	131,522	77,425	101,931	134,922	98,467	95,584	100,451	1,398,442
Mexico	0	0	0	1,976	9,998	17,510	15,278	14,467	4,240	7,252	16,226	7,315	667	515	95,444
Canada	19,553	32,006	15,858	147	0	0	0	0	0	0	0	6,081	8,933	11,117	93,695
Saudi Arabia	0	38,361	0	0	0	0	0	0	0	0	0	0	0	0	38,361
HS 0206															
World	71,120	102,719	107,699	62,914	79,688	106,604	116,899	111,079	79,437	133,704	216,201	189,289	196,357	225,794	1,799,504
Australia	17,168	24,630	22,133	39,448	51,417	69,935	78,920	68,718	42,894	62,720	79,811	77,740	78,034	95,292	808,860
United States	43,162	66,082	74,054	9,623	3,730	4,440	6,218	11,041	19,286	37,311	86,457	73,919	70,665	86,266	592,254
New Zealand	2,866	0	6,461	8,180	11,697	12,845	14,190	14,943	8,462	13,743	19,224	18,949	17,646	17,388	166,594
Canada	6,366	5,835	3,690	1,163	1,851	2,097	2,114	3,364	2,993	5,126	5,371	4,082	4,134	1,747	49,933
Spain	0	0	0	155	1,212	2,260	2,221	1,553	671	4,178	5,166	1,762	11,112	13,832	44,122
France	19	0	1	256	1,907	2,879	3,548	4,234	2,320	4,198	4,649	2,212	1,849	2,395	30,467
Mexico	0	0	0	235	1,763	4,095	4,064	3,715	1,485	2,334	2,913	1,875	829	926	24,234
Poland	38	212	157	378	472	1,277	1,622	1,122	66	217	1,349	1,010	4,382	1,135	13,437
Germany	0	0	7	36	0	18	0	0	0	755	4,025	3,945	2,637	1,374	12,797
Denmark	221	620	894	2,498	1,961	3,361	1,256	123	0	0	76	8	9	0	11,027
Chile	0	51	91	100	1,169	1,057	1,474	958	748	858	1,371	918	1,031	853	10,679
Domestic Consumption:															
1000 MT CWE	528	619	618	470	443	496	522	536	546	609	677	683	713	745	8,205

Table 16: Taiwan Beef Imports 2001-2014 Unit: US Dollar Thousand, Domestic Consumption

Exporters	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	Total
HS 0201															
World	28,251	27,649	39,674	39,011	56,688	50,491	66,385	80,821	72,544	106,840	135,710	113,001	171,180	211,130	1,199,375
United States	17,180	17,208	23,063	533	21,383	29,154	44,827	62,366	56,352	84,337	62,173	36,754	120,740	146,890	722,960
Australia	5,975	5,048	5,179	17,332	20,504	12,165	11,403	11,459	11,144	15,475	61,731	64,858	38,334	42,437	323,044
New Zealand	4,378	4,657	10,896	21,125	14,796	9,164	10,039	6,730	5,043	6,490	10,679	10,012	11,210	15,428	140,647
HS 0202															
World	143,996	167,572	208,006	182,488	230,194	266,583	249,222	275,979	269,946	357,327	408,969	378,508	440,871	479,360	4,059,021
Australia	65,593	79,054	82,907	81,980	100,087	98,783	98,219	101,562	101,814	120,153	149,110	161,676	171,143	184,014	1,596,095
New Zealand	36,910	39,317	61,771	94,612	102,865	85,583	82,408	81,642	68,785	78,091	100,892	104,151	96,509	105,422	1,138,958
United States	31,047	36,391	54,730	2,595	20,351	71,775	58,360	74,534	80,987	132,951	131,242	84,957	144,954	147,394	1,072,268
Nicaragua	0	0	24	1,150	2,866	4,225	4,213	5,903	3,893	7,000	11,662	13,402	13,948	21,835	90,121
Canada	10,304	11,896	7,693	0	0	0	1,362	6,926	10,017	10,712	6,393	1,522	2,637	5,794	75,256
Panama	143	870	880	2,151	4,024	4,999	2,961	3,402	2,696	5,390	7,619	11,363	9,073	9,546	65,117
HS 0206															
World	6,495	11,435	20,774	30,944	27,663	21,858	25,407	37,645	36,698	38,086	46,157	52,908	45,353	64,841	466,264
Netherlands	0	0	0	1,115	1,010	364	1,212	1,762	1,303	2,536	4,633	12,696	7,525	13,082	47,238
United States	3,776	6,076	10,834	13,699	10,554	9,973	7,462	13,155	18,255	14,400	16,380	15,671	11,245	12,666	164,146
Australia	1,104	1,911	3,212	3,499	4,936	2,601	4,547	4,792	4,301	4,334	6,513	7,271	10,130	12,447	71,598
Canada	474	1,700	3,854	7,229	6,210	5,729	7,781	10,353	8,533	9,991	10,101	8,734	7,376	11,149	99,214
New Zealand	605	1,009	1,211	1,796	2,892	1,429	1,696	2,089	1,211	1,469	2,072	1,867	1,745	4,197	25,288
Nicaragua	0	0	21	66	339	326	419	1,132	618	1,316	1,563	1,905	2,329	3,112	13,146
Denmark	506	650	787	1,838	1,115	746	592	901	513	1,595	1,967	1,879	1,267	3,097	17,453
Hungary	0	3	585	1,125	342	86	203	1,231	140	949	1,309	1,533	1,322	2,286	11,114
Domestic Consumption:															
1000 MT CWE	85	96	107	87	101	110	107	109	118	136	135	121	136	144	1,592

Table 17: Hong Kong Beef Imports 2001-2014 Unit: US Dollar Thousand, Domestic Consumption

Exporters	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	Total
HS 0201															
World	17,710	19,984	21,985	25,819	32,930	39,440	47,741	49,993	55,076	66,940	79,685	88,364	94,565	107,095	747,327
Australia	7,085	7,957	7,388	17,459	19,745	18,981	22,951	21,943	25,679	28,040	33,385	35,444	37,036	40,557	323,650
United States	4,965	6,335	9,140	168	0	8,578	9,663	11,970	12,291	15,741	21,929	27,941	32,182	35,291	196,194
New Zealand	4,225	3,896	4,471	5,648	5,694	5,592	5,787	5,864	4,685	4,733	5,735	5,201	5,461	5,424	72,416
Japan	388	0	0	0	0	0	1,382	5,302	7,347	8,956	10,059	10,821	10,766	13,498	68,519
Canada	392	468	237	314	5,137	3,328	2,701	1,490	2,138	2,373	4,057	4,004	3,322	3,364	33,325
Brazil	101	186	311	435	407	1,875	3,320	2,266	1,397	5,748	2,266	3,082	4,015	3,670	29,079
HS 0202															
World	114,735	115,962	140,398	106,796	117,324	137,714	178,245	307,702	419,892	457,364	535,202	692,949	1,537,887	2,059,416	6,921,586
Brazil	26,238	23,257	31,304	48,546	46,806	61,207	78,654	158,243	210,165	179,853	176,434	290,974	680,914	909,716	2,922,311
United States	41,409	51,984	70,057	4,048	0	6,856	24,589	38,454	70,743	101,472	161,823	222,404	646,413	867,087	2,307,339
Canada	2,212	1,803	667	6,871	32,507	28,276	25,340	29,617	27,356	59,061	64,606	57,832	113,646	116,454	566,248
China	18,158	11,806	11,746	17,741	15,954	17,988	25,889	34,113	30,252	33,441	45,795	29,700	8,194	2,633	303,410
New Zealand	11,748	12,010	12,049	10,893	7,664	9,171	11,594	17,125	21,082	21,705	23,906	26,042	20,698	24,294	229,981
Australia	5,415	5,236	3,773	4,889	3,827	5,399	4,830	5,474	14,348	23,578	30,953	25,050	22,686	58,961	214,419
Argentina	3,305	4,281	7,821	10,977	8,236	5,414	4,989	12,846	24,714	16,428	9,734	11,440	15,851	12,390	148,426
HS 0206															
World	254,623	237,991	299,245	285,087	298,137	393,595	662,424	1,317,523	1,461,013	1,379,913	1,561,503	1,375,690	1,701,926	2,117,980	13,346,650
Brazil	50,050	52,400	77,305	90,352	107,940	154,134	247,585	371,905	469,926	426,718	499,074	501,434	692,343	759,432	4,500,598
United States	55,966	56,356	67,503	31,601	18,538	37,391	69,946	250,932	236,315	209,059	167,670	135,251	162,440	284,671	1,783,639
Germany	20,879	19,856	27,721	22,058	26,767	31,480	79,225	168,087	166,233	168,338	214,827	177,006	159,098	223,924	1,505,499
Netherlands	21,244	18,210	17,928	26,041	33,793	35,103	51,808	99,770	93,831	101,133	127,406	118,895	143,998	144,133	1,033,293
Argentina	16,577	13,933	21,435	27,721	26,985	28,083	45,593	69,240	98,885	75,150	88,958	83,929	110,930	111,568	818,987
Australia	11,291	8,669	9,721	5,951	13,123	20,631	28,769	37,681	65,365	52,877	80,787	71,829	100,561	123,870	631,125
Canada	20,526	15,897	19,960	14,603	5,396	10,938	25,068	85,112	84,507	86,391	52,464	30,873	34,465	46,002	532,202
Domestic Consumption:															
1000 MT CWE	85	85	92	93	102	103	102	127	163	163	161	249	481	654	2,660

Table 18: Vietnam Beef Imports 2001-2014 Unit: US Dollar Thousand, Domestic Consumption

Exporters	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	Total
HS 0201															
World	453	721	936	1,146	1,434	2,133	2,628	3,104	3,122	5,023	4,703	5,178	6,638	7,942	45,161
Australia	190	517	528	719	785	1,223	1,736	2,185	2,591	3,169	3,514	3,806	4,959	5,996	31,918
New Zealand	168	135	248	328	213	230	543	606	373	765	924	971	1,171	902	7,577
United States	52	62	74	7	112	246	115	94	128	122	206	301	483	836	2,838
India	0	0	0	0	16	0	0	66	0	936	47	47	0	0	1,112
Argentina	0	0	56	86	284	150	220	78	0	0	0	0	0	0	874
Netherlands	7	7	29	0	0	216	0	0	0	0	0	0	0	0	259
Japan	27	0	1	5	0	0	0	16	0	0	0	0	0	201	250
HS 0202															
World	213	709	593	1,365	1,745	3,364	8,881	25,381	17,337	20,061	30,340	43,741	51,901	84,599	290,230
India	0	0	0	34	416	1,304	4,651	18,327	13,638	13,654	20,603	26,187	29,872	54,866	183,552
United States	32	207	203	0	236	346	1,639	2,214	1,180	2,583	4,111	7,417	12,040	16,263	48,471
Australia	140	429	319	674	397	912	1,306	1,852	1,677	2,938	4,616	9,310	8,614	11,469	44,653
New Zealand	2	73	71	111	210	368	348	1,075	171	369	477	661	973	1,443	6,352
Argentina	0	0	0	254	386	400	683	591	255	193	0	82	34	140	3,018
HS 0206															
World	58	833	399	202	34	244	1,486	6,256	2,476	1,109	1,422	4,058	11,172	15,119	44,868
India	0	541	301	31	8	0	0	0	136	78	313	2,538	9,269	7,351	20,566
United States	0	0	0	0	0	27	256	2,710	1,103	659	475	660	731	330	6,951
Australia	25	0	1	14	17	66	171	757	438	180	263	425	854	3,204	6,415
Spain	0	0	0	0	0	0	0	62	0	0	57	77	175	2,029	2,400
Canada	0	0	0	0	0	0	0	1,502	503	81	58	32	34	141	2,351
Germany	0	140	0	0	8	35	752	357	0	0	0	0	0	254	1,546
France	0	9	0	0	0	0	25	144	0	0	239	260	0	558	1,235
Domestic Consumption:															
1000 MT CWE	81	86	89	98	112	125	156	175	189	206	217	223	220	223	2,200

Table 19: Egypt Beef Imports 2001-2014 Unit: US Dollar Thousand, Domestic Consumption

Exporters	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	Total
HS 0201															
World	0	8	260	402	0	66	0	503	349	23,725	5,360	2,147	79	2,989	35,888
Australia	0	0	0	0	0	0	0	90	40	23,120	1,698	250	50	147	25,395
Sudan	0	0	0	0	0	0	0	0	0	0	0	1,311	0	2,028	3,339
Denmark	0	0	0	0	0	0	0	0	0	95	2,672	434	0	0	3,201
Brazil	0	0	83	402	0	0	0	329	0	204	0	115	0	0	1,133
India	0	3	0	0	0	0	0	0	0	0	0	0	0	757	760
Netherlands	0	0	0	0	0	0	0	0	0	0	497	0	0	0	497
Germany	0	0	0	0	0	0	0	0	3	151	241	0	9	0	404
United Kingdom	0	0	177	0	0	0	0	0	1	89	0	0	0	0	267
United States	0	0	0	0	0	0	0	0	0	66	146	0	20	0	232
HS 0202															
World	126,927	189,760	149,422	180,206	277,048	409,546	490,267	483,252	407,488	706,225	657,736	911,096	834,748	1,196,322	7,020,043
Brazil	61,532	81,694	131,604	163,298	248,407	368,094	379,110	156,053	171,346	362,724	348,349	543,633	483,925	592,953	4,092,722
India	43,929	53,836	58	44	476	11,423	86,537	272,750	193,778	280,830	244,271	276,208	313,257	531,158	2,308,555
United States	49	1,124	1,829	12	656	1,455	2,701	3,393	4,630	18,917	36,436	62,642	18,743	43,104	195,691
Argentina	487	38,542	13,939	13,901	20,527	24,395	13,101	1,472	12,102	4,257	761	0	716	97	144,297
Australia	767	1,159	89	306	432	486	1,513	3,778	3,185	15,795	7,126	12,007	10,117	14,433	71,193
New Zealand	1,764	333	320	309	0	170	584	174	1,166	4,560	5,036	7,012	4,758	6,686	32,872
China	12,588	1,826	0	45	0	369	1,303	5,498	1,811	1,665	1,238	0	738	0	27,081
Uruguay	381	5,808	660	202	1,756	71	964	109	2,111	3,589	431	0	0	0	16,082
Paraguay	0	1,182	0	0	338	209	783	736	9,556	1,118	0	0	0	200	14,122
Colombia	0	0	0	0	0	0	0	0	0	0	7,979	4,169	0	0	12,148
HS 0206															
World	30,248	34,277	35,509	16,791	38,803	67,085	70,722	92,840	88,346	100,256	188,578	202,323	224,323	255,981	1,446,082
United States	30,038	34,169	35,491	3,376	26,246	55,501	63,737	74,390	72,970	87,594	167,332	185,301	203,880	218,629	1,258,654
Brazil	15	0	0	6,730	5,446	10,550	6,073	9,705	7,881	5,174	6,349	5,184	11,472	17,635	92,214
Australia	27	0	0	219	188	0	1	60	639	2,381	8,247	6,202	4,240	10,593	32,797
Canada	0	0	0	0	0	0	81	116	0	2,575	5,194	4,514	4,001	1,478	17,959
Argentina	0	0	0	5,832	6,011	685	183	434	93	0	0	0	0	0	13,238
India	0	42	0	0	29	0	364	2,038	1,105	0	0	0	39	2,032	5,649
Netherlands	58	0	0	0	0	0	0	0	555	0	15	16	176	2,824	3,644
New Zealand	110	16	0	0	0	36	14	20	0	0	1,410	359	374	431	2,770
Germany	0	0	0	0	0	0	0	233	1,108	90	0	0	0	1,220	2,651
Japan	0	0	0	0	0	0	0	519	667	0	0	0	0	917	2,103
China	0	0	0	0	0	266	0	1,087	260	139	0	0	0	0	1,752
Domestic Consumption:															
1000 MT CWE	584	621	568	629	722	757	658	516	535	605	529	530	480	580	8,314

Table 20: Russia Beef Imports 2001-2014 Unit: US Dollar Thousand, Domestic Consumption

Exporters	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	Total
HS 0201															
World	45,126	49,314	13,651	30,299	40,233	65,272	70,948	88,206	59,138	98,038	188,780	311,595	421,611	472,674	1,954,885
Real Values	214,869	203,312	49,464	91,275	101,589	143,103	136,680	144,055	94,694	137,478	228,380	350,868	451,942	472,674	2,820,385
Belarus	0	0	0	0	0	0	0	0	0	0	0	89,925	207,672	329,873	627,470
Lithuania	0	31	14	3,106	12,269	27,088	38,738	45,958	32,070	41,975	73,496	69,824	37,029	25,499	407,097
Germany	37,077	45,196	12,523	23,026	18,431	32,117	24,226	27,422	15,207	25,194	32,422	14,288	618	0	307,747
Ukraine	0	710	139	375	0	0	831	0	150	664	22,026	41,125	46,079	22,839	134,938
Australia	47	103	111	177	811	1,962	3,823	8,859	9,658	14,543	14,180	18,435	41,869	9,034	123,612
Brazil	0	0	34	892	1,254	7	34	292	80	305	2,188	13,909	40,966	29,136	89,097
Poland	65	787	53	522	3,687	0	0	1,026	82	6,223	13,096	23,454	16,995	7,027	73,017
United States	15	51	72	0	0	0	0	2,889	1,524	6,285	13,376	16,953	424	171	41,760
HS 0202															
World	475,980	542,347	606,994	657,600	912,837	1,531,801	1,698,441	2,574,168	2,255,386	2,072,228	2,234,780	2,645,002	2,452,515	2,249,478	22,909,557
Real Values	2,266,400	2,235,989	2,199,432	1,981,012	2,304,920	3,358,346	3,272,009	4,204,043	3,611,418	2,905,879	2,703,568	2,978,378	2,628,954	2,249,478	38,899,827
Brazil	1,789	29,547	99,148	170,602	375,278	588,326	1,074,613	1,344,512	1,205,627	974,586	936,106	1,099,164	1,325,976	1,305,249	10,530,523
Paraguay	2,458	4,337	2,091	23,896	66,237	217,523	156,934	269,706	165,419	211,803	184,204	548,593	616,988	557,354	3,027,543
Argentina	1,366	0	24,485	103,357	235,029	349,157	259,623	212,866	484,206	114,665	56,238	37,001	61,965	92,854	2,032,812
Uruguay	0	12,726	7,340	409	4,899	183,702	50,291	262,920	234,118	256,651	290,384	279,027	148,170	90,419	1,821,056
Ukraine	152,530	185,719	212,062	162,698	140,643	5,711	92,934	62,108	59,438	43,568	34,847	26,189	22,722	22,907	1,224,076
Australia	3,666	4,204	1,676	948	1,246	31,685	8,219	227,289	60,433	149,032	241,051	124,265	88,535	7,462	949,711
Germany	161,264	75,162	50,479	35,202	23,860	39,370	14,428	23,842	6,332	55,792	39,978	15,436	6,902	18,790	566,837
United States	1,512	2,300	1,227	117	0	0	0	71,915	11,841	85,684	164,661	220,674	274	203	560,408
HS 0206															
World	85,469	113,152	120,559	119,753	206,395	295,460	329,472	421,996	412,019	414,751	440,031	462,926	361,124	266,494	4,049,601
Real Values	406,964	466,503	436,843	360,754	521,149	647,771	634,720	689,189	659,742	581,604	532,336	521,273	387,104	266,494	7,112,449
Germany	10,081	12,838	13,981	28,269	44,813	48,389	47,975	85,201	94,561	85,703	74,014	60,004	35,149	23,051	664,029
Argentina	126	135	400	644	2,417	31,536	40,941	44,449	70,080	50,637	54,425	73,177	83,732	94,922	547,621
United States	31,294	48,581	47,083	5,352	12,732	16,975	28,940	74,415	73,050	63,105	50,074	62,435	1,151	3,393	518,580
Russia Domestic Consumption: 1000 MT CWE	2,244	2,394	2,436	2,422	2,563	2,475	2,537	2,706	2,505	2,488	2,346	2,398	2,393	2,289	34,196

Table 21: China Beef Imports 2001-2014 Unit: US Dollar Thousand, Domestic Consumption

Exporters	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	Total
HS 0201															
World	677	766	1,059	2,836	3,086	3,727	6,320	8,082	7,540	6,784	9,051	11,442	67,341	20,923	149,634
Australia	594	644	943	2,817	3,075	3,682	6,290	7,979	7,340	6,621	9,051	11,239	63,272	20,923	144,470
New Zealand	3	0	0	0	1	0	15	1	12	40	0	12	3,826	0	3,910
United States	77	122	116	19	0	0	0	22	0	0	0	0	0	0	356
HS 0202															
World	5,165	11,910	10,873	7,177	5,683	4,723	7,844	9,946	36,507	77,438	86,078	243,218	1,202,804	1,269,036	2,978,402
Australia	2,580	2,851	3,767	5,685	5,498	4,495	4,967	6,414	14,410	24,573	41,233	118,627	657,870	617,834	1,510,804
Uruguay	0	0	0	8	174	167	2,115	3,188	12,981	21,149	26,974	49,416	268,234	308,509	692,915
New Zealand	147	202	135	878	10	60	268	278	6,811	6,479	9,844	26,065	152,904	190,623	394,704
Canada	14	174	74	0	0	0	0	0	0	0	1	10,927	80,217	59,413	150,820
Argentina	0	0	0	0	0	1	0	0	0	79	0	927	42,726	83,791	127,524
Brazil	0	49	573	558	0	0	495	66	2,304	25,158	8,027	37,256	0	0	74,486
United States	2,382	8,633	6,324	48	0	0	0	0	0	0	0	0	0	0	17,387
Costa Rica	0	0	0	0	0	0	0	0	0	0	0	0	854	8,865	9,719
Japan	41	0	0	0	0	0	0	0	0	0	0	0	0	0	41
HS 0206															
World	85,734	78,091	154,013	214,755	159,624	143,272	355,287	567,792	395,388	804,690	1,292,439	1,483,915	1,583,448	1,481,678	8,800,126
United States	38,751	55,015	95,318	96,687	63,850	46,766	81,181	126,667	58,418	205,321	800,333	744,387	522,485	526,478	3,461,657
Denmark	12,122	4,405	25,656	45,141	37,639	11,854	65,688	189,355	157,354	293,066	197,721	262,600	275,960	234,258	1,812,819
Canada	12,765	13,424	26,747	40,768	24,525	18,086	26,674	48,728	94,763	176,281	107,250	135,903	157,639	104,604	988,157
France	2,161	670	0	0	19,287	56,218	164,046	181,280	54,189	46,326	64,673	72,953	105,358	94,178	861,339
Germany	0	0	0	144	127	439	1,557	38	145	19,722	37,361	95,081	199,595	167,860	522,069
Spain	0	0	0	0	0	15	42	0	19,181	28,577	45,107	65,682	95,581	124,996	379,181
Australia	7,119	2,094	3,365	16,719	4,558	4,942	5,440	6,002	6,951	9,458	12,030	17,013	33,712	22,739	152,142
Uruguay	122	0	0	4,887	2,389	1,158	5,288	743	1,941	4,254	6,749	11,360	29,869	37,000	105,760
Ireland	525	9	0	0	238	331	1,960	11,660	0	11,355	12,231	20,810	21,917	23,875	104,911
Domestic Consumption:															
1000 MT CWE	5,052	5,214	5,415	5,566	5,614	5,692	6,065	6,080	6,340	6,520	6,449	6,680	7,052	7,297	85,036

Table 22: U.S. HS 0201 Exports and Market Share. Unit: U.S. Dollar Thousand Region: NAFTA

Importers	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	Total
Mexico	20,009	14,577	17,858	2,868	5,183	12,317	11,768	24,728	15,930	14,236	19,238	22,460	19,693	28,769	229,634
US Market Share	33.8	26.3	33.8	5.8	9.6	29.1	23.3	55.5	50.9	59.3	67.1	74.6	65.9	68.2	
Canada	19,141	18,134	20,032	4,797	13,139	16,669	20,541	34,107	26,524	39,176	48,169	42,215	33,490	38,263	374,397
US Market Share	7.6	7.2	8.7	3.4	8.4	13.9	11.2	24.9	15.6	23.4	24.3	18.4	16.1	12	

Table 23: U.S. HS 0202 Exports and Market Share. Unit: U.S. Dollar Thousand. Region: Asia

Importers	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	Total
Japan	472,479	310,170	438,812	402	477	11,114	71,518	105,689	158,870	192,680	286,649	319,738	466,153	566,886	3,401,637
US Market Share	60	57.9	58.5	0.8	0	1.6	9.9	11	18.8	19.6	20.9	23.9	33.2	37.3	
South Korea	333,035	551,093	617,819	664	0	160	99,778	269,246	171,871	453,364	581,086	474,793	479,816	700,314	4,733,039
US Market Share	65.5	70.3	76.5	20.2	0.7	0	11.6	25.5	40	42.5	45.3	43.2	42.4	46.8	
Hong Kong	38,031	48,689	57,250	51	21	6,448	25,237	29,429	67,338	139,472	189,865	289,012	722,195	1,026,652	2,639,690
US Market Share	36.1	44.8	49.9	3.8	0	5	13.8	12.5	16.8	22.2	30.2	32.1	42	42.1	
Taiwan	27,056	32,257	43,542	23	12,391	65,509	54,740	67,698	94,772	134,012	132,891	88,337	136,398	159,403	1,049,029
US Market Share	21.6	21.7	26.3	1.4	8.8	26.9	23.4	27	30	37.2	32.1	22.4	32.9	30.7	

Table 24: U.S. HS 0202 Exports and Market Share: Unit: U.S. Dollar Thousand. Region: Potential Future Markets

Importers	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	Total
Russia	4,904	12,649	6,936	12	473	0	17	50,357	13,198	92,625	185,358	217,110	0	0	583,639
US Market Share	0.3	0.4	0.2	0	0	0	0	2.8	0.5	4.1	7.4	8.3	0	0	
China	8,440	7,501	8,390	28	3	51	500	626	251	942	0	0	0	0	26,732
US Market Share	46.1	72.5	58.2	0.7	0	0	0	0	0	0	0	0	0	0	
Vietnam	73	157	126	9	3,604	4,713	26,718	116,911	136,641	117,278	177,331	153,223	25,464	21,737	783,985
US Market Share	15	29.2	34.2	0	13.5	10.3	18.5	8.7	6.8	12.9	13.5	17	23.2	19.2	
Egypt	2,857	7,013	7,037	13	544	481	530	4,026	23,498	78,396	94,136	79,578	37,023	5,789	340,921
US Market Share	0	0.6	1.2	0	0.2	0.4	0.6	0.7	1.1	2.7	5.5	6.9	2.2	3.6	