Political Influence and the Implications of the US Food Safety Modernization Act for Fruit and Vegetable Trade

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by

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Abstract

A major initiative in the US food and agriculture sector is the Food Safety Modernization Act (FSMA) of 2011. First, it empowers the Food and Drug Administration (FDA) to embark on a preventive approach to food safety by requiring food firms to adapt traceability and HACCP systems along their supply chains. Secondly, the FDA is required to maintain strict border measures to ensure that unsafe foods of international origin are not allowed into domestic supply chains. Fruit and vegetables remains a key target under the law. As a result, fruit and vegetable import refusals are anticipated to increase. An area of contention, however, comes from the political-economy perspective where many think that the regulation has a disguised motive of providing economic protection. For example, the law exempts small scale producers in the US while no studies suggest they have been better at preventing foodborne illnesses; and the law comes at a time when the US fruit and vegetable industry faces increasing foreign competition while unemployment remained consistently high across almost all sectors of the US economy. In view of this, the potential exists for a politically motivated regulation to have far fetching implications on countries most dependent on the US market such as Mexico, Canada and China. Hence, the study seeks to establish whether a cause-and-effect relationship between political influence and import refusals exists in order to provide insights into the validity of the claim. Other objectives include assessing the trend in *Salmonella* foodborne disease incidence (reported by FDA as the single most challenging to US food supply chain) as a justification for FSMA; assessing the conformity of FSMA to international trade agreements and; the implications of the law for relative competitiveness of domestic and foreign firms. Using US agricultural sector unemployment and antidumping activity as proxy variables for political influence, the results suggest that import refusals from Mexico and Canada rise significantly when agricultural sector unemployment rises while a rise in antidumping cases increase refusals from Mexico but not for Canada and China. It therefore recommends further studies on import refusals regarding specific products before mounting a challenge against US import refusal behavior.

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List of Abbreviations

ALERT	Number of alerts and recalls
FAOSTAT	Food and Agriculture Organization Statistics
FDA	Food and Drug Administration
FSMA	Food Safety Modernization Act
IMPCAN	Value of fruit and vegetable imported from Canada
IMPCHI	Value of fruit and vegetable imported from China
IMPMEX	Value of fruit and vegetable imported from Mexico
IPPC	International Plant Protection Convention
NAFTA	North American Free Trade Agreement
OIE	The International Office of Epizootics
RCAN	Import refusals from Canada
RCHI	Import refusals from China
RMEX	Import refusals from Mexico
SPS	Sanitary and Phytosanitary Standards Agreement
TBT	Technical Barriers to Trade Agreement
UNEMP	US Agriculture sector unemployment
WTO	World Trade Organization

Chapter 1: Introduction

1.1 Background

In the first decade of the 21st century, trade in fruit and vegetables expanded considerably relative to many other agricultural products. According to Huang (2004, p.3):

> the average value share of fruits and vegetables (including pulses and tree nuts) in global agricultural exports increased from 11.7 percent in the period 1977-81 to 15.1 percent in 1987-91 and reached an alltime high of 16.5 percent in 1997-2001.

This, in part, is due to: (1) technological innovations in transportation, communication and storage systems that allow fresh produce to be moved further in a fresh state and to be available as fresh products throughout the year (Pollack 2001); (2) increasing awareness of the nutritional advantages of fruit and vegetable consumption (Pollack 2001) and; (3) trade liberalization which opened most horticultural products to high valued markets (Gulati et al 2005). Consequently, the number of sanitary and phytosanitary (SPS) trade measures brought against fresh produce doubled to 270 over the period of 1995-2000 (FAO 2003) as consumers became more conscious about the health hazards associated with the production, processing and/or handling channels.

The US is the latest country to revise its SPS measures against fruit and vegetables as a result of high-profile foodborne disease incidence which are claimed to have undermined public confidence in the US food safety system (Carte Pate and Leavitt Partners 2010). Several cases of *E. coli* and *Salmonella* in the US have been associated with the consumption of domestic and imported foods including fruit and vegetables (Carte Pate and Leavitt Partners 2010). In 2011, for instance, *Salmonellosis* attributed to imported pawpaw from Mexico caused 97 hospitalization cases in Texas (FDA 2011a) while *E. coli* associated with strawberry farms in Oregon State reportedly led to a death (Kitzhaber 2011). At the national level, the Center for Disease Control and Prevention (CDC) estimates that about 48 million Americans suffer from foodborne health complications in a year (Scharff 2012). Unlike other foodborne incidence that are declining, *Salmonella* contaminations continue to increase with an annual infection rate of 1.2 million people (at an annual cost of US$365million) thereby posing a significant risk to US food safety (CDC 2010).

It is in response to this rising anxiety that US President Barack Obama signed into law new food legislation – the Food Safety Modernization Act (FSMA) – in January 2011. The Act expands the regulatory mandate of the US Food and Drug Administration (FDA) in an attempt to increase the efficacy of the US food safety system. According to Leavitt Partners (2011, p. 1):

> Several provisions in FSMA raise the standards for all registered facilities (domestic and foreign) and these will become an important hurdle when it comes to importing food into the U.S. Foreign facilities that produce, manufacture, hold, pack or distribute food will have to comply with registration requirements, increased U.S. FDA access to records, conducting hazard analysis and implementing preventive controls, performance standards, implementing product tracking systems and increased record keeping provisions, and implementing mitigation strategies for intentional adulteration.

The FDA must verify and certify that imported foods comply with the regulations. Food certification may also be done by any FDA accredited third party auditor (US Food Safety Modernization Act 2011, Section 307). Other provisions include allowing the FDA to grant expedited entry to importers that exhibit satisfactory compliance and, the mandate to embargo or mandatorily recall any food product it believes may have adverse health implications (US Food Safety Modernization Act 2011, Nakuja et al 2011).

The FSMA covers approximately 80 percent of all foods with the exception of meat, poultry and dairy products that are regulated separately by the US Department of Agriculture (USDA) (FDA 2011b; Nakuja et al 2011). The FSMA, however, exempts small-scale producers and processors exclusively in the US under its provisions, but does not allow them for similar foreign firms (US Food Safety Modernization Act 2011, Section 419(f)). In the US, small scale firms are interpreted as those who sell over 50 percent of their produce directly to consumers; sell within 275 mile-radius of production site and/or have an annual gross income of not more than US$500,000 (Colorado Farm Market 2011; US Food Safety Modernization Act 2011, Section 419a (4)).

The regulations have a major focus on fruit and vegetables (US Food Safety Modernization Act 2011, Section 419a (4)). This is because most fruit and vegetables are a favourable growth media for foodborne pathogens, and also because foodborne pathogens are a major hazard for US food supply chains (Ackerman 2002). While there is a widely held perception among the US public that the food safety standards in most foreign countries are lax, the US on the other hand consistently imports about 60 percent of the fresh fruit and vegetables consumed domestically (Superville and Jalonick 2011). It is for this reason that the law requires the FDA to develop safe agronomic practices that must be adopted by firms in foreign countries if they wish to continue exporting to the US (FDA 2011c).

The passage of FSMA brought forth varied questions about its likely effects on the food supply chains. Ribera and Knutson (2011) asserted that the FSMA will place substantial cost on private actors in the supply chain and consequently raise food prices. The increase in prices will likely arise from higher compliance cost which producers are expected to pass onto consumers. It is envisaged in this study that the regulations will likely increase the risk of fruit and vegetable exports by virtue of FDA's "unlimited powers" to recall products or deny an export mandate based on its definition of satisfactory compliance. Such actions could make the regulation more costly for leading exporting countries (such as Canada, Mexico and China) whose fruit and vegetable farmers depend to a considerable degree on the US market.

From the political-economy perspective, that FSMA's non-foreign small-scale businesses exemption raises questions regarding whether it was lobbied for to increase standards against foreign products in order to provide protection to the domestic industry. Academics, of course, have long raised questions as to whether food safety measures were used in nefarious ways to provide economic protection. For example, according to Menzie and Prentice (1987, p. 947):

> There are suspicions and some evidence, however, that these regulations have been used to control movements beyond the legitimate levels.

Kerr et al (1986), for example, established an inverse relationship between spot market price and Canadian beef rejections at the US border. Baylis et al (2009) have shown that import refusals rise when unemployment in a given import substitution sector is increasing. Investigating the manipulation of import refusals and food safety regulations to provide economic protection for domestic industry is the core objective of this thesis.

1.2 Problem statement

Lawley (2004) hypothesized that political decisions are largely driven by the short-term pressure of the political cycle. Hence, the recent performance of the economy may better reflect the incentive an incumbent government has to implement a policy that has direct influence on the economy. Lawley's hypothesis, therefore, suggests that government will be responsive to measures advocated by political pressure groups in times of poor economic performance than will be the case in an era of prosperity. This is because protectionist vested interests may have more resonance with voters in era of economic adversity.

Lawley (2004)'s hypothesis may well reflect the situation surrounding the FSMA and its focus on fruit and vegetables. The FSMA is anticipated to increase fruit and vegetable import refusals as a result of its perceived higher standards against foreign firms, and it is a subject for debate as to whether the FSMA is politically motivated. This is particularly contentious given that the FSMA comes at the time when the US fruit and vegetable industry is facing increasing foreign competition with net imports rising from US$2billon to approximately US$11 billion over the period of 2001 to 2010 (Johnson 2012). The law also comes at the time when unemployment is consistently high across almost all sectors of the US economy as a result of the 2008 financial crises, thereby raising expectations that politicians may be faced with considerable pressure to protect domestic industries. However, notwithstanding evidence of political motivated standards increasing import refusals for some selected products, the specific case of political influence in fruit and vegetable import refusals has not been investigated.

Secondly, complying with the new US regulations is mandatory. Hence, it presents an additional cost (i.e. compliance cost) to actors in the fruit and vegetable supply chain. While studies (e.g. Song and Cheng 2010; Markus et al 2005) suggest that higher compliance cost will decrease exports, Roberts et al (1999) argued that the effects of compliance cost on the domestic and foreign firms depends on the elasticity of demand for imports in the implementing country. As such, the effects of a regulation are localized and may not be generalizable. However, the specific analysis of the potential effect of US food regulations on the relative competitiveness of domestic and foreign firms under FSMA is yet to be studied.

Last, but not the least, the exemption of small scale producers from undertaking hazard analysis without extending the exemption to other small scale producers adds some important issues – it would appear to violate the Non-discrimination principle of the WTO. Besides, the FSMA was enacted on the grounds that foodborne disease incidence (especially *Salmonella*) was rising (FDA 2011d), yet no study verified whether it could justify the need for more stringent measures. Moreover, there appears to be no scientific evidence that small scale producers in the US have been better at preventing foodborne related incidence. Hence, the legitimacy of the exemption remains questionable under the *National Treatment* principle of the WTO and its SPS agreement as well as US commitments under NAFTA. It is also expected that once full details of the FSMA regulations become available, foreign firms supplying the US may face higher compliance cost relative to US firms. The objectives of this thesis are therefore:

1. To test for political influence in fruit and vegetable import refusals.
2. To assess the *prima facie* justification for the new regulations (i.e. FSMA).
3. To analyze the relative competitiveness of domestic and foreign firms under the FSMA.
4. To assess the conformity of the FSMA with US commitments under the WTO, NAFTA and SPS agreement.

1.3 Justification

Trade measures under the SPS and TBT sub-agreements of the WTO are deemed legitimate if there is an identifiable problem that can be addressed through a measure. This requires a clear problem to be identified and the measure put in place to be explicitly related to the problem. The assessment of the *prima facie* case for the revised regulations under the FSMA will provide a quantitative measure of the foodborne disease incidence situation in the US which was used to justify the enactment of the new regulations. Similarly, the test for political influence in fruit and vegetable import refusals provides evidence as to whether food regulations are only serving a legitimate objective or, in addition, have been providing economic protection. This information can be the basis upon which international trade challenges against US food regulations could be mounted.

The current regulations results in two major kinds of compliance groups in the market: domestic and foreign producers (the latter are expected to bear greater compliance cost), yet studies delineating the potential effects of compliance costs associated with the FSMA are limited. Determining these effects is important for shedding light on how the FSMA will affect the relative competiveness of domestic and foreign firms in the fruit and vegetable industry.

The present study seeks to review literature on the conformity of the new regulations (FSMA) to the WTO, NAFTA and SPS agreements. Since there is the propensity for governments to institute regulations that are biased against foreign firms, a review is important to shed light on any discrepancies that could form the basis for exporting countries to mount a challenge in the existing international dispute mechanisms.

1.4 Scope of the study

While there is a considerable difference between food safety standards and food safety regulations, the two are used interchangeably in this study. The study focuses on fruit and vegetables although the new regulations cover a wider range of foods. The study also employs highly aggregated national level data on import refusals as firm level data is largely absent.

The new regulations arising from the FSMA have not yet been fully developed and implemented. Hence, the analysis provides limited insights into expectations regarding how the regulations will affect the competitiveness of domestic and foreign firms. This study is by no means a complete assessment of the effects of the new regulations on firm level competiveness and the results may therefore vary depending upon the underlying assumptions. The assessment of the conformity of regulations to WTO, NAFTA and SPS agreement is based on a social science interpretation of the trade rules rather than a strict legal interpretation. Hence, the conclusions only provide the basis to justify a legal investigation.

1.5 Organization

This thesis is organized into eight chapters. Besides Chapter 1, Chapter 2 and Chapter 3 that covers the Introduction, Literature Review and Theoretical Framework respectively, the remaining part of the thesis is organized into standalone chapters each addressing an objective. Each chapter has an objective focuses on some thematic area including methodology, results, discussion and summary. Hence, Chapter 4 covers political influence in fruit and vegetable import refusals while Chapter 5 focus on empirical evidence for *prima facie* justification for new regulations. Chapter 6 zeros in on the relative competitiveness of foreign and domestic firms while Chapter 7 concentrates on the conformity of the new regulations with WTO, NAFTA and SPS agreements. Chapter 8 summarizes the general conclusions and recommendations of the study.

Chapter 2: Literature Review

2.1 Introduction

This chapter reviews literature on four thematic areas. Issues covered include historical perspectives on food safety, impacts of food safety standards on trade, foodborne disease incidence and areas where the SPS is weak that provide the basis for illegitimate protection, and the relationship between food safety standards and compliance costs.

2.2 Historical perspective of food safety

There is considerable evidence that food safety has been part of every generation's concern. In the Old Testament, God warned the people of Israel neither to touch nor eat dead animals. Anyone who did was required to wash his or her cloths to become clean (Leviticus 11: 38-39). In ancient China, - 500 B.C. – Confucius, an ethical philosopher, is reported to have warned people against the consumption of spoiled food or food that had not been properly cooked (Roberts 2001; Food-safety-and-you.com 2010). In 1795, Napoleon Bonaparte, in his ambition to extend the territory under French control in Europe, promised to reward anyone who could provide a mechanism to ensure that food supplied to his soldiers did not spoil (Ding and Wolfstetter 2011; Food-safety-and-you.com 2010). In all of these, while the intention to keep consumers safe from food hazards or make food last is by far the primary focus, making food safe and storable remains challenging.

Progress in food safety has been accelerated by the rise of science and technology. The invention of the microscope is noted to have allowed scientists view microbial organisms and further consolidated the science that maggots in rotten meat were hatched from the microscopic eggs of flies as opposed to the thoughts that they originated from lifeless animal flesh (Kusinitz 2012). Gartner's[1] path breaking experiment in the 18th century, for example, was the first scientific investigation to establish a causal relationship between microbial organisms and a foodborne disease (Food-safety-and-you.com 2010; Roberts 2001). Gartner made people consume beef from a sick cow, who subsequently became sick themselves, leading to the conclusion that the disease causing bacteria came from the diarrhoea of cows (Food-safety-and-you.com 2010; Roberts 2001). This experiment provided important insights into how foodborne disease organisms can be transmitted and their consequence for human health.

Despite the awareness that scientists had created about foodborne hazards, standards for the production, processing, handling and/or storage of foods received little attention until foodborne diseases garnered a wider national interest. Statistics had revealed that countries were losing many more people to foodborne diseases than were lost in combat. A typical example is the Spanish American War (1898) in which the US lost over a 1000 soldiers as a result of spoiled food supplied to them as opposed to 379 who died in combat (Food-safety-and-you.com 2010).

[1] Roberts (2001) referred to August Gärtner as the first scientist to isolate a foodborne disease causing organism (*Bacillus enteritidis)* from patients who had eaten a sick cow.

In response, US President Theodore Roosevelt ordered an investigation into the meat-packing industry whose recommendations provided the impetus for the government to enact the Pure Food and Drug Act and the Meat Inspection Act of 1906 (Food-safety-and-you.com 2010).

Food safety issues have heightened in recent times, which many partly attribute to globalisation. Kerr (2004) argues that globalisation has been instrumental in raising the profile of food safety because there is an increasing chance for people to become vectors of disease transmission. Such awareness, coupled with improved scientific knowledge and the role of the state in providing protection against foodborne hazards has provided the incentives for governments to establish institutions to deal more effectively with food safety issues. Examples include, the FDA of US, founded in 1930; the Federal Ministry of Food, Agriculture and Forestry of Germany, founded in 1949; Australia New Zealand Food Authority, founded in 1991; and many others. These institutions are charged with introducing sanitary methods in food production and handling. However, with trade expanding in the midst of rising food safety concerns, food safety regulations acted increasingly as trade barriers as a result of the absence of internationally harmonized safety measures and institutions to foster them. For example, the International Office of Epizootics (OIE) reports that a Rinderpest outbreak in Belgium as a result of the movement of cattle from India to Brazil through Antwerp port (in 1920) led to a complete ban in trade (OIE 2010). Incidents such as this created the need for an international platform to handle health related issues that impacted on animal trade. Consequently, the International Office of Epizootics was established in 1924 to provide governance on trade related issues pertaining to animal health.

The jurisdiction of the OIE was limited to the 24 countries in which it had been ratified (OIE 2010). A larger international organisation - the General Agreement on Tariffs and Trade (GATT) - was signed (in 1947) and ratified in 1948. GATT's main objective was to create an international negotiation platform where tariffs, which had been raised in the Great Depression of the 1930s, would be negotiated down (Gaisford and Kerr 2001).

The GATT-1947 did not have an explicit clause to deal with sanitary and phytosanitary (SPS) trade measures. The SPS measures were inherently captured under the non-discrimination principle which required both imported and foreign products to be treated the same. Such treatments include pesticide use, plant and animal health (FAO 2000). Nonetheless, member countries were mandated under GATT Article XX (b) to take measures they deem fit in order to protect human, animal, or plant life/health such that consumer safety is not compromised, but those measures are not be disguised protection (FAO 2000).

Following Tokyo Round of negotiations (completed in 1979) that established the Agreement on Technical Barriers to Trade (TBT), it was brought to light that SPS measures were fast becoming an effective alternative trade protection measure as tariffs were negotiated down (FAO 2000, Isaac 2001). Consequently, SPS measures were formally slated for negotiation during the Uruguay Round (FAO 2000). The FAO (2010) reports that opinions regarding SPS measures were divided along developed and developing country lines and the issues were: (1) what ought to be an SPS measure and; (2) whether they needed to be harmonised. While developed countries insisted for each country to have its own SPS measure, developing countries argued for harmonization of SPS measures because they feared fragmented standards could afford developed countries the opportunity to use costly standards against their products (FAO 2000). In the end, five areas were agreed upon: (1) "international harmonization on the basis of the standards developed by the international organizations"; (2) "development of an effective notification process for national regulations"; (3) "setting-up of a system for the bilateral resolution of disputes"; (4) "improvement of the dispute settlement process" and; (5) "provisions concerning the scientific basis for measures" (FAO 2000).

The SPS Agreement employs a science-based approach for setting standards. Three pre-existing scientific organisations were officially recognized as standards setting organizations. These are the Codex Alimentarius Commission (Codex), the International Office of Epizootics (OIE) and Secretariat of the International Plant Protection Convention.

Codex Alimentarius Commission: The Codex Alimentarius Commission is responsible for developing food safety standards as they apply in food trade (WTO 2011a). The organisation urges member countries to harmonise standards as a strategy to address differences that could hinder trade.

The International Office of Epizootics (OIE) – or the World Organization for Animal Health as it is also called: The OIE is responsible for developing standards for animal health and zoonotic[2] diseases. It is charged with informing member countries about animal disease outbreaks and control mechanisms across the world, keeping up to date records of animal diseases, coordinating animal surveillance and disease responses research, and promoting harmonisation of regulations in animal and animal product trade (WTO 2011a).

The International Plant Protection Convention (IPPC): The IPPC is responsible for developing measures to protect domestic plant resources from disease and pest infestation associated with trade. Its main activities include developing standards for pest risk analysis and measures for establishing pest-free zones (WTO 2011a).

These science-based organisations provide guidelines and minimum standards on which national standards must be based. Member countries may use higher standards provided there is sufficient scientific justification. At any point that a country embarks on a domestic regulatory measure that, in turn, affects trade; that country is obliged to notify others and have a bureau where enquiries can be made (WTO 2011a).

The SPS agreement also promotes the use of equivalence of regulations negotiated between importers and exporters. In this regard, if an exporting country demonstrates that its domestic standards provide the same level of protection as the importing country's own, the two standards should be accepted as equivalent. Further, the agreement also recognises regionalisation policies whereby parts of countries declared free of a disease may be granted access to importing country markets (WTO 2011a).

2.3 Impact of food safety standards on trade

While food safety standards are primarily targeted at protecting consumers against food hazards, there is an understanding that standards may be motivated by the desire to provide economic protection. Rent-seeking interest groups may lobby the government to impose illegitimate, overly strict, or excessively costly standards that will protect them against foreign competition. Such standards are as a result of the weaknesses in the SPS agreement which makes it a bit more difficult to establish a unifying science for standards justification. Such hidden motives have provided the impetus for research into the impacts of food safety standards on trade.

The impact of food safety standards on trade has mixed evidence. Evidence on one side of the argument supports the proposition that food safety standards enhance trade. In particular,

[2] A zoonotic disease is one that can be transmitted between animals and humans (WHO 2012)

those who view standards as a market failure correcting mechanism will argue that appropriate standards increase consumer confidence and demand. For example, governments are inclined to ban the importation of any food that poses a danger to consumers where appropriate standards do not exist. With standards in place, imports may be re-opened to foods that meet the requirements of the food safety laws. An example of the case where standards were shown to enhance trade is Aflatoxin B1[3] standards in cereals and nuts. Applying a gravity model to trade from 15 developing countries (exporters) and four importing countries, Otsuki et al (2001a) demonstrated that the presence of Aflatoxin B1 standards will increase trade by 51 percent relative to where no standards exist.

Secondly, the impact of food safety standards has been studied in terms of harmonised versus fragmented standards - where countries have different standards. Otsuki et al (2001b) compared the impact of harmonised Aflatoxin B1 standards with fragmented standards using a gravity model. Their results supports the proposition that harmonisation of standards is trade enhancing. They estimated trade in cereals and nuts to increase by US$38 million dollars when standards are harmonised compared to when they are fragmented.

Furthermore, the impact of food safety standards have been investigated in the context of their impact on developed versus developing countries. Henson and Loader (2001) argue that developed countries are better at complying with food safety standards than developing ones because the developed countries have the institutional capacity and appropriate infrastructure required for effective compliance. Consequently, stringent food safety standards could make developed countries more competitive in international markets than their developing country counterparts. Anders and Caswell (2009)'s work corroborates Henson and Loader (2001)'s assertion in their examination of the situations under which food safety standards catalyze or inhabit trade. By partitioning countries engaged in seafood trade with US into developed and developing, they concluded that stringent standards negatively (acted as trade barrier) affected seafood trade with developing countries and positively (act as catalyst) affected seafood trade with developed countries. Their conclusion, therefore, supports the proposition that the impact of food safety standards depends on the ability of the exporting country to comply.

Roberts et al (1999), nonetheless, maintain that analysing the impact of food safety regulations on trade without taking into account the price elasticity of import demand may not lead to accurate estimates. They argued that standards result in increased product price since producers will usually pass on the added cost, in whole or part, to consumers. Hence, the ultimate impact of food safety standards will depend on the price elasticity of the product in question. Where the product exhibits inelastic demand, increased product price as a result of tighter standards will have little effect on trade because consumers are insensitive to price changes. On the other hand, imposition of standards will negatively affect trade for products characterised by elastic demand.

Research has also largely analysed the impact of food safety standards on trade with little effort to segment their effects for private and public standards. While public standards are mandatory food laws of a country (e.g. FSMA), private standards, on the other hand, are developed by individual firms or groups of firms but may be compulsory only for a producer who wants to sell into their supply chain (Hobbs 2010, Henson 2006). It is the government's responsibility to verify that foods supplied into these private supply chains are in compliance with the state's food laws irrespective of their origin. Henson (2006), therefore, argues that

[3] Wilson and Otsuki (2001) described Aflatoxin B1 as a toxic-carcinogenic chemical that develops in cereals and nuts when the produce is not properly dried and stored.

empirical estimates segregating food safety impacts are limited because both private and public standards act together in influencing trade, and trade may change when either of them is considerably altered. Henson (2006) also maintains that private standards could become a significant trade barrier since they are not sanctioned under WTO, and therefore do not need to conform to international trade rules.

2.4 The US fruit and vegetable standards

The US is the world largest importer of fruit and vegetables by value, accounting for approximately 20 percent of world imports (FAOSTAT 2010). Internationally, importation is governed by the Plant Protection Act 2000. The Act empowers the state to inspect and certify that imported fruit and vegetables do not harbour disease organisms that could harm domestic plant resources. The US officials are also required by the Act to keep list of countries from which fruit and vegetables may be imported in order to limit the movement of pests and obnoxious weeds that could harm domestic plant resources as a result of trade (US Plant Protection Act 2000).

Further, the US develops mandatory industry wide standards to govern fruit and vegetable marketing in the country. For instance, the Agricultural Marketing Services (AMS) define industry wide standards and implement the Perishable Agricultural Commodities Act 1993 for fruit and vegetables. The Perishable Agricultural Commodities Act specifically seeks to ensure fair and ethical trading practices are upheld in fresh and frozen fruit and vegetable marketing (United Fresh Produce 2011).

For private standards, the Trade Standards Practitioners Network (2011) and Bureau Veritas Services (2007) maintain that although GlobalGAP is the largest internationally recognised farm level private standard for fresh fruit, the Safe Quality Food (SQF) 1000 standard largely govern fresh fruit and vegetable standards in the US. The SQF is charged with ensuring that microbial contamination in fresh fruit and vegetables is reduced to acceptable minimums as defined by US food laws (Trade Standards Practitioners Network 2011). The incoming Food Safety Modernisation Act 2011 might require adjustments to these private standards in the US and globally if exporters wish to continue accessing the US fruit and vegetable market since it requires the FDA to develop mandatory agronomic standards for fruit and vegetables.

2.5 Foodborne diseases, food safety standards and protectionism

Hobbs and Kerr (1999) underscored the importance of microbial organisms in cheese production as an agrifood industry. In 1997, they estimated that over 15,000,000 tonnes of cheese produced worldwide dependent on microbial activity. Notwithstanding these, pathogenic microbes on the other hand, continue to threaten the safety of food, cause food spoilage and account for over 90 percent of foodborne diseases (Hobbs and Kerr 1999).

Varying opinions exist to explain the increasing microbial contamination in food chains. For example, Hobbs and Kerr (1992) argued that the rise in microbial contamination is partly attributed to longer supply chains. According to them, food supply chains have lengthened with regards to number of participants and distance over which foods have to be moved. In particular, increasing participation expand opportunities for microbial contamination while longer distances tend to reduce the shelf-life of most fresh fruit and vegetables even before they get to consumers. Hence, microbial contaminations turn into a cost for businesses and consumers as supply chains lengthen.

While foodborne diseases have been widely publicized, it appears that their cost has not been satisfactorily estimated as a result of methodological weaknesses. It is perceived that cost of foodborne diseases are either overestimated or underestimated. Hobbs and Kerr (1999) argue that the cost of foodborne diseases, when estimated as direct medical cost and cost of spoiled food, is an underestimation since cost of private and public standards that are in place to prevent disease incidence are largely ignored. They also argue that while researchers might be tempted to use an alternative estimation measure such as willingness to pay for disease free food, it may underestimate or overestimate depending on the respondent’s perception of the significance of foodborne diseases.

Despite the challenge in costing foodborne diseases, there seems to be a general understanding that foodborne diseases are increasingly becoming both an economic and a societal menace in the world. In response, food safety measures have been evolving rapidly. For example, in 1991, the UK enacted the Due Diligence Defense Act which had the objective of holding participants along food supply chains more responsible to lapses in food safety (Hobbs and Kerr 1992). The EU Plant Protection Act requires phytosanitary certification on all imported fruit and vegetables outside and upon arrival in EU (United Nations 2007); and the US FSMA requires food firms to adopt a preventive approach to food safety by implementing HACCP at sensitive points of processing, handling and storage. These Acts empower the authorities of their respective countries to define standards governing foods. Although the standards have legitimate intent, a number of concerns have been expressed regarding the basis on which such standards are justified. It is believed that standards may be enacted with the hidden motive of providing economic protection. For example, Davis (2003) maintains that EU’s ban on hormone-treated beef has been mentioned by European officials as one arising from public pressure rather than a scientific justification.

The SPS agreement maintains that food safety standards may be instituted provided there is a sufficient scientific justification, and standards must be proportional to the level of risk. However, what constitute sufficient science is disputable. What seem to compound the acceptability of scientific justification are the two acceptable alternative risk analysis frameworks within SPS Agreement: (1) the scientific rationality approach and; (2) the social rationality approach. These approaches differ in their definition of risk and account for the differences in judgement and measures needed to address risk (Isaac 2001). Depending on the intended motive, the implementing country may use a risk assessment framework that provides the highest form of protection while exporting countries may not be able to challenge it. The SPS agreement also lacks discipline on how high standards may be set. No upper limit on standards’ stringency implies that highly restrictive trade standards that are not proportional to the perceived or actual risk can be equally justified.

Further, the SPS allows countries to take precautionary measures where there is not sufficient scientific evidence to assess a risk. For example, in 1989, Canada and the US took precautionary measures to ban the importation of fruit and vegetables from Chile after grapes tainted with cyanide from Chile were found in the US (Robinson 2011). The challenge countries face is the duration of time that markets take to re-open after precaution or real risk has been identified. The SPS agreement has no definite time for such markets to re-open and this can keep market closed forever. For instance, Isaac (2001) indicates that many export markets were still close to Canadian beef after BSE occurred in Canada (in 2003) although the government believe it had eliminated the menace.

In the fruit and vegetable industry, the US and other importing countries banned importation of avocados from Mexico when seed weevil[4] was first noticed in Mexican orchards in 1914. Although the Mexican government controlled the pest and other countries re-opened their markets, the US remained closed even after scientific studies proved that the pest was successfully controlled (Strollo 1997). The case was raised during the NAFTA negotiations as Mexico pushed the US to allow imports. In 1995, the US accepted imports from Mexico to Alaska on the basis that the pest could not survive the cold weather in Alaska (Strollo 1997; Bakshi 2003). The avocado growers association in California rebelled against the decision indicating that the basis for assessing the risk from regional imports led to underestimation (Strollo 1997). No pest outbreak was identified and subsequent negotiations led to the US further allowing imports into north-eastern states in 2001 (Bakshi 2003). This implies that the ban only existed to provide economic protection and the Mexican avocados had been denied access to the US market for much of the 20^{th} century – to the direct benefit of US producers.

It can be argued that producers are those who would traditionally request protection against imports. However, the source of protectionism seems to be broadening such that consumers are the source of protectionist activities regarding the kind of food a country can import. For example, the EU banned beef produced using growth hormones from North America because their consumers did not want it. Kerr (2010) indicated that although scientists, including EU scientists, have found that growth hormones do not pose a risk, EU consumers have lobbied governments to maintain the ban and, instead, accept retaliation from North America. Such tendencies only tend to inhibit trade despite the lack of scientific evidence.

Further, protection in recent times has emerged from the politician's interest in pursuing an action just to please interest groups although such actions might not be scientifically justified. Such acts are what Kerr (2004) refers to as *political precaution*[5]. For instance, when the World Health Organization (WHO) recommended that regular washing of hands was a safe precaution to avoid infestation and spread of H1N1 influenza after confirmed reports publicised its outbreak in Mexico, Kerr (2009) argued that China (the world's leading producer of pork) defied WHO's directive and its leadership exercised political precaution by banning imports just to shore up domestic prices that had plummeted as a result of highly publicised media reports about the influenza.

These lapses in compliance with the SPS agreement coupled with the incentives to provide protection has motivated researchers to devise means of introducing transparency and to shed light on protectionist tendencies. For example, the SPS agreement encourages trading nations to use regionalization in handling trade in animal and animal products where imports can be accepted from a disease free zone. This recommendation has largely not been adhered to. In times of outbreak, the entire country's exports are banned. In response, Loppacher et al (2006) provided insights about measures needed to address the regionalization of disease incidence using a partial equilibrium model where an outbreak will be restraint to geographic areas but not political borders. Their study suggest that regionalisation will be effective if countries provide a

[4] Strollo (1997) describes the seed weevil as an avocado pest that destroys avocado seed and contaminates the flesh thereby causing a loss in appearance and market value.

[5] Kerr (2004, p. 35) defines political precaution as "when politicians are being pressured to "do something", or to be "seen to be doing something" in the face of strongly expressed concerns by members of civil society even when risks are very low or largely speculative".

compensation scheme to the affected areas such that they are not enticed to smuggle their produce to the disease free-zone for sale.

Baylis et al (2009) empirically tested for political pressure in US seafood import refusals. It is believed that import refusal could be politically influenced given that former quantitative restrictions have been eliminated. They used three variables to proxy political pressure: (1) change in employment within a given import substitution sector; (2) number of anti-dumping cases brought against a product and; (3) lobbying expenditure. They explained that when a given domestic sector is shedding labour (unemployment) as a result of increased foreign competition, the domestic industry may lobby government to minimize the amount of imports into the country and that could be seen in rising import refusals. Also, producers of like products within a country may file an antidumping case against a product as a direct means of seeking protection. Hence, rising antidumping cases may elicit a response whereby government is pressed into using the border inspection mechanism to step up refusals. The conclusions were significant with regards to unemployment and antidumping but not with lobbying expenditure. A specific case where anti-dumping is thought to be politically motivated is fresh tomato trade. For example, in 2001, US producers filed an anti-dumping case against Canadian greenhouse tomatoes and Canada, later in the same year, filed an antidumping case against US tomatoes. The study to determine injury did not find evidence of injury being suffered by US tomato producers and Canada subsequently withdrew their application which tends to indicate that its motivation was retaliation (Schmitz et al 2003).

2.6 Food safety standards and compliance cost

Hobbs and Kerr (1992) argue that the compliance cost of food safety regulations can be substantive depending on the market and the risk associated with a particular geographic location. They argue that compliance cost may arise as a result of training of personal, laboratory testing, etc. Maskus et al (2005) analysed the increase in cost of exporting for firms in developing countries when complying with developed countries standards. Their study suggests that a 1 percent increase in investment to comply with standards raise variable production cost within the range of 0.06 and 0.13 percent.

Further, compliance with food safety standards may alter the competitive advantage of firms in an international market. Henson (2006) argue that where food safety becomes a primary concern to consumers, competition is shifted from price to safety and firms use private standards as mechanisms to outcompete each other. Moreover, Henson and Heasman (1998) finds that while small firms are laggards in complying with food safety standards compared to large firms, large firms are generally better at complying with standards in a manner that yield competitive advantage over smaller firms. Consequently, firms that are more competitive on standards have the tendency to lobby for more stringent regulations in order to eliminate their competitors (Hammoudi et al 2011).

In addition, compliance cost could potentially change the relationship between actors in the supply chain or the structure of firms. Complying with standards may involve investment in specialised assets and agents will want relationships that best safeguard those investments. Where the degree of asset specificity is high such that the asset has zero alternative value outside the given use, the higher the chance that firms will want to vertically integrate (Williamson 1986).

2.7 Summary

Food hazards are recognised as a major public health risk. Hazards can be in the form of poisoning or foodborne diseases arising from pathogenic organisms. Besides the direct cost of medication and deaths, foodborne hazards add a substantive cost to businesses and governments as a result of the private and public standards that must be developed to prevent or limit the effects of outbreaks. However, standards are increasingly becoming a challenge to international agrifood trade leading to the establishment of international agreements such as SPS and TBT to handle food issues in trade. Rather than enhancing trade, lapses in the agreements have become the means that threaten their success. Standards are also perceived as politically motivated and may not be based on science. In the SPS agreement – which focuses on food safety regulations – countries can set higher standards without other member countries being able to determine if those standards are proportional to the risk. Hence, countries, especially developed countries, continue to impose more stringent standards resulting from consumer’s lobbying and rent-seeking groups. While some estimates suggest that such standards are trade enhancing, others have equally shown their negative impacts. It is also hinted that stringent standards may be increasingly eliminating smaller firms and firms in developing countries from high valued markets. Depending on the compliance cost and location of the firms, standards are changing the supply chain relationships towards vertical coordination and increasing use of contracts as a result of the rising monitoring and specialised investment that are made to comply with them.

Having reviewed relevant literature on the historical perspectives through to protectionism in food safety standards, the next chapter focuses on theoretical framework underlying food safety regulations pertaining to the study.

Chapter 3: Conceptual Framework

3.1 Introduction

The chapter presents the theoretical concepts underlying food safety standards and how they are used to provide economic protection from international competitors. It is therefore divided into two subsections: economic concepts pertaining to food safety regulations; and protectionist use of food safety regulations in international trade.

3.2 The economics of food safety standards

Roberts et al (1999) indicate that food safety regulations act as a mechanism to correct market failures associated with the production, processing and handling of food along the supply chain. Such market failures arise as a result of asymmetric information about food attributes. Market failure is therefore the rationale behind food safety standards and underpins the conceptual framework developed herein.

The Fig 3.1 illustrates the concept of food safety regulations from the market failure perspective as it applies to FSMA, where the vertical and horizontal axes are price and quantity respectively. It is assumed that a firm may either choose to produce (1) safe food or (2) unsafe food (i.e. food contaminated with pathogenic organisms). Safe food production is however deterred because of food's credence attributes which creates the incentive for unsafe food to be sold as safe. Hence, a safe food producer is not able to charge premium for safety.

The firm is therefore faced with either of the two costs: (1) cost of supplying safe food; and (2) cost of supplying unsafe food. In the diagram, the marginal cost of safe food and unsafe food are MC^1 and MC respectively while AC^1 and AC are their respective average costs. The utility function of consumers is such that safety is preferred. Hence, the firm minimizes cost of safe food by producing q^1 at P^1. However, since the firm does not have the incentive to invest in safety, food safety is undersupplied. As a result, the firm's actual average cost falls from AC^1 to AC. In the full information world, the non-safe food producer would have been producing q* at P where it fully discloses information about the safety of its food. However, as the firm is aware that consumers do not have full information about the safety of its product, there is an incentive for it to produce unsafe food for sale as safe food. This is done by equating the marginal cost of unsafe food to the average cost of safe food and thereby produces more product (q) at market price P^1. This is a market failure since the firm is undersupplying safety though consumers presumably paid for it. The government's goal is therefore to institute measures that mandate the firm to supply safe food. To accomplish this, the government institutes new food regulations that make it mandatory for the firm to produce safe food and to help consumers have the value for safety they pay for. If the regulations are correctly structured, complying with safety standards lead to an increase in average and marginal costs of firms from AC and MC to AC^1 and MC^1 respectively and the firm produces q1 at P^1 by equating marginal cost of safe food to its average cost. The compliance cost of the regulations is therefore equivalent to the area of $ABqq^1$.

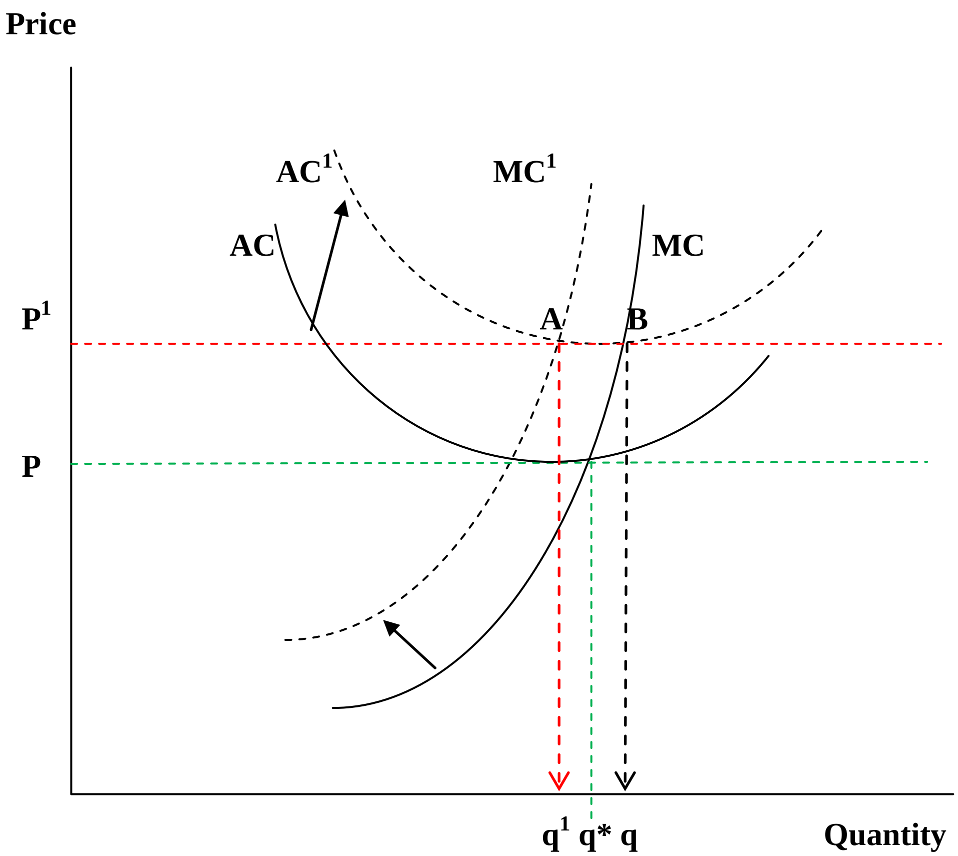

Fig 3.1 Food safety standards as a corrective measure in market failure

3.3 Protectionism framework in food safety regulations

Although food safety regulations are primarily targeted at correcting market failures associated with food, the regulations could, however, be constituted to offer disguised economic protection. The Fig 3.2 illustrates how food safety regulations may be used to provide protection to the domestic industry. The vertical and horizontal axes are price and quantity respectively while D and S are demand and supply respectively in the importing country. In the diagram, the demand facing the domestic industry (D) is assumed to be representing safe food. The regulations in place which ensure the present level of food safety are referred to as “Normal regulations”. When the importing country does not implement any further safety measures, Qs^1 of food is supplied by the domestic producers while Qd^1 is the quantity demanded in the economy. Since demand exceeds supply the domestic economy imports an amount of food equal to IM^1 (i.e. $IM^1=Qd^1- Qs^1$).

Let us now assume that the domestic producers complain about low prices for their products as a result of foreign competition. The government, being aware that imports cannot be restricted through the use of tariffs or quantitatively, possibly because of international commitments, may decide to use more stringent food safety regulatory measures – referred to as “overly strict regulations”. To be able to justify these regulations, the government may look for some real or perceived evidence such as foodborne contaminations that are associated with imported food. It is assumed herein that evidence of such are found and the government decides to implement a regulatory mechanism to reduce the risk of foodborne complications.

The compliance cost of the new regulation will make food more expensive in the domestic economy (as foreign producers who are not able to meet the regulatory requirements exit the market) leading to an increase in food price from P to P^1. Domestic production is stimulated as a result of the higher price leading to an increase in quantity supply from Qs^1 to Qs^2 while demand declines from Qd^1 to Qd^2 and imports decline from IM^1 to IM^2 as a result. Although the regulation increase producer surplus in the domestic economy by A (which is the disguised motive of the regulation), consumer surplus decline by A+B+C+E. The regulatory intervention of overly strict regulation therefore leads to a decline in welfare (i.e. welfare decline by B+C+E) and a deadweight loss to the economy of E.

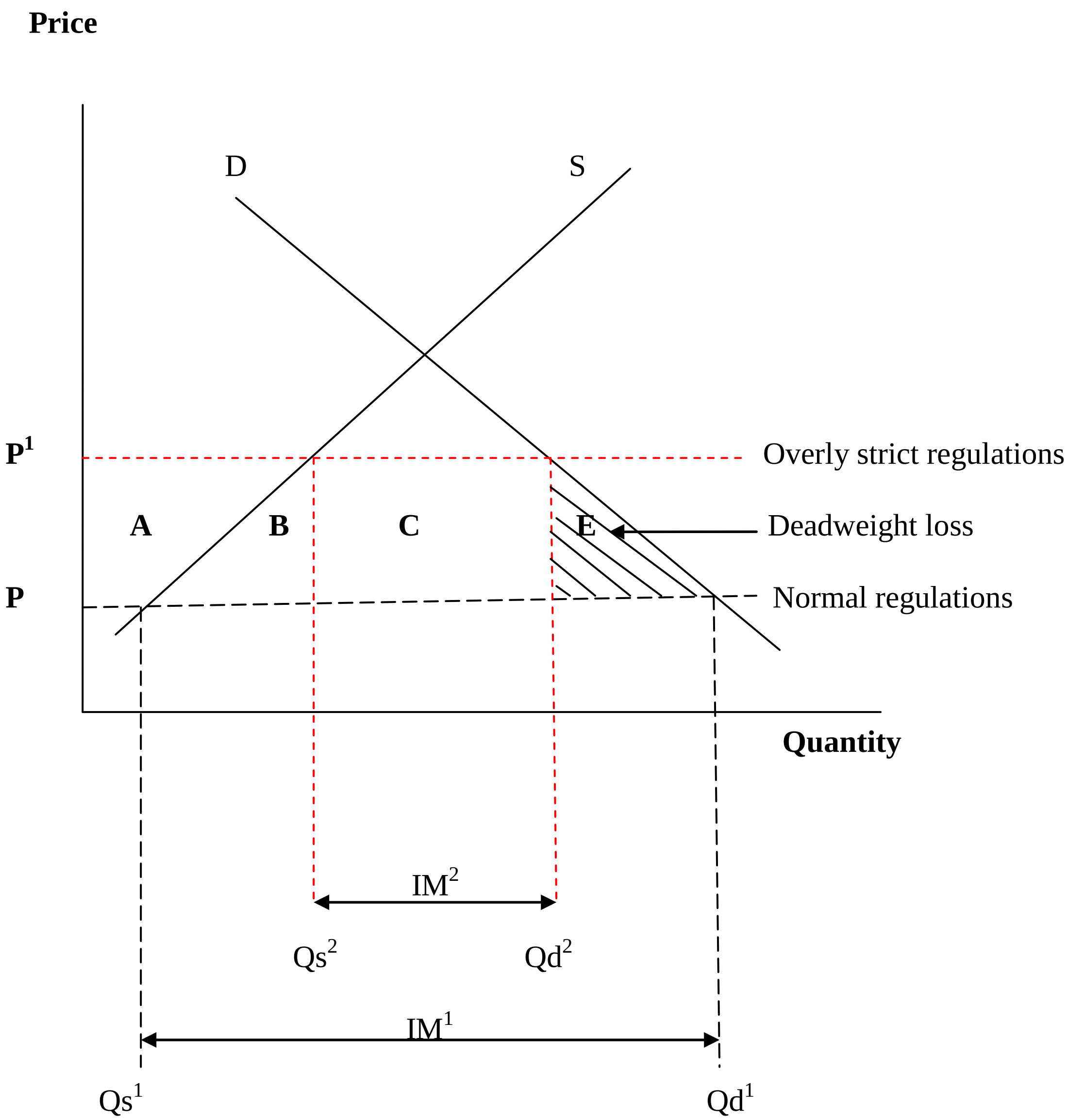

Fig 3.2 Protectionist use of food safety regulations

3.4 Summary

Food safety regulations exist primarily to correct market failures associated with the production, processing and/or handling of food. Such market failure arises as a result of the credence nature of some food attributes. Hence, the role of the government is to ensure that regulations are effective in communicating information about these attributes to consumers. However, the regulations may also be constituted in a manner that it is meant to provide disguised protection to the domestic industry. This is possible because the SPS agreement - which governs domestic food regulations - does not place an upper limit on the stringency of food regulations. As such, importing countries can increase the stringency of their regulations to the extent that it is over and above the scientifically recommended level. Such overly strict measures turn to eliminate foreign competitors to the benefit of domestic producers but it deteriorates consumers' welfare. Hence, the next chapter test for political influence in fruit and vegetable import refusals as one disguised form of using a regulatory measure to influence refusals for domestic industry gain.

Chapter 4: Political Influence in Import Refusals

4.1 Introduction

Chapter 4 tests the proposition that fruit and vegetable import refusals under US food safety regulations have been politically motivated. It includes sections on the methodology, results and discussion, and summary.

4.2 Methodology

Non-compliance with food safety regulations constitute the acceptable basis on which food destined for import is rejected. From the political-economy perspective, regulations serve as a framework under which protection may be achieved through refusals. However, regulations may not be changed frequently to provide the needed protection in response to the desires of domestic groups. In response, interest groups may have to lobby decision makers to alter the manner in which government officials apply them. For instance, Kerr et al (1986) finds that Canadian beef tended to be inspected and rejected more often at the US border when the spot market price of beef in the US was low. This is the type of political influenced behavior the study examines.

In this thesis, political influence is defined as tacit manipulation of fruit and vegetable imports to protect the vested economic interests of the US fruit and vegetable industry. This can be accomplished by rejecting products destined for exports from countries that compete with US industry for the local market in accordance with the domestic market conditions and the desires of interest groups. The refusals have to be tacit because refusals based on domestic sector interests contravene international trade agreements. Such interests include protection from foreign competition and retention of employment in the industry.

Several countries compete with the domestic farmers for the US market. Hence, the vested interests of the US fruit and vegetable industry could have far reaching implications on their exports. According to USDA trade statistics, from 2000 to 2011 Mexico (the leading exporter to US) supplied approximately 34 percent by value of total US imports, and about 70 percent of Mexican fruit and vegetables are exported to the US. Canada's share of US fruit and vegetable imports (as the second largest exporter by value) has averaged approximately 13 percent from 2000 to 2010. Approximately 85 percent by value of Canada's fruit and vegetable exports are destined for the US market. Further, China emerged as one of the world's major exporters of fresh food products after the 2008 financial crises. Although China is currently the fourth largest exporter, it has been the source of approximately eight percent, by value, of US imported fruit and vegetables. The trend also suggests that China's exports will expand considerably relative to those of Canada and Mexico. Hence, the US fruit and vegetable market is important to these countries.

The FDA, by its constitutional mandate, verifies that all imported fruit and vegetables are in compliance with US food regulations at the point of entry. Those that are not in compliance are either refused entry, re-exported or destroyed (Humphrey 2003). Following the argument that food regulations may be politically motivated to provide economic protection to domestic industries, Baylis et al (2009) tested for political pressure in US seafood import refusals using monthly observations over the period of 1998 to 2004. Their implicit assumption is that governments can effectively provide protection to domestic producers by increasing import refusals. They thought this activity was likely because quantitative restrictions had been eliminated under WTO trade rules agreed upon in the Uruguay Round.

The approach of Baylis et al (2009) is adapted to test the hypothesis of political influence applied to fruit and vegetables refused entry into US from Mexico, Canada and China. While acknowledging that our examination of political influence in import refusals prior to the new regulatory regime is not a direct test for political influence in impending regulations (i.e. FSMA), it can provide some insights about how the pending regulations will operate. In particular, the test will establish whether there appears to be political influence in fruit and vegetable import refusals to inform the debate as to whether the anticipated rise in refusals under FSMA is politically motivated.

In this study, we use unemployment rate as a measure of political influence. It is hypothesized that a rise in unemployment will be associated with an increase in import refusals. When unemployment rises in a given import substitution sector, government will move to protect domestic industries by increasing refusals. Increasing refusals restricts imports and, hence, increases demand for domestic produce. Consequently, product price increase and producers in turn increase labour demand in order to expand output to take advantage of the higher prices. In the end, import refusals will increase when unemployment increases.

Although the fruit and vegetable industry constitutes approximately 15 percent of the US agricultural sector (US Census Bureau 2012), Calvin and Martin (2010) indicate that it is the most labour intensive industry in US agricultural sector. The industry's labour demand is at a peak during harvesting followed by a substantial layoff afterwards. This makes the industry a considerable contributor to fluctuations in agricultural sector unemployment. Hence, the study uses US agricultural sector unemployment as proxy for unemployment in the fruit and vegetable (UNEMP) industry due to lack of unemployment data specifically for the fruit and vegetable industry.

Further, antidumping is also used as a measure of political influence in this study. Particularly, domestic firms bring anti-dumping cases (ANTID) against foreign ones as a legal means of seeking protection. As such, it is expected that evidence of anti-dumping activity might be a signal for regulatory institution to increase protection. Hence, antidumping is expected to have a significant positive effect on import refusals, where refusals are politically motivated.

Baylis et al (2009) also used lobbying expenditure as a proxy for protectionist motivation on the premise that firms spend resources to lobby the government for protection. Hence, an increasing lobbying expenditure arising from the fruit and vegetable industry could be an indication of the desire for increased protection. Lobbying expenditure is, however, excluded from this analysis purely as a result of data limitations. Lobbying expenditure is reported as annual data. Hence, converting it from annual to monthly is not possible without the data losing its essential properties. Although Baylis et al (2009) converted annual lobbying expenditures to monthly observations by matching them with trade data, such a conversion can be expected to introduce multicollinearity as a result of the likely correlation between trade values and lobbying expenditure.

The value of fruit and vegetables imported from a specific country is introduced to control for the number of refusals from that country. It is hypothesized that as imports rise, the number of products that will genuinely be rejected because they did not comply with US food safety laws may increase. This is because as the volume of products destined for export increase, the time spent in screening to eliminate non-complying ones is reduced as a result of the desire to dispatch highly perishable fruit and vegetable products to export market in order to avoid losses. This could result in lots of non-complying products being carried along only to be rejected at the point of entry. Hence, a positive relationship is expected between import refusals and value of imports. Where value of imports is not included, the coefficients of the remaining independent variables in the equation will overestimate their effects on import refusals. As such, imports from Mexico (IMPMEX), imports from Canada (IMPCAN) and imports from China (IMPCHI) are introduced into the import refusal equations of Mexico (4.1), Canada (4.2) and China (4.3) respectively. The RMEX, RCAN and RCHI are refusals from Mexico, refusals from Canada and refusals from China respectively.

Further, food safety alerts and recalls in the US (ALERT) is introduced to account for genuine concerns for safety. Rising alerts pertaining to fruit and vegetables will increase scrutiny in inspection and possibly increase refusals. Hence, food safety alerts is expected to have a positive effect on import refusals. The import refusal equation for each country is represented as:

$$RMEX_t = \beta_0 + \beta_1 IMPMEX_t + \beta_2 UNEMP_t + \beta_3 ALERT_t + \beta_4 ANTID_t + \varepsilon_{t0} \quad (4.1)$$
$$RCAN_t = \theta_0 + \theta_1 IMPCAN_t + \theta_2 UNEMP_t + \theta_3 ALERT_t + \theta_4 ANTID_t + \varepsilon_{t1} \quad (4.2)$$
$$RCHI_t = \rho_0 + \rho_1 IMPCHI_t + \rho_2 UNEMP_t + \rho_3 ALERT_t + \rho_4 ANTID_t + \varepsilon_{t2} \quad (4.3)$$

Where ε_{t0} , ε_{t1} and ε_{t2} are error terms in equations (4.1), (4.2) and (4.3) respectively. The hypothesis of political influence in fruit and vegetable import refusals is tested by estimating and testing the significance of the regression coefficients of the unemployment and antidumping variables.

4.3 The data

The analysis uses monthly data from October 2001 to December 2011 because data on import refusals is only available for this period. Import refusals for Mexico, Canada and China were sourced from the FDA and measured as the number of refusals per month. Data on value of fruit and vegetables (US$) imported into the US from a country were sourced from US Department of Agriculture while unemployment data was obtained from US Bureau of Labor Statistics. The data on antidumping was sourced from the Global Antidumping Database of The World Bank and measured as the total number of antidumping cases brought against fresh fruit and vegetable products by US farmers per month.

4.3.1 Descriptive statistics

The descriptive statistics of the data is shown in Table A4.3.1[6]. The average number of refusals for Mexico, Canada and China are 46.1626, 7.365854 and 22.85366 respectively. The data reveals minimum refusals per month to be 8, zero (0) and 3 while maximum number of refusals per month to be 187, 82 and 100 respectively for Mexico, Canada and China. Moreover,

[6] Table or figure number preceded with the letter 'A' indicates they are in the Appendix.

import refusals are positively skewed for each country. This implies that majority of the data points are closer to the minimum values.

Further, the average import values of fruit and vegetables from Mexico, Canada and China per month are approximately US$337million, US$77.5million and US$77million respectively. The minimum values of imported fruit and vegetables from Mexico, Canada and China per month are about US$63million, US$12.3million and US$1.4million while maximum import values are US$805million, US$186million and US$15million respectively. As with refusals, import values are positively skewed. Moreover, there about 4.878 food safety alerts and recalls per month in the US. The data shows a minimum of zero (no alerts) and maximum of 45 alerts cases per month. Food safety alert is positively skewed.

The average, minimum and maximum agricultural sector unemployment rates in the US are 10.28195 percent, 2.4 percent and 21.3 percent respectively. Unemployment data is positively skewed implying that majority of the data points is closer to the lower tail. In the case of antidumping, there are about 0.373984 antidumping cases against fresh fruit and vegetable products per month. The data ranges from minimum of no antidumping to a maximum of 2 antidumping activities per month. Antidumping is positively skewed.

4.3.2 Seasonal influence in monthly data

Agricultural monthly data may be subject to seasonal influence emanating from weather conditions or the behavior of economic agents (Schulze 2009). Seasonal influences, if present, must be removed because regressions involving seasonality can produce spurious estimates. As shown in Fig A4.3.2.1, Fig A4.3.2.2, Fig A4.3.2.3, Fig A4.3.2.4, Fig A4.3.2.5, Fig A4.3.2.6, Fig A4.3.2.7 and Fig A4.3.2.8, the fluctuations of the line graphs indicates the possibility of seasonality which need to be tested for. All variables are transformed into logarithms accept antidumping. This is because more than half of the months had zero (0) antidumping cases. Since the logarithm of a zero is not defined, those values would have to be adjusted, if in logarithms, thereby decreasing the sample size substantially.

4.3.3 HEGY test for seasonal unit roots

An econometric test for seasonal influence is a test for seasonal unit roots in the data (Greene 2003; Schulze 2009). This is done using a HEGY test. For a time series variable y_t, Schulze (2009) maintains that seasonal unit roots is tested for by estimating and testing for the significance of the coefficients (γ_i and π_i) of the equation (4.4) below.

$$\begin{aligned}\Delta_{12} y_t = \beta_0 + \beta_1 t + \sum_{i=1}^{11} \gamma_i\, d_{it} + \pi_1 z_{1,t-1} + \pi_2 z_{2,t-1} + \pi_3 z_{3,t-1} + \pi_4 z_{3,t-2} + \pi_5 z_{4,t-1} \\ + \pi_6 z_{4,t-2} + \pi_7 z_{5,t-1} + \pi_8 z_{5,t-2} + \pi_9 z_{6,t-1} + \pi_{10} z_{6,t-2} + \pi_{11} z_{7,t-1} + \pi_{12} z_{7,t-2} \\ + \sum_{j=1}^{p} \delta_j \Delta_{12} y_{t-j} + \varepsilon_{1t} \qquad (4.4)\end{aligned}$$

According to Schulze (2009, p. 6, 7)[7]:

> β_0 is the constant, t is the deterministic trend and d_i represents seasonal dummies, where $d_{it} = 1$ if t corresponds to month i and 0 otherwise. The zi 's cover non-singular linear transformations of lagged values of y_t

The *t* and *di* coefficients test for deterministic seasonal pattern. These are reduced to zero where seasonality does not follow a deterministic pattern. The hypotheses of seasonal unit roots at different monthly frequencies are stated in Table 4.3.3 below. With the exception of π_1, which tests for regular unit roots, all other pi (π) test for seasonal unit roots[8].

Table 4.3.3 Statement of hypotheses

Test	Null hypothesis	Alternate hypothesis
T –test (t1)	π_1=0: Unit roots at 0 frequency	No unit roots
T–test (t2)	π_2 = 0: Seasonal unit roots at 2nd frequency	No seasonal unit roots
F-Test (F34)	$\pi_3 = \pi_4$ = 0: Seasonal unit roots at 3rd and 4th frequency	No seasonal unit roots
F-Test (F56)	$\pi_5 = \pi_6$ = 0:Seasonal unit roots at 5th and 6th frequency	No seasonal unit roots
F-test (F78)	$\pi_7 = \pi_8$ = 0: Seasonal unit roots at 7th and 8th frequency	No seasonal unit roots
F-test(F910)	$\pi_9 = \pi_{10}$ = 0:Seasonal unit roots at 9th and 10th frequency	No seasonal unit roots
F-test(F1112)	$\pi_{11} = \pi_{12}$ = 0:Seasonal unit root at 11th and 12th frequency	No seasonal unit roots
F-test (F1-12)	$\pi_1 = \ldots = \pi_{12}$ = 0: Unit root or seasonal unit root present	No unit/seasonal unit roots
F-test(F2-12)	$\pi_2 = \ldots = \pi_{12}$ = 0: Seasonal unit root present	No seasonal unit roots

4.3.3.1 HEGY test results

The results of the seasonal unit root test are summarized in Table 4.3.3.1. Intercept, trend and seasonal dummies were included in the deterministic part of the HEGY equation for each variable. The t-statistic of pi_1 (π_1) for each variable is not significant. Hence we accept the null hypothesis that refusals from Canada, refusals from Mexico, refusals from China, imports from Canada, imports from China, imports from Mexico, unemployment, alerts and antidumping have regular unit roots.

Further, the t-statistic of pi-two (π_2) for each variable is not significant with the exception of antidumping. This suggests that each of the variables has seasonal unit root at the second frequency apart from antidumping. Moreover, with the exception of antidumping, the joint F-statistic (F34) for each variable is not significant implying that each variable has seasonal unit roots at the third and fourth frequencies.

[7] Details of Zi's transformation are shown in Franses (1991, p.202).

[8] For critical values of HEGY Test, refer to Franses and Hobijn (1997, pp.25-47)

In conclusion, RMEX, RCAN, RCHI, IMPMEX, IMPCAN, IMPCHI, UNEMP and ALERT have seasonal unit roots at second frequency (t2) and at third and fourth frequency (F34) in addition to regular unit roots. Antidumping, on the other hand, only has regular unit roots.

Table 4.3.3.1 HEGY test for seasonal unit roots

Test	**RCAN (L=10)**	**RMEX (L=10)**	**RCHI (L=10)**	**IMPMEX (L=8)**	**IMPCAN (L=8)**	**IMPCHI (L=6)**	**UNEMP (L=4)**	**ALERT (L=6)**	**ANTID (L=2)**
$t(\pi_1)$	0.5064	0.1126	1.2391	1.3759	1.0225	1.1160	0.1126	0.9181	1.5005
$t(\pi_2)$	-0.6396	0.2714	1.2412	1.4218	1.1289	1.3102	-0.2714	1.4724	2.8838***
F34	0.6783	0.3270	1.5107	1.6470	1.2616	1.2800	0.3070	1.5910	4.2824***
F56	7.8759***	8.3253***	9.0227***	11.0238***	4.4859***	4.2045***	8.3253***	10.0559***	11.0451***
F78	2.9496***	6.3610***	5.8502***	7.5081***	3.7523***	3.6110**	6.3610***	7.9993***	5.1307***
F910	7.3821***	9.2316***	7.2682***	8.4432***	6.3491***	3.6057**	9.2316***	12.4790***	8.7349***
F1112	5.2661***	6.9208***	8.0226***	10.4511***	3.9740***	4.2364***	6.9208**	9.2902***	8.0680**
F1-12	6.1235***	4.625***	4.7958***	7.1235***	5.3763***	5.0660***	4.625***	7.0273***	11.4832***
F2-12	7.2378***	5.0150***	4.7717***	7.2926***	5.3424***	5.0109***	5.0150***	6.8568***	12.1370***

****, ** and * indicate significance at 1 percent, 5 percent and 10 percent respectively. L is number of lags included*

4.3.4 Johansen cointegration test

The HEGY test results indicate that the data is not stationary in levels but stationary after first differencing. This could pose a challenge because regressions with non-stationary data can lead to spurious regressions. However, if the residual from a time series regression of non-stationary data is stationary, then the regression is no longer spurious but represents the true long-run relationship between the variables (i.e. the variables cointegrate). Hence, we use the Johansen cointegration test to check for long-run relationships between the variables.

Since π_1, π_2, π_3 and π_4 are not rejected as indicated by the HEGY test, the appropriate filter for regular unit roots would have been $(1\text{-}L^4)$. However, regular unit roots are not removed because their removal will defeat the essence for cointegration test. Further, although the HEGY test suggests that both stochastic and deterministic seasonal unit roots are present, seasonality is assumed to follow a deterministic pattern. As such, the deterministic seasonality is addressed by including 12-monthly seasonal dummies in the cointegration model. Stochastic seasonality is deferred for future research.

The Johansen cointegration test uses two criteria: the Trace Statistic and Maximum Eigenvalue criterion. The Trace-Test tests the null hypothesis that the number of cointegration equations is less than or equal to r (= *0 to n*) versus the alternative that there is no cointegration. The Maximum Eigenvalue, on the other hand, tests the null hypothesis of *n* distinct cointegration equations against the alternative of *n+1* (Greene 2003; Skrabic and Tomic-Plazibat 2009).

We test for cointegration under the assumption that the deterministic component has only *intercept*, both *intercept and trend* and *neither intercept nor trend* using seasonally adjusted data (arising from seasonal unit root test). A test for cointegration was done by including variables in a specific equation. Hence, in Table A4.3.4.1, the variables included are those present in the import refusals equation for Mexico. The value of imports from Canada and China are excluded because we are testing for cointegration between variables that define import refusals from Mexico. Similarly, in Table A4.3.4.2, only the value of imports from Canada (IMPCAN) was included while value of imports from China (IMPCHI) was included in Table A4.3.4.3.

The results of the Maximum Eigenvalue and Trace statistic are each significant at the zero cointegration rank. This shows that there is one cointegration equation between variables that define import refusals from Mexico (Table A4.3.4.1). Similarly, the Maximum Eigenvalue and Trace statistic again shows one cointegration equation between variables that define import refusals from Canada (Table A4.3.4.2) and finally, the Maximum Eigenvalue and Trace statistic shows one cointegration equation between variables that define import refusals from China (Table A4.3.4.3).

4.4 Vector Error Correction Model (VECM)

Since the Johansen cointegration test indicates that there is cointegration between the variables, this implies that there is a long-run relationship between the variables. Hence, estimating import refusal equations as in equations (4.1), (4.2) and (4.3) will underestimate the relationship between the variables since it fails to capture the long-run component. To capture this, the equations are re-specified and estimated using the Vector Error Correction Model (VECM). The VECM estimates the long-run and short-run relationship between the variables, as well as estimating the speed at which the short-run coefficients adjust to the long-run (Greene 2003; Madalla and Kim 2000). The condensed VEC model can be written as:

$$\Delta y_t = \sum_{i-1}^{k-1} \Gamma_i \Delta y_{t-i} + \Pi y_{t-k} + \varepsilon_t \qquad (4.5)$$

(Skrabic and Tomic-Plazibat 2009)

Where:
y_t is an *n x 1* vector of endogenous variables
ε_t is a nx1 vector of stochastic disturbances

Π has a rank equivalent to the number of distinct cointegration equations and decomposed as $\Pi = \alpha\beta^{\tau}$, where:

β is a *n x r* matrix of cointegration relationship parameters
α is a *n x r* matrix of speed of adjustment coefficients
(Greene 2003; Skrabic and Tomic-Plazibat 2009).

The full VECM specification equations for import refusals for Mexico, Canada and China are shown in equations (4.6), (4.7) and (4.8) respectively. The component of the equation in brackets is the long-run relations and the component outside the brackets is the short-run. α_1, α_2 and α_3 represent the speed at which the short-run component adjust to the long-run in equations (4.6), (4.7) and (4.8) respectively.

$$\Delta RMEX_t = \alpha_1(RMEX_t - \beta_1 IMPMEX_t - \beta_2 UNEMP_t - \beta_3 ALERT_{t-1} - \beta_4 ANTID_{t-1} - \beta_0) + \beta_5 \Delta RMEX_{t-1} + \beta_6 \Delta IMPMEX_{t-1} + \beta_7 \Delta UNEMP_{t-1} + \beta_8 \Delta ALERT_{t-1} + \beta_9 \Delta ANTID_{t-1} + \beta_{10} \quad (4.6)$$

$$\Delta RCAN_t = \alpha_2(RCAN_t - \theta_1 IMPCAN_t - \theta_2 UNEMP_t - \theta_3 ALERT_{t-1} - \theta_4 ANTID_{t-1} - \theta_0) + \theta_5 \Delta RCAN_{t-1} + \theta_6 \Delta IMPCAN_{t-1} + \theta_7 \Delta UNEMP_{t-1} + \theta_8 \Delta ALERT_{t-1} + \theta_9 \Delta ANTID_{t-1} + \theta_{10} \quad (4.7)$$

$$\Delta RCHI_t = \alpha_3(RCHI_{t-1} - \rho_1 IMPCHI_{t-1} - \rho_2 UNEMP_t - \rho_3 ALERT_{t-1} - \rho_4 ANTID_{t-1} - \rho_0) + \rho_5 \Delta RCHI_{t-1} + \rho_6 \Delta IMPCHI_{t-1} + \rho_7 \Delta UNEMP_{t-1} + \rho_8 \Delta ALERT_{t-1} + \rho_9 \Delta ANTID_{t-1} + \rho_{10} \quad (4.8)$$

The seasonally adjusted data (using seasonal dummies) were used in the VEC model estimation. In the VEC model estimation, every variable is automatically differenced once. Hence, to get rid of the unit roots in the seasonally adjusted data, all variables were incorporated at their un-differenced state for the model to automatically difference them once to remove all regular unit roots.

4.5 Results

The results for import refusals are discussed separately for Mexico, Canada and China below.

4.5.1 Import refusals from Mexico

The VECM included one lag as suggested by Akaike Information Criterion (AIC), Schwarz Information Criterion (SC), Final Predictor Error (FPE) and Hannan-Quinn information criterion

(HQ) (Table A4.5.1.1)[9]. The estimated VECM of import refusals for Mexico is shown in Table A4.5.1.2. Although the joint probability of Jacque-Bera statistics[10] (689.7945) is significant, it is however not significant with respect to the first component of Table A4.5.1.3, where refusals from Mexico is a dependent variable. Hence, we fail to reject the null hypothesis of normally distributed error terms. Besides, the LM[11] statistic (Table A4.5.1.4) and White Heteroskedasticity[12] statistic (Table A4.5.1.5) are not significant indicating that there are no spherical disturbances in the model. The F-statistic is significant at 1 percent implying that independent variables jointly explain the variations in the model.

4.5.1.1 Long-run effects of import refusals from Mexico

The long-run relationship between import refusals from Mexico, unemployment, value of fruit and vegetables imported from Mexico, food safety alerts and antidumping is the cointegration equation of the estimated VECM for Mexico (Table 4.5.1.1). The results show that in the long-run, import refusals from Mexico are explained by US agricultural sector unemployment, food safety alerts and the value of fruit and vegetables imported from Mexico.

Value of fruit and vegetables imported from Mexico has a positive effect on import refusals. It is also significant at 1 percent. The positive relationship between value of fruit and vegetables imported from Mexico and import refusals implies that refusals increase with increasing imports. This is because when the quantity of fruit and vegetables destined for export increase, the time spent in screening the products to eliminate the non-complying ones is reduced. As a result, the number of products rejected for non-compliance increase with increasing volume of imports. The results suggest that a 1 percent rise in value of fruit and vegetables imported from Mexico will increase import refusals by 10.39 percent in the long-run.

Food safety alerts have a positive effect on import refusals in the long-run and it is significant at 1 percent. There is a positive relationship between food safety alerts and import refusals because when alerts are issued, FDA agents are prompted to thoroughly inspect imports. This increases the chance of finding a non-complying product. In the event that one is found, the entire truckload or container is rejected. In the long-run, refusals will tend to rise as food safety alerts increase. The results show that a 1 percent rise in food safety alerts will increase import refusals from Mexico by 2.39 percent.

The US agricultural sector unemployment (measuring political influence) has a significant (10 percent significance level) effect on import refusals in the long-run. Unemployment has a positive effect on import refusals as expected. Since fruit and vegetables are a labour intensive

[9] Information criteria suggest the number of months the model must be lagged

[10] The Jacque-Bera tests the null hypothesis that error terms are normally distributed. Error terms must be normally distributed for the research results to be generalizable.

[11] LM test for serial correlation. Serial correlation tests the null hypothesis that error terms from one time period is not correlated with another time period. Serial correlation exists when the error terms correlate and it causes estimated standard errors to become smaller. Hence serial correlation can lead to the situation where one is likely to reject the null-hypothesis when it should not be rejected

[12]Heteroskedasticity tests the null hypothesis that variance of error terms are same for the entire sample against the alternate that variance varies along the sample size. LM and White Heteroskedasticity test constitute a test for spherical disturbances

industry with seasonal labour demand, labour demand increases during harvesting and decrease afterwards. Hence, agricultural sector unemployment increases during the production season and decline after harvesting time. Consequently, a rise in agricultural sector unemployment in the US arises to a considerable degree from the fruit and vegetable industry. In the event that the government decides to protect job losses in agriculture, a greater effort has to be geared towards stabilizing employment in the fruit and vegetable industry. Under the current WTO commitments whereby quantitative restriction is limited, tacit manipulation of imports might be anticipated. This results in an increase in import refusals as unemployment increases in agricultural sector. The results indicate that a 1 percent rise in agricultural sector unemployment in the US will increase import refusals from Mexico by 3.35 percent in the long-run.

Antidumping has a positive effect on import refusals in the long-run. It is, however, not significant. The direct relationship between antidumping and import refusals confirms the proposition that when antidumping is initiated against imported products (i.e. seeking direct protection against foreign completion), officials are lobbied to increase protection. However, antidumping may not be significant in explaining import refusals from Mexico in the long-run as a result of the low level of antidumping activity observed in the analysis.

Table 4.5.1.1 Long-run effects of import refusals from Mexico

Variable	coefficient	Standard error	t-statistic
$RMEX_{t-1}$	1.0000		
$IMPMEX_{t-1}$	10.3860	1.1979	8.6696***
$UNEMP_{t-1}$	3.3525	1.1467	2.9236*
$ALERT_{t-1}$	2.3934	0.4429	5.4039***
$ANTID_{t-1}$	0.6348	0.5836	1.0877
$@TREND$	0.0333		
β_0	82.219		

****, ** and * are significance at 1 percent, 5 percent and 10 percent respectively*

4.5.1.2 Short-run effects of import refusal from Mexico

The short-run relationship is captured by the error correction component of the VEC model (Table 4.5.1.2). In the short-run, import refusals from Mexico are explained by past refusals from Mexico, value of fruit and vegetables imported from Mexico, food safety alerts and antidumping.

In the short-run, past import refusals from Mexico (lagged by 1 month) have a negative effect on current refusals. Past import refusals is significant at 10 percent. This may be due to the fact that as a country's imports begin to face rising rejection, importers identify and address the reasons associated with rejection to subsequently decrease future refusals. The results show that a 1 percent increase in past refusals will decrease current refusals from Mexico by 0.47 percent in the long-run.

The value of fruit and vegetable imported from Mexico has a positive effect on import refusals from Mexico and it is significant at 10 percent. The positive relationship between value of fruit and vegetables imported from Mexico and import refusals suggest that refusals will increase when imports increase. As in the long run case, when import volumes rise the time spent on screening to eliminate non-complying ones is reduced. This allows more non-complying products to be shipped for export only to be rejected at the border. Sometimes, the whole truckload or container is rejected if one non-complying item is found. Eventually, the number of refusals will increase as imports increase. The results show that a 1 percent rise in value of fruit and vegetables imported from Mexico will increase refusals from Mexico by 0.46 percent in the short-run.

Food safety alerts have a significant (at 10 percent) positive effect on import refusals. The positive relationship between food safety alerts and import refusals from Mexico indicates that refusals will increase when the government issues more food safety alerts. This is because alerts tend to prompt officials to check food products more thoroughly than they would have done if there were no alerts. The results show that a 1 percent rise in food safety alerts will increase refusals from Mexico by about 0.059 percent.

Agricultural sector unemployment in the US (measuring political influence) has no significant effect on import refusals from Mexico in the short-run although it bears the expected positive sign. This is because unemployment usually rises gradually rather than showing a sudden increase. Hence, officials may not be prompted until unemployment figures become alarmingly high which explains why refusals do not immediately respond to changes in unemployment in the short run.

Antidumping (as a measure of political influence) has a positive effect on import refusals from Mexico in the short-run. Antidumping is also significant at 1 percent. This confirms the hypothesis that when antidumping activity is initiated against imported products (i.e. seeking direct protection against foreign competition), officials are lobbied to increase protection. Further, Mexico is a low cost producer of fruit and vegetables by virtue of its climatic condition, which allows all year round production coupled with relative cheap labour (Calvin and Martin 2010). This could create the perception among the US farmers that Mexican producers may engage in predatory pricing. In this regard, when an antidumping activity is initiated against fruit and vegetables, government may well be lobbied to increase protection through import refusals which can explain the significant relationship between import refusals and antidumping.

The short-run adjustment coefficient (-0.024460) has a negative sign. The short-run adjustment coefficient is significant at 10 percent. This suggests that the model corrects about 2.44 percent per month of any increase in refusals.

Table 4.5.1.2 Short-run effects of import refusals from Mexico

Variable	Coefficient	Standard error	t-statistic
α_1	-0.02446	0.01172	-2.0871*
$\Delta RMEX_{t-1}$	-0.46603	0.08522	5.46832*
$\Delta IMPMEX_{t-1}$	0.45576	0.17163	2.65546*
$\Delta UNEMP_{t-1}$	0.07551	0.20569	0.36712
$\Delta ALERT_{t-1}$	0.0588	0.02189	2.68652*
$\Delta ANTID_{t-1}$	1.2074	0.21121	5.7167***
$@TREND$	2.70E-05	0.00064	0.04184
β_{10}	-0.0018	0.04585	-0.04055

****, ** and * are significance at 1 percent, 5 percent and 10 percent respectively*

4.5.2 Import refusals from Canada

The VECM included one lag as suggested by Akaike Information Criterion (AIC), Schwarz Information Criterion (SC), Final Predictor Error (FPE) and Hannan-Quinn information criterion (HQ) (Table A4.5.2.1)[13]. The estimated VECM of import refusals for Canada is shown in Table A4.5.2.2. Although the joint probability of Jacque-Bera statistics[14] (856.3214) is significant, it is, however, not significant with respect to component 1 of Table A4.5.2.3, where import refusals from Canada is the dependent variable. Hence, we fail to reject the null hypothesis of normally distributed error terms. Besides, the LM[15] statistic (Table A4.5.2.4) and White Heteroskedasticity[16] statistic (Table A4.5.2.5) are not significant indicating that there are no spherical disturbances in the model. The F-statistic is significant at 5 percent implying that the independent variables jointly explain variations in the model.

[13] Information criteria indicates the number of months the model must be lagged

[14] The Jacque-Bera test tests the null hypothesis that the error terms are normally distributed. Error terms must be normally distributed for the research results to be generalizable.

[15] LM test for serial correlation. Serial correlation tests the null hypothesis that error terms from one time period is not correlated with another time period. Serial correlation exists when the error terms correlate and it causes estimated standard errors to become smaller. Hence serial correlation can lead to the situation where one is likely to reject the null-hypothesis when it should not be rejected

[16]Heteroskedasticity test the null hypothesis that variance of error terms are same for the entire sample against the general alternate that variance of error term varies along the sample size. LM and White Heteroskedasticity test constitute a test for spherical disturbances

4.5.2.1 Long-run effects of import refusals from Canada

The long-run relationship between import refusals from Canada, value of fruit and vegetables imported from Canada, US agricultural sector unemployment, food safety alerts and antidumping is the estimated cointegration equation of the VECM for Canada (Table 4.5.2.1). The results show that, in the long-run, US agricultural sector unemployment, value of fruit and vegetables imported from Canada and food safety alerts explain import refusals from Canada.

The value of fruit and vegetables imported from Canada has a positive effect on import refusals from Canada in the long-run. It is also significant at 1 percent. The positive relationship between value of fruit and vegetables imported from Canada and import refusals confirms the hypothesis that non-complying products rise with increasing imports. This is because, when imports rise, the time spent in screening products from production site before exporting is reduced. This tends to increase the number of non-complying products which get rejected at the border. The results show that a 1 percent rise in value of fruit and vegetables imported from Canada will increase import refusals from Canada by 1.63 percent in the long-run.

Food safety alerts have a significant (5 percent significance level) positive effect on import refusals. The results show that a 1 percent increase in food safety alerts will increase import refusals from Canada by 0.27 percent. The safety of Canadian fruit and vegetables is of concern to US consumers as Canada is one of the largest sources of imports. Hence, it is likely that when alerts are issued, inspection of fruit and vegetables from Canada will be intensified to prevent any potential food safety hazards from getting into US.

Agricultural sector unemployment in the US (measuring political influence) has a positive effect on import refusals as expected. Agricultural sector unemployment is significant at 10 percent. Since fruit and vegetable is a labour intensive industry with seasonal labour demand, changes in unemployment across the agricultural sector tends to arise to a considerable degree from the fruit and vegetable industry. As such, government's intervention to protect job losses in agricultural sector could lead to a greater focus on the fruit and vegetable industry. In this regard, protection may be increased in the fruit and vegetable industry by increasing import refusals, which reflects the direct relationship between import refusals and agricultural sector unemployment. This conforms to Baylis et al (2009)'s finding that declines in employment in a given import-substitution sector increases import refusals. The results suggest that a 1 percent increase in unemployment will increase Canadian import refusals by 1.28 percent in the long-run.

Antidumping, on the other hand, has no significant effect on import refusals in the long-run although a positive relationship exist between antidumping and import refusals from Canada. The positive relationship between import refusals and antidumping confirms the expectation that refusals will usually increase when domestic producers request an antidumping investigation. Since antidumping is regarded as wake-up call on the government to come to the aid of domestic firms against unfair foreign competition, officials may be lobbied to restrict product entry at the same time. However, antidumping is probably not significant in the long-run because of fairly small number of antidumping cases noted over the study period. A large sample size is preferred in long-run analysis. Further, Canada serves as the largest export market for US fruit and vegetable producers. Hence, attempts to manipulate import refusals when an antidumping case has already been made could trigger retaliation and possibly jeopardise access to the Canadian market. In any event, antidumping did not have a significant effect on import refusals from Canada.

Table 4.5.2.1 Long-run effects of import refusals from Canada

Variable	Coefficient	Standard error	t-statistic
$RCAN_{t-1}$	1.0000		
$IMPCAN_{t-1}$	1.633905	0.21239	7.69306***
$UNEMP_{t-1}$	1.282111	0.23797	5.38775***
$ALERT_{t-1}$	0.267799	0.08610	3.11036**
$ANTID_{t-1}$	0.103433	0.07233	1.43005
$@TREND$	0.007018		
θ_0	-13.00450		

****, ** and * are significance at 1 percent, 5 percent and 10 percent respectively*

4.5.2.2 Short-run effects of import refusals from Canada

The Table 4.5.2.2 reports the short-run estimates of import refusals for Canada. In the short-run, import refusals from Canada are explained by value of fruit and vegetables imported from Canada and food safety alerts. Past import refusals from Canada has an inverse relationship with current refusals although it is not significant. This implies that when refusals rise, exporters/importers identify and address the reason for the incident in order to ensure that in future imports are not impeded by refusals.

The value of fruit and vegetable imported from Canada has a positive effect on import refusals from Canada in the short-run and it is significant at 10 percent. As in the long-run, the positive relationship between value of imports and refusals confirms the hypothesis that the number of non-complying products will rise whenever imports rise. This is because, when imports rise, the time spent on screening products at production sites before exporting is reduced. This tends to increase the number of non-complying products entering the export supply chain, which subsequently get rejected at the border. The results show that a 1 percent rise in imports will increase import refusals by 0.63 percent.

Food safety alerts has a significant (10 percent significance) positive effect on import refusals from Canada in the short-run. The model predicts that a 1 percent rise in food safety alerts will increase import refusals from Canada about 0.15 percent in the short-run. The positive relationship between food safety alerts and import refusals arise because, when alerts are issued, officials intensify inspection to prevent any unsafe food from getting into US. This increases the chance of finding non-complying products, which consequently increase import refusals.

Agricultural sector unemployment in the US (measuring political influence) has no significant effect on import refusals from Canada in the short-run. This is partly because unemployment usually rises gradually rather than showing a sudden increase. As such officials may not be prompted until unemployment figures become alarmingly high and, hence, import refusals in response to unemployment may be muted.

Further, although antidumping has a positive effect on import refusals from Canada as expected, it is not significant. The direct effect between import refusals and antidumping confirms the expectation that refusals will usually increase when domestic producers request an antidumping investigation. This could be the case because antidumping is a call on the government to protect domestic firms against unfair foreign competition which the government responds to by increasing refusals. Although Canada is the second largest exporter of fruit and vegetables to US, production is limited by climatic condition to at most four months in a year. For most parts of the year and for some vegetables, production is undertaken in greenhouses. Greenhouse production makes Canada a high cost producer and therefore decreases the likelihood that firms will undertake predatory pricing, which is a condition antidumping. Further, as in the long-run, since Canada is the second largest export market for US fruit and vegetables, manipulating Canadian imports in the glare of an antidumping investigation could trigger retaliation and jeopardise access to Canadian market. In any case, antidumping tend to have no significant effect on import refusals from Canada.

The short-run adjustment coefficient (-0.769446) is significant (at 5 percent) with a negative effect as expected. This suggests that the model corrects about 76.94 percent of any increase in import refusals per month.

Table 4.5.2.2 Short-run effects of import refusals from Canada

Variable	Coefficient	Standard error	t-statistic
α_2	-0.769446	0.13377	-5.75217**
$\Delta REFCAN_{t-1}$	-0.014259	0.10299	-0.13845
$\Delta IMPCAN_{t-1}$	0.629207	0.23799	2.64389*
$\Delta UNEMP_{t-1}$	0.122241	0.34953	0.34973
$\Delta ALERT_{t-1}$	0.14579	0.06150	2.3705*
$\Delta ANTID_{t-1}$	0.138696	0.14668	0.94557
$@TREND$	7.38E-05	0.00108	0.00430
θ_{10}	-0.000330	0.07679	-0.00868

****, ** and * are significance at 1 percent, 5 percent and 10 percent respectively*

4.5.3 Import refusals from China

The VECM included one lag as suggested by Akaike Information Criterion, Schwarz Information Criterion, Final Predictor Error and Hannan-Quinn information criterion (Table A4.5.3.1)[17]. The estimated VECM of import refusals for China is shown in Table A4.5.3.2. Although the joint probability of Jacque-Bera statistics[18] (824.3441) is significant, it is however not significant with respect to component 1 of Table A4.5.3.3, where refusals from China is the dependent variable. Hence, we fail to reject the null hypothesis of normally distributed error terms. Besides, the LM[19] statistic (Table A4.5.3.4) and White Heteroskedasticity[20] statistic (Table A4.5.3.5) are not significant indicating that there are no spherical disturbances in the model. The F-statistic is significant at 1 percent and, therefore, suggests that the independent variables jointly explain the variations in the model.

4.5.3.1 Long-run effects of import refusals from China

The cointegration coefficients indicate the long-run determinants of import refusals from China (Table 4.5.3.1). The results show that the value of fruit and vegetables imported from China, food safety alerts and US agricultural sector unemployment explain import refusals from China in the long-run.

The value of fruit and vegetables imported from China has a significant (at 1 percent) positive effect on import refusals from China. The results show that a 1 percent rise in value fruit and vegetables imported from China will increase the associated import refusals by 37.07 percent. The positive relationship between value of fruit and vegetables imported from China and import refusals confirms the hypothesis that refusals will increase when imports increase. This is because with higher volumes of product to export, time spent on product screening to eliminate non-complying ones before exporting is reduced. As such, the number of non-complying products associated with imports will rise as imports rise.

Further, food safety alerts have the expected positive effect on import refusals from China and it is significant at 1 percent. There is a positive relationship between food safety alerts and import refusals because when alerts increase FDA officials intensify inspection to prevent any unsafe food from getting into US. This consequently leads to increase refusals when alerts increase. The results show that 1 percent rise in food safety alerts will increase import refusals from China by 6.31 percent in the long-run.

Agricultural sector unemployment in the US (measuring political influence) has a direct relationship with import refusals although it is not significant. Since fruit and vegetables are a labour intensive industry with seasonal labour demand, a general rise in unemployment across

[17] Information criteria indicates the number of months the model must be lagged

[18] The Jacque-Bera test tests the null hypothesis that the error terms are normally distributed. Error terms must be normally distributed for the research results to be generalizable.

[19] LM test for serial correlation. Serial correlation tests the null hypothesis that error terms from one time period is not correlated with another time period. Serial correlation exists when the error terms correlate and it causes estimated standard errors to become smaller. Hence serial correlation can lead to the situation where one is likely to reject the null-hypothesis when it should not be rejected

[20]Heteroskedasticity test the null hypothesis that variance of error terms are same for the entire sample against the general alternate that variance of error term varies along the sample size. LM and White Heteroskedasticity test constitute a test for spherical disturbances

the agricultural sector tends to arise to a considerable degree from the fruit and vegetable industry. As such, government's intervention to protect seasonal increases in agricultural sector unemployment may bring forth a greater focus on the fruit and vegetable industry. In this regard, protection may be accomplished in fruit and vegetable industry by increasing import refusals, which reflects the direct relationship between import refusals and agricultural sector unemployment.

Antidumping, on the other hand, has no significant effect on import refusals in the long-run although it has the expected positive effect on import refusals. The positive relationship between import refusals and antidumping confirms the expectation that refusals will usually increase when domestic producers request an antidumping investigation. However, antidumping may not be significant in the long-run in this model because of the small number of cases observed.

In summary, antidumping and agricultural sector unemployment are not significant in explaining import refusals from China. The model therefore suggests that import refusals from China are not politically influenced in the long-run. A possible argument for this may be that China is a relatively smaller supplier of fruit and vegetables in the US market compared to major exporters such as Mexico and Canada. China's long distance from US reduces its ability to supply fresh produce relative to Mexico and Canada. As such, Chinese exports over the years may not have been perceived as a threat to the US fruit and vegetable industry to the same degree as Canadian and Mexican products. Hence, China's exports did not need to be politically restrained to protect the domestic producers. Rather, the significance of food safety alerts variable implies that US public is concerned about the safety of Chinese fruit and vegetables rather than their economic competitiveness.

Table 4.5.3.1 Long-run effects of import refusals from China

Variable	Coefficient	Standard error	t-statistic
$RCHI_{t-1}$	1.0000		
$IMPCHI_{t-1}$	37.07205	5.82129	6.36836***
$UNEMP_{t-1}$	0.2641	0.41284	1.56321
$ALERT_{t-1}$	6.308861	2.27896	2.76831**
$ANTID_{t-1}$	0.056059	1.97333	0.02841
$@TREND$	0.248285		
ρ_0	-260.4409		

****, ** and * are significance at 1 percent, 5 percent and 10 percent respectively*

4.5.3.2 Short-run effects of import refusals from China

In the short-run, import refusals are explained by past import refusals from China, value of fruit and vegetables imported from China and food safety alerts. Past Chinese import refusals have a significant (1 percent significance level) negative effect on import refusals. This implies that when previous refusals are substantial, potential exporters/importers take more stringent measures to identify and address the causes of rejection to ensure that future rejections are reduced. The results show that a 1 percent increase in past import refusals from China will decrease current import refusals by 0.49 percent in the short-run.

Food safety alerts have a positive effect on import refusals from China. It is significant at 5 percent. This again indicates that the US is more concerned about the safety of Chinese products than their competitiveness, especially given recent food scares that have been associated with some Chinese foods (Patience 2011). The results suggest that a 1 percent increase in food safety alerts will increase import refusals by 0.08 percent.

Agricultural sector unemployment in the US and antidumping (both measuring political influence) are not significant although they exhibit the expected direct relationship with import refusals in the short-run. As in the long-run, a possible argument for this is because China is a relatively smaller exporter of fresh fruits and vegetables to US compared to major exporters such as Mexico, Canada and Chile. China's long distance from the US reduces its ability to supply fresh produce to US relative to Mexico and Canada. As such, Chinese exports over the years may not have been perceived as a threat to US fruit and vegetable industry to the same degree as Canadian and Mexican products and, hence, did not need to be politically restrained to protect the domestic producers. Rather, the significance of food safety alerts suggests that the US public is more concerned about the safety of Chinese fruit and vegetables rather than their economic competitiveness.

Further, the coefficient of adjustment (-0.015008) is negative and significant (5 percent level) as expected. This suggests that the model corrects about 1.5 percent per month of any previous increase in import refusals.

Table 4.5.3.2 Short-run effect of import refusals from China

Variable	Coefficient	Standard error	t-statistic
α_3	-0.015008	0.00467	-3.2137**
$\Delta REFCHI_{t-1}$	-0.494332	0.08278	-5.97197***
$\Delta IMPCHI_{t-1}$	0.075918	0.03280	2.3145*
$\Delta UNENMP_{t-1}$	0.327921	0.23134	1.41747
$\Delta ALERT_{t-1}$	0.082215	0.02489	3.3031**
$\Delta ANTID_{t-1}$	0.134666	0.10240	1.31507
$@TREND$	0.000161	0.00075	0.21344
ρ_{10}	0.025301	0.05369	0.47121

****, ** and * are significance at 1 percent, 5 percent and 10 percent respectively*

4.5.4 Summary

The results of political influence in fruit and vegetable import refusals are summarised below in sub-sections for Mexico, Canada and China.

4.5.4.1 Import refusals from Mexico

Refusals from Mexico are explained by antidumping, agricultural sector unemployment in the US, food safety alerts and the value of fruit and vegetables imported from Mexico. The results show that rising fruit and vegetable imports from Mexico leads to rise in import refusals in both long-run and short-run. Food safety alerts have a significant positive effect on import refusals. As such, when food safety alerts are increased, refusals from Mexico rise as well. This might be due to intensified inspection of all foods when alerts are issued in order to eliminate any potential hazard associated with imports. The results also show that when antidumping cases brought against fruit and vegetable rise, import refusals from Mexico increase in the short-run. Antidumping does not affect import refusals in the long-run and this might be attributed to the generally low level of antidumping activity observed. US agricultural sector unemployment, on the other hand, has a significant positive effect on import refusals only in the long run. The results show that a 1 percent rise in agricultural sector unemployment will increase import refusal about 3.35 percent in the long-run.

4.5.4.2 Import refusals from Canada

The results indicate that import refusals from Canada are explained by unemployment, the value of fruit and vegetables imported from Canada and the number of food safety alerts issued in the US. In the long-run, food safety alert have a significant positive effect on import refusals. The results show that a 1 percent increase in food safety alerts will increase import refusals about 0.26 percent in the long-run. Further, a 1 percent rise in food safety alerts increases import refusals by 0.15 percent in the short-run. Rising fruit and vegetable import values from Canada leads to an increase in import refusals. This may be because, when import volumes increase, time spent on inspecting products before they are dispatched for export is reduced. As such, non-complying products associated with imports increase which subsequently gets rejected at the border.

Agricultural sector unemployment in the US has a significant positive effect on import refusals in the long-run. This is particularly the case because fruit and vegetables contribute significantly to unemployment in agriculture as a result of seasonal labour demand. Hence, during off seasons, labour is laid off and then re-hired during production. The government's attempts to fight unemployment in agriculture therefore require action in the fruit and vegetable industry. As it is an import substitution industry, government's interventions to protect jobs can come from restricting imports. This can explain the direct relationship between import refusals and agricultural sector unemployment. The model predicts that a 1 percent increase in unemployment will increase import refusal by 1.28 percent in the long-run. Antidumping, on the other hand, has a positive effect on import refusals both in the long-run and short-run but it is not significant. This may be due to the limited antidumping activity observed. It could also be because Canada provides the largest export market for US fruit and vegetable farmers. Hence, any attempt to manipulate imports in the glare of an antidumping investigation might trigger retaliation and jeopardize US access to the Canadian market.

4.5.4.3 Import rrefusals from China

Past import refusals from China, the value of fruit and vegetables imported from China and the number of food safety alerts explains import refusals from China. Food safety alerts positively affect refusals from China, both in the short-run and long-run. This is because when alerts are issued, FDA officials may step up inspection rigor to prevent any unsafe food from entering the US, which leads to increase refusals. The results show that 1 percent rise in food safety alerts will increase refusals by 6.3 percent and 0.08 percent in the short-and long-run respectively. Rising fruit and vegetable imports from China leads to an increase in import refusals. Imports have a direct relationship with refusals because, it may be that when volumes destined for exports increase the time spent on screening the products is reduced. This leads to more non-complying products being left undetected only to be rejected at the border.

Neither antidumping nor unemployment are significant in explaining import refusals from China. A possible argument may be that China is a relatively smaller exporter of fresh fruits and vegetables compared to major exporters such as Mexico, Canada and Chile. China's long distance from US reduces its ability to supply fresh produce to US relative to Mexico and Canada. As such, Chinese exports over the years may not have been perceived as a threat to the US fruit and vegetable sector to the same degree as Canadian and Mexican exports. Hence, China's exports did not need to be politically restrained to protect the domestic producers. Rather, the significance of the food safety alerts variable may imply that the US is more concerned about the safety of Chinese fruit and vegetables rather than their economic competitiveness.

Having examined import refusals for political influence, the next chapter examines the trend in *Salmonella* foodborne disease *incidence* as a justification for the FSMA**.**

Chapter 5: *Prima facie* Justification for New Regulations

5.1 Introduction

This chapter presents the methodology, results and discussions pertaining to evidence of foodborne diseases as a *prima facie* justification for new regulations (i.e. the FSMA).

5.2 Methodology

Foodborne disease incidence has been a key argument for the institution of new regulations (FDA 2011c). It is argued that disease incidence is increasing in recent times. An observation, the FDA suggested that increasing incidents are an indication of the infectiveness of current regulations in ensuring the safety of food in the US (FDA 2011c). Hence, the FSMA needed to be enacted as a more effective regulation that empowers FDA to embark on a preventive approach to food safety.

The CDC defines *incidence* as the number of cases per surveillance population (usually 100,000 people). Most notable incidences are caused by *Salmonella*, *Campylobacter*, *E. coli*, *Listeria*, *Vibrio*, *Yersinia*, *Clostridium perfringens* and *Staphylococcus aureus*. While incidence of many of these pathogenic organisms are declining, *Salmonella* incidence have been increasing, and it represents the single most challenging foodborne disease for the US food safety systems (CDC 2010). This chapter focuses on analysing the trend[21] in *Salmonella* foodborne disease incidence as a justification for the FSMA. It is therefore hypothesised that FSMA is legitimate if foodborne disease incidence show a significant rising trend. Hence, the *prima facie* justification for new food safety regulations is assessed by testing for a significant direct relationship between *Salmonella* incidence and a time variable (referred to as "Time").

5.3 Econometric model

The disease incidence of a microbial organism is modelled to follow a pattern where incidence at a given time (t) is dependent on previous incidence (t-i). Previous *Salmonella* incidence (i.e. $Salmonella_{t-i}$) is expected to positively affect current incidence ($Salmonella_t$). The reason being that, microbial organisms by virtue of their exponential growth increase considerably upon outbreak thereby making past incidences important in predicting future occurrences. Hence, $Salmonella_{t-i}$ is expected to have a positive effect on current incidence.

Further, we include the "time" variable (measured as number of months) to investigate whether incidence are decreasing, increasing or have remained constant over the study period. Though sporadic spikes in incidence are not desirable, it is assumed that food safety institutions are more concerned about trend. A rising trend implies that the food safety systems in the US are ineffective and therefore need strengthening. Hence, time is expected to have a significant

[21] Trend is the relationship between *Salmonella* incidence and time.

positive effect on *Salmonella* incidence to justify the enactment of FSMA. *Salmonella* incidence is therefore modelled as:

$$Salmonella_t = \beta + \beta_o Time + \beta_1 Salmonella_{t-i} + \varepsilon_t \quad (5.1)$$

Where:

i = 1, 2, 3, ……, 11 (number of lags)

β and ε measures constant and error terms respectively.

5.3.1 Testing for structural break

Further, the FDA (2011c) argued that the trend in *Salmonella* foodborne disease is as well changing. However, studies showing trend of *Salmonella* have largely not considered statistical changes. Hence, we first of all explore the data for any possible changes in *Salmonella* incidence trend (.i.e. testing for structural break). Testing for unknown alterations in a time series variable is important since data involving breaks could mislead − leading to conclusions that the data is non-stationary (Madalla and Kim 1998). In this study, examining the data for altered trend is helpful in shedding light on the behavior of disease incidence over time. For example, although the overall incidence could be rising as argued, there is a possibility that incidence could be falling in recent times. Such an observation implies that foodborne disease incidence are beginning to fall and do not merit new regulations.

Testing for breakpoints has been pioneered by the Chow Test. However, the Chow Test requires the exact break date to be known and the estimated Chow statistic is then compared with critical values of the F-distribution. Where the statistic is significant, then we conclude that a break occurred at the given point. Hence, a major limitation of the Chow Test is its inapplicability where the researcher does not have a definite date in mind (Madalla and Kim 1998). In view of this, Quandt (1958, 1960) proposed the Supremum (Max Chow) Test as a technique for estimating statistical break dates where the exact break date is unknown. According to Allaro et al (2010, p. 394):

> These tests are calculated by using individual Chow Statistics for each date of the data except from some trimmed portion from both ends of it. The Supremum test is calculated for and finds the date that maximizes Chow Statistics which also is the most possible break point.

Madala and Kim (2000) indicated that breakpoints must be tested for within the range of the 15th percentile and 85th percentile of the data range in order to avoid breaks to the tails. Although the full disease incidence ranges from January 1995 to December 2010, the test is carried over the period of July 1997 to September 2008, inclusive. The Chow Test is therefore the basic unit underlying Quandt's analysis. The Chow formula has an F-distribution given as:

$$F_{(k,\, n_1+n_2-2k)} = \frac{(RSS_T - RSS_1 - RSS_2)/k}{(RSS_1 + RSS_2)/(n_1+n_2-2k)} \qquad (5.2)$$

Where:
RSS_T= sum of squared risiduals for the pooled model

RSS_1 = sum of squared reisduals for sub-sample model 1
RSS_2 = sum of squared residual for sub-sample model 2
k = number of estimated parameters including the constant term
n_1 = sample 1's sample size
n_2 = sample 2's sample size
n = total sample size(i.e. $n_1 + n_2$)
(Adapted from Madalla and Kim 2000)

The estimated Chow statistics are plotted over time. However, the Max Chow statistic is the highest absolute significant statistic tested under critical values provided by Andrews (1993). The Max-Chow is distributed as:

$$Max\ Chow = \max_{\pi_1 < m < \pi_2} F(\pi_1, \pi_2, \lambda) \quad (5.3)$$

Where:
m = breakpoint

$$\pi_1 = \frac{number\ of\ date\ points\ excluded\ at\ lower\ bound}{Entire\ sample\ size(T)}$$

$$\pi_2 = \frac{number\ of\ date\ points\ excluded\ at\ the\ upper\ bound}{Entire\ sample\ size(T)}$$

$$\lambda = {\pi_2(1-\pi_1)}/{\pi_1(1-\pi_2)}$$

(Adapted from Hansen (2009))

The data is said to have multiple breakpoints when two or more significant statistics have equal absolute values. Evidence of a structural break will amount to estimating equation (5.1) in two sub-models as in (5.2) and (5.3):

$$Sample\ 1: Salmonella_t = \beta + \beta_o Time + \beta_1 Salmonella_{t-i} + \varepsilon_t, t = 1, 2, \ldots. m \quad (5.4)$$

$$Sample\ 2: Salmonella_t = \beta * + \beta_{o1} Time + \beta_{11} Salmonella_{t-i} + \varepsilon_t, t = m+1, \ldots., T \quad (5.5)$$

Where there is no break, the equation 5.1 will be estimated.

5.4 Results and discussion

The results of the analysis of *Salmonella* for foodborne disease incidence as a justification for FSMA are presented in subsections below. The analysis covers descriptive statistics, trend in incidence, structural break test and the estimated disease incidence model.

5.4.1 Descriptive statistics

The data on foodborne disease incidence was sourced from the Center for Disease Control and Prevention (CDC) of the US and ranges from January 1995 to December 2010. It is limited to 2010 because the new regulation was signed in January 2011. Hence, it is expected that the reasons for the institution of the new regulations would be observable prior to 2011[22].

The average and median infection per month of *Salmonella* in the US are about 319.4 and 233 respectively over the study period. While the minimum and maximum incidence per month is about 7 and 1873 respectively, the data is positively skewed. This implies that majority of the data points are closer to the lower tail (Table 5.4.1).

Table 5.4.1 Descriptive statistics of *Salmonella* incidence

Statistic	SAMONELLA
Mean	319.4167
Median	233.0000
Maximum	1873.000
Minimum	7.000000
Std. Dev.	291.4810
Skewness	2.153130
Kurtosis	9.331644
Jarque-Bera	469.0687
Probability	0.000000
Sum	61328.00
Sum Sq. Dev.	16227587
Observations	192

5.4.2 *Salmonella* disease incidence

The monthly foodborne disease incidence for *Salmonella* in the US from January 1995 to December 2010 is shown in Fig 5.4.2.1. The vertical and horizontal axes are disease incidence (in natural logarithms) and years respectively. Monthly data shows frequent fluctuations in *Salmonella* incidence across years.

[22] Besides, 2011 data is still provisional and could not be used in the analysis.

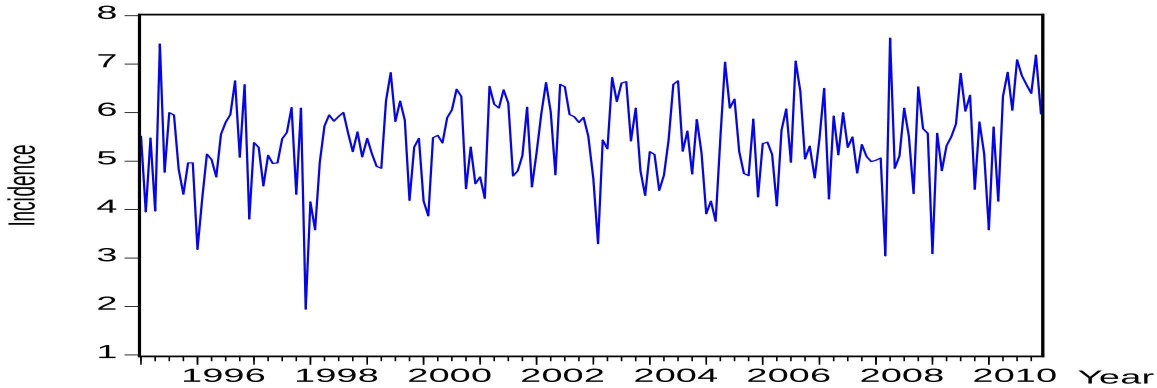

Fig 5.4.2.1 Trend in *Salmonella* incidence in US: 1995 – 2010

5.4.3 Results of structural break test

The plot of Chow-statistic from the period May 1997 to September 2008 is presented in Fig 5.4.3.1 below. The vertical axis is composed of Chow-statistics and critical values while the horizontal axis is the years. Chow values are significant at the point where absolute value is greater than or equal to the critical value. In the diagram, the Maximum Chow value is 4.35 but this is below Andrew (1993)'s critical values at 10 percent, 5 percent and 1 percent. Hence, it is concluded that there are no structural break(s) in *Salmonella* incidence over the study period. The *Salmonella* incidence model is therefore estimated in a single equation as in (5.1).

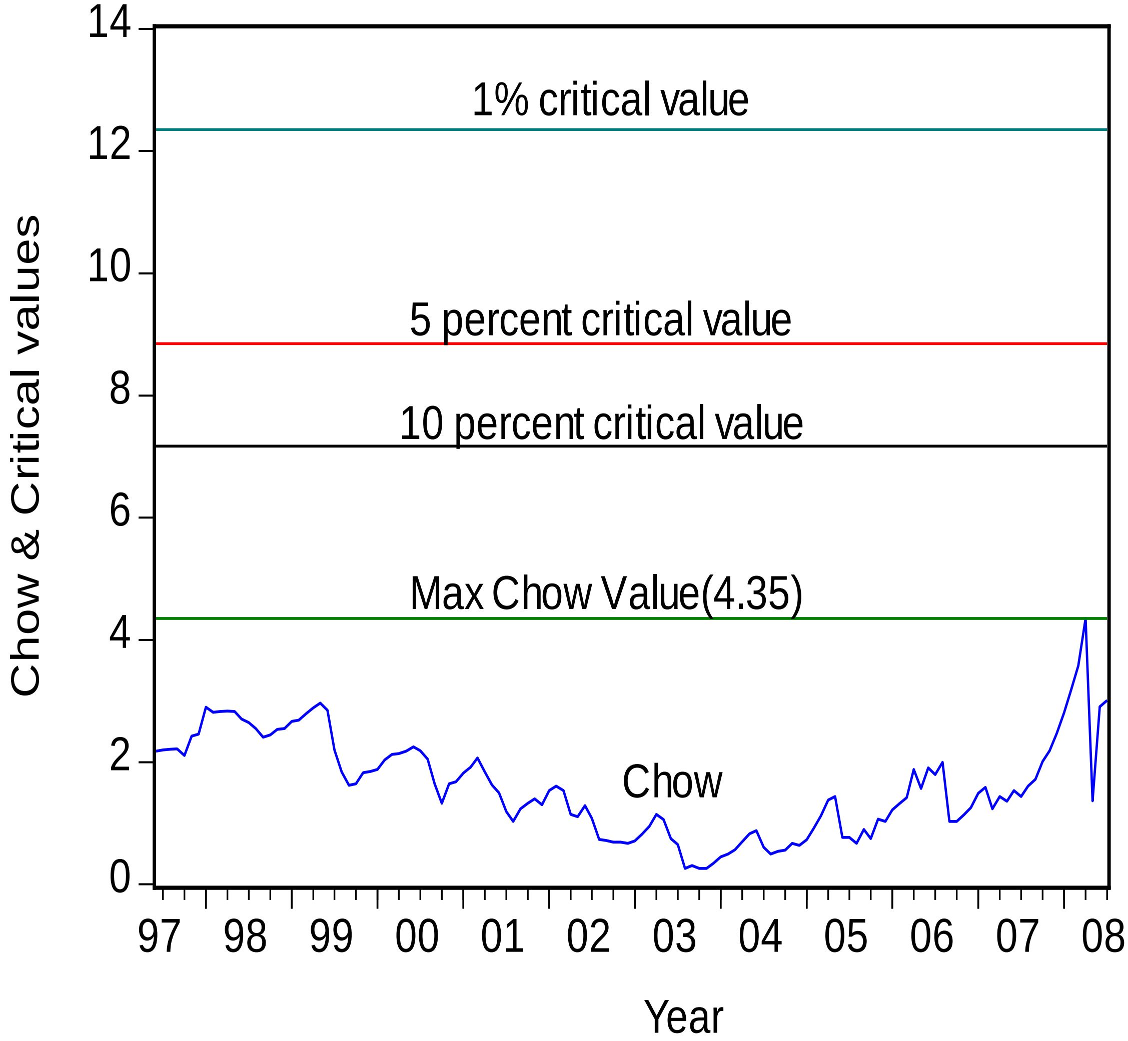

Fig 5.4.3.1 Max Chow test for break in *Salmonella* incidence

5.4.4 Estimated *Salmonella* incidence model

The results of *Salmonella* foodborne disease incidence is shown in Table 5.4.4. The coefficient of determination (R-square) is 0.044622 indicating that about 4.5 percent of the variation in incidence is explained by the model. Further, the F- statistic (0.013692) is significant at 5 percent, implying that independent variables jointly explain the variations in *Salmonella* incidence. The LM test for serial correlation (Table A5.4.4.1) and the White Heteroskedasticity test (Table A5.4.4.2) are both not significant. Hence, we fail to reject the null hypothesis of no spherical disturbances in the model.

Previous incidence (SALM(-1)) has a positive effect on current incidence, and it is significant at 1 percent. This, in part, confirms the hypothesis that past incidence increases future outbreaks. The results show that a 1 percent increase in previous incidence will increase current incidence about 0.13 percent.

Further, the Time (0.770412) has a positive effect on disease incidence and is significant at 5 percent. The positive relationship between incidence and Time shows that disease incidence increases over time. This suggests that US food regulations are becoming obsolete in preventing *Salmonella* outbreaks and justifies the US decision to strengthen food safety regulations.

Table 5.4.4 Estimated *Salmonella* disease incidence model

Dependent Variable: SAMONELLA
Included observations: 191 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	203.4420	45.29555	4.491434	0.0000
SAMONELLA(-1)	0.130412	0.072310	1.803516	0.0729*
TIME	0.770412	0.382212	2.015667	0.0453**

R-squared	0.044622	Mean dependent var	319.7801
Adjusted R-squared	0.034459	S.D. dependent var	292.2035
S.E. of regression	287.1248	Akaike info criterion	14.17329
Sum squared resid	15498846	Schwarz criterion	14.22438
Log likelihood	-1350.550	F-statistic	4.390413
Durbin-Watson stat	2.028822	Prob(F-statistic)	0.013692

*** and * are significance at 5 percent and 10 percent respectively*

5.5 Summary

The *Salmonella* incidence in the US has been rising over time. The results show that *Salmonella* foodborne disease incidence has a significant positive relationship with time. This suggest that present food safety regulations may becoming less effective and might justify the US decision to strengthen its food safety laws. However, the Max Chow Test failed to establish evidence of statistical change in *Salmonella* foodborne disease incidence trend over the study period.

Having looked at the trend in *Salmonella* foodborne disease incidence as the justification for the FSMA, the next chapter proceeds to examine the implications of the FSMA for the relative competitiveness of US and foreign firms.

Chapter 6: FSMA and Competitiveness of Firms

6.1 Introduction

This chapter presents a graphical analysis of the relative competitiveness of domestic and foreign firms under the FSMA. A partial equilibrium model is used to analyze the economic competitiveness of firms under the new regulation under two scenarios: (1) all firms face equal compliance cost; and (2) compliance cost is higher for foreign firms. Compliance cost is assumed to be a variable cost such that it affects both the average and marginal costs of a firm. It is also assumed that there are no transportation or transaction costs. Finally, we assume that firms operate in a perfectly competitive market, are equal in size and cost, and produce the same kind of product referred to here as a particular fruit or vegetable.

6.2 Equal compliance cost

The Fig 6.1 below illustrates the scenario where compliance cost is equal for US and foreign firms supplying a fruit (or vegetable) into the market (i.e. US domestic market). It is also assumed under this scenario that both foreign and domestic firms can supply the market without any existing trade barriers inhibiting the foreign firm's access to the market. The vertical and horizontal axes in each graph represent price and quantity respectively. Further, the average cost facing the US and foreign firm are c^u and c^f with associated marginal costs mc^u and mc^f respectively. Prior to the implementation of the FSMA, the US and foreign firm produce q^u and q^f of fruit (or vegetable) respectively. Representing the market demand as D and market supply by S[23], the equilibrium quantity and price of the fruit (or vegetable) in the market will be P and Q respectively, where market supply equals demand.

If compliance cost increase by equal margins to $c^{u'}$ and $c^{f'}$ for both the US and foreign firm, output will decrease to *qu'* and $q^{f'}$ respectively. Consequently, industry supply will decline from S to S^1. The decline in supply for fixed demand leads to an increase in market price from P to P^1 whiles quantity demanded decline from Q to Q^1. Each firm will therefore be making normal profit after FSMA. Hence, competitiveness of one firm relative to another does not change when compliance cost increase by same margin.

[23] Where the supply curve is the horizontal sum of the individual firm marginal cost curves over the relevant range – including those of our illustrative firms. Hence, the scales on the quantity axes are not the same in the market graph and for those of the firms.

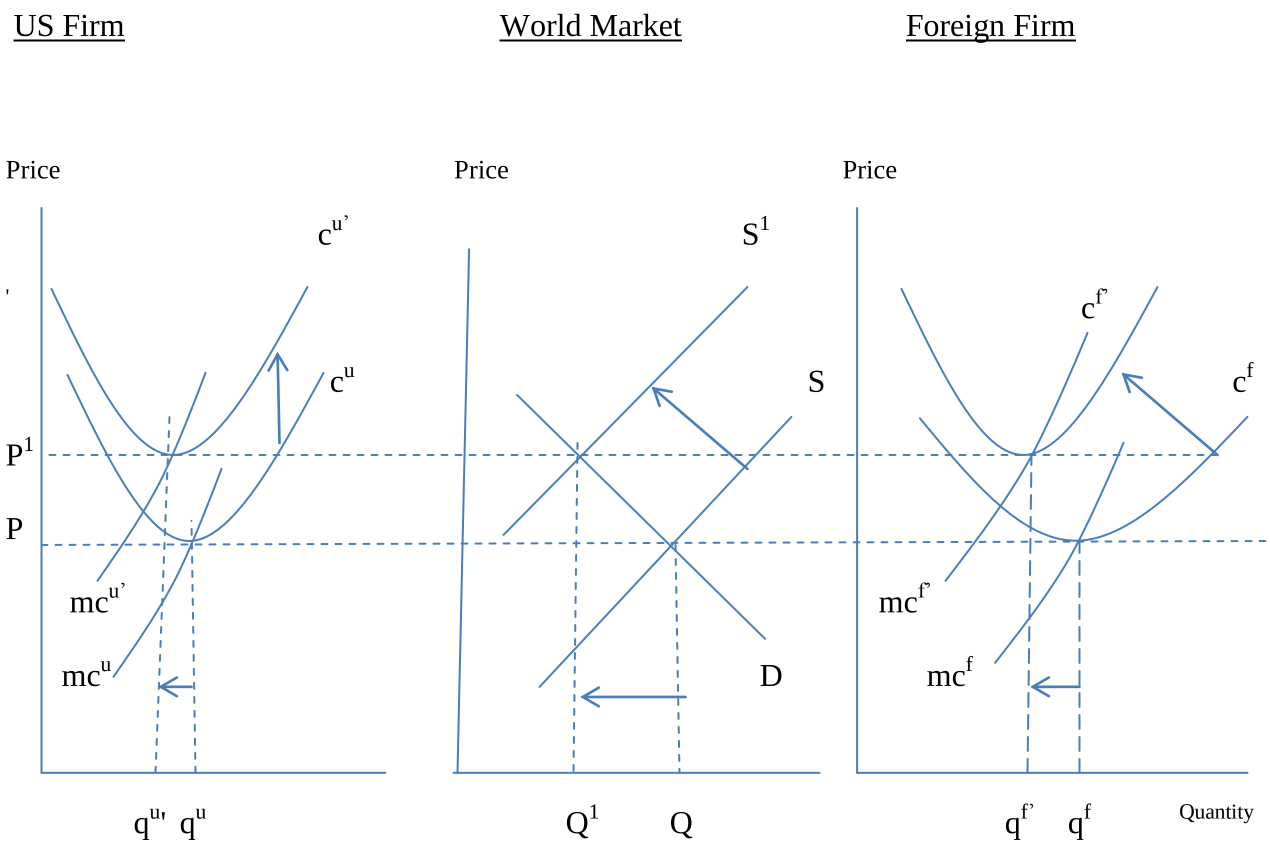

Fig 6.1 Firm competitiveness under equal compliance cost

6.3 Higher compliance cost for foreign firms

The second scenario considers the case where foreign firms face a higher compliance cost compared to their US counterparts. The reason for the higher cost is partly because while US firms would be inspected once a year under the FSMA, foreign firms must be inspected not less than twice and the costs of inspection are born by the firms. In addition, the law exempts small scale producers in the US from traceability and HACCP measures. As such, the compliance cost for foreign firm (=$c^{f'}$- c^{f}) is higher than that of the domestic firm (= $c^{u'}$-c^{u}) as shown in Fig 6.2. If both firms were to have equal increase in cost, then Q^1 output will be supplied as in Figure 6.1 at price P^1. However, since the US firm has a lesser compliance cost it will be benefiting from the supernormal profits created (equal to the shaded area) at P^1. The supernormal profit will attract more US firms into the industry thereby increasing industry supply from S^1 to S^2 while price falls to P^2 (i.e. equilibrium output supplied increase to Q^2). The decline in price implies that foreign firms will be selling below cost and therefore exit the market in the long-run. Hence, foreign firms are less competitive when domestic firms face a lower compliance cost.

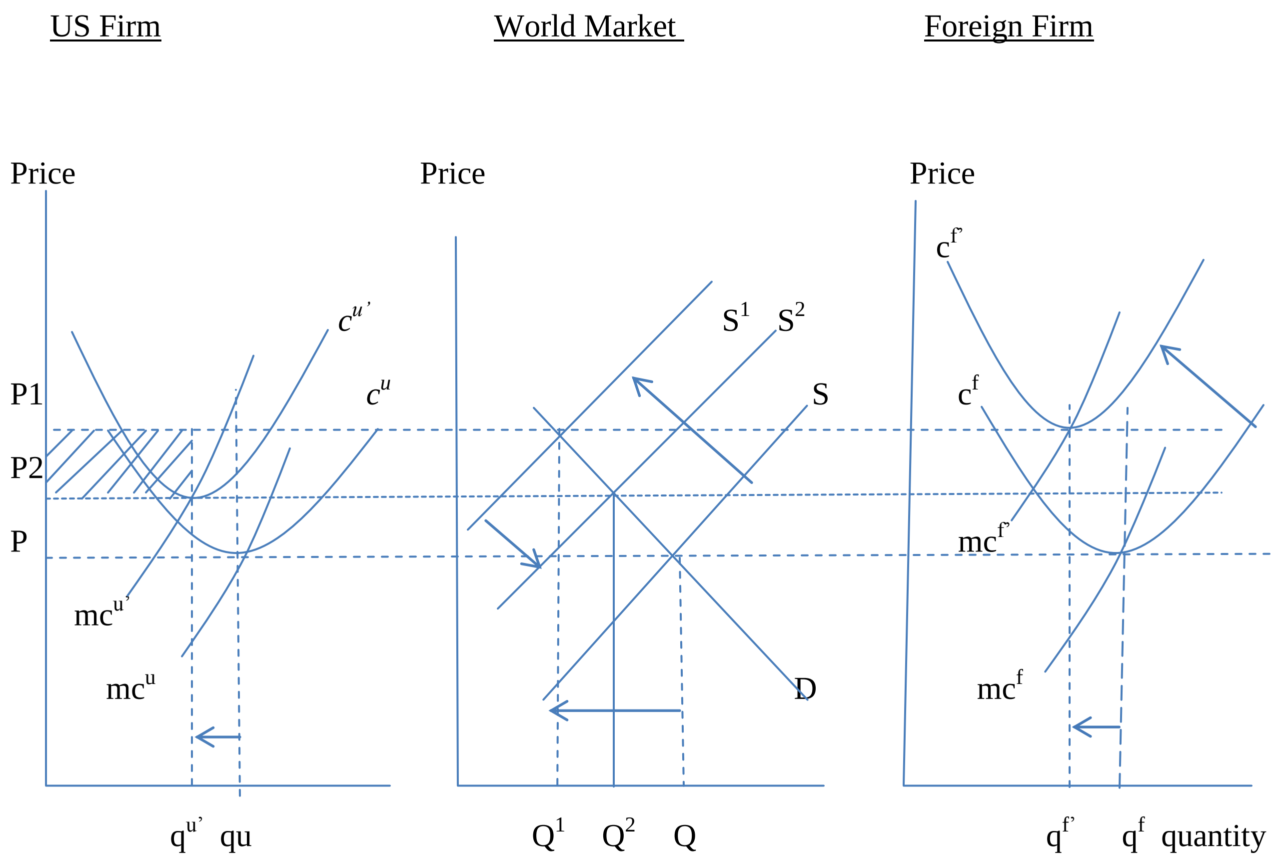

Fig 6.2 Firm competiveness under un-equal compliance cost

6.4 Summary

FSMA will not affect the relative competitiveness of firms when compliance cost increase by equal margin for both the US and foreign firm. However, when foreign firms face a higher compliance cost, supernormal profits will be created for US firms and this will continue to attract new firms in the US. The sustained entry will therefore increase industry supply given a fixed demand and cause equilibrium market price to fall. The fall in price will cause foreign firms to incur losses and eventually exit production in the long run. Hence, foreign firms are less competitive when compliance cost is lower for domestic firms. The implication is that the market share of foreign firms declines while those of domestic firms increase. This is the reason for *National Treatment principle* being a part of trade agreements. The net effect is the same as imposing formal border measures such as tariffs.

Having examined the implications of FSMA on the relative competitiveness of foreign and US firms, the next chapter examines the conformity of the regulations to the WTO, SPS and NAFTA.

Chapter 7: Conformity of FSMA to WTO, NAFTA and SPS

7.1 Introduction

This chapter discusses the conformity of the FSMA provisions to WTO general principles, the WTO's SPS agreement and NAFTA commitments.

7.2 Conformity to WTO

The WTO employs two major principles to ensure that the actions of countries are not applied indiscriminately to inhibit trade. These are the *Most-Favoured-Nation principle* and the *National Treatment principle.*

The Most-favoured-nation (MFN) implies that when a country offers special trade measures such as lowered tariffs or other preference in connection with export or importation to a trading partner (its most favoured-nation), other WTO members automatically become entitled to such offers (GATT 1947, Article I). Member countries cannot offer discriminatory trade measures such that some countries face higher tariffs than others. The FSMA suggests that countries that are perceived to have lax food safety laws will be targeted and those that demonstrate that their food safety standards provide the same level of protection may be recognised as equivalent to FSMA. This is legitimate under Article 4 of the SPS agreement which allows countries to discriminate or require stricter measures against products from countries whose food safety regulations are considered not to be equivalent to their domestic regulations. In these cases the non-discrimination requirement is waived. In view of this, we conclude that FSMA is in compliance with Most-Favoured-Nation Principle.

The National treatment principle bans discrimination against an imported product once it gets into the domestic market. Although the US attempted to introduce the certain Country of Origin Labelling (COOL) provisions that sought to differentiate between imported and domestic beef and pork products, this was struck out by WTO Dispute Settlement Body. The DSP ruled in November 2011, that COOL is a TBT measure and conveys a less favourable treatment to foreign beef and pork and hence is inconsistent with the US obligation under the WTO (WTO 2012). For now, the FSMA does not specify any preferential treatments for domestic goods when it takes effect. Imported fruit and vegetables once they clear border inspections and enter the US market are expected to be treated the same way as domestic products. We therefore conclude that FSMA does not have any intent that seems to violate the National Treatment principle and, hence, conforms to general WTO principle.

7.3 Conformity to SPS Agreement

Member countries can take food safety measures in accordance with the SPS agreement to protect lives and the environment provided those measures are based on sound science (SPS Agreement, Article 1). Further, the SPS agreement requires that in order for food safety measures to not arbitrarily inhibit trade, the food safety measures that a country employs must be proportionate to the level of risk. With respect to the FSMA, the level of risk that is posed by foodborne diseases and illness is not precisely defined. As such, it cannot be ascertained whether the standards set out by the FSMA are proportionate to the level of risk. If this proves contentious, resolution will have to await the outcome of a challenge at a WTO disputes panel.

The SPS also require member countries to execute food safety measures in a non-discriminatory manner. However, the FSMA exemption for US small scale farmers from some of its measures (i.e. traceability and HACCP) despite there being no scientific justification absolving them may constitute an arbitrary and discriminatory application of food safety measures. The US would need to demonstrate to trading partners that US small scale farmers do not pose a danger to food safety while similar sized foreign farmers do pose a risk. Without a scientific justification, the exemption for small US farmers would qualify as an arbitrary application of SPS measures to restrict trade.

There are precedents for such actions being considered discriminatory. For example, Australia banned the importation of Apples from New Zealand because fire blight was found in New Zealand. Fire blight is a fungal disease which damages the leaves of apple trees and young shoots thereby greatly inhibiting the ability of apple trees to photosynthesis and fruit. New Zealand established that the fire blight was only associated with leaves and could not be transmitted by mature apples through trade but Australia maintained that the ban was precautionary due to insufficient scientific knowledge. New Zealand subsequently filed a case against Australia at the WTO in 2007. In 2010 the WTO Dispute Settlement Body ruled that there was sufficient scientific information to do a risk assessment and the risk assessment showed that imports of mature fruit could not lead to spread of fire blight. The Panel therefore ruled that Australia’s ban was inconsistent with its obligation under the application of SPS measures (WTO 2011b).

The New Zealand-Australia conflict provides some insights about the likely challenges that the FSMA might be facing from WTO trading partners. The US might be challenged to prove that the risk of foodborne disease in the US is comparable to the standards put against foreign firms. In particular, the exemption of domestic small scale farmers in US, and the relatively more frequent inspection of foreign firms compared to domestic ones, both of which appear to lack scientific justification appear open to challenge. Hence, the FSMA could be viewed as inconsistent to US obligation under SPS agreement and imposes a higher compliance cost on foreign firms. This is because the FDA determines how frequently foreign firms must be inspected and the fees they pay for inspection. When the cost is considerable, foreign firms could be rendered less competitive and the FSMA could constitute discriminatory application under the SPS (WTO 2011b).

7.4 Conformity with NAFTA

The NAFTA incorporates the WTO principles of National Treatment and Most Favoured Nation in its agreement. NAFTA members are to extend Most Favoured Nation and National Treatment principles to trade within the NAFTA region and must not discriminate between trading partners. For now, the FSMA document has not specified any preferential treatment for either Canada or Mexico and, hence, can neither be accused of violating National Treatment nor the Most Favoured Nation principles under NAFTA.

However, NAFTA has Rules of Origin by which member countries are to maintain lower tariffs on products wholly produced in the NAFTA region but extends a higher tariff to non-NAFTA members (Chapter Four of NAFTA Legal text). Fruits and vegetables produced wholly in Canada, Mexico and US are presently qualified as products under NAFTA Rules of Origin. NAFTA's rule of origin is not considered a violation of National Treatment since WTO recognises regional trading blocs such as NAFTA and EU provided their rules are consistent with WTO. The reduction in tariffs for NAFTA members is recognised as a measure to further enhance trade between NAFTA members. For the most part, the NAFTA applies WTO rules to SPS issues.

7.5 Summary

While it may be pre-mature to judge the conformity of the regulations, basing conformity of the FSMA with NAFTA, WTO and SPS raises some concerns. While generally, the regulations follow National Treatment and Most-Favoured Nation principles under the NAFTA and WTO, we found the exemption for small scale producers in US without extending the same level of exemption to foreign firms to be an arbitrary application of food safety measures. As the FDA further develops the new regulatory framework under the FSMA, the results should be closely monitored by trading partners.

The next Chapter summarises the conclusions covering political influence in fruit and vegetable import refusals, prima facie assessment of the justification of FSMA, relative competitiveness of foreign and domestic firms under FSMA and the conformity of FSMA to international trade agreements.

Chapter 8: Conclusions and Recommendations

8.1 Introduction

The chapter presents the general conclusions, recommendations and suggested areas for future research.

8.2 Conclusions

The notion that food safety regulations can be politically motivated has received considerable attention among academics and policy makers. In particular, it is perceived that one way of politically influencing trade flows is by manipulating import refusals under the guise of food safety standards. This study used agricultural sector unemployment and antidumping against fruit and vegetables as proxies for political interference in fruit and vegetable import refusals from Mexico, Canada and China. The results show that rising agricultural sector unemployment in the US increases import refusals from Mexico and Canada in the long-run. Agricultural sector unemployment in the US has no significant effect on import refusals from China. It is arguable that farm labour could better approximate unemployment situation in the fruit and vegetable industry. Farm labourers, however, neither have a strong political force nor the incentive to lobby government for imports retrain. Lobbying better reflect the direct interest of producers to protect their firms. Accordingly, a general rise in unemployment across an industry reflects the times that business owners are willing to take decision to protect their industry as a pressure/lobbying group, thereby making unemployment a better proxy for political influence than farm labour,

The thesis finds that antidumping has a significant positive effect on import refusals from Mexico in the short-run. Further, antidumping has a positive relationship with import refusals from Canada and China, it is, however, not significant.

In controlling for genuine concerns for safety, the study included number of food safety alerts and recalls issued in the US. The results suggest that food safety alerts has a significant positive effect on import refusals for Mexico, Canada and China. Hence, increasing number of alerts and recalls is associated with increasing fruit and vegetable import refusals. Controlling for volume of imports yields similar results. The study finds that as the volume of fruit and vegetables imported from a specific country into the US rises, the associated number of rejections at the border increase as well for Canada, Mexico and China.

In addressing the justification for the FSMA, the thesis investigates the trend in *Salmonella* food borne diseases incidence in the US. The results suggest that *Salmonella* foodborne disease incidence have been rising significantly over the years. This tends to justify the US decision to strengthen food safety laws.

The thesis also finds that differences in compliance cost (where foreign firms are faced with considerable compliance cost relative to domestic ones) will tend to undermine the competitiveness of foreign producers of fruits and vegetables who supply the US market. Further, the thesis investigates the conformity of the FSMA to US commitment under NAFTA, WTO and SPS measures. It is concluded that although the regulations do not generally violate National Treatment and Most Favoured Nation principles under NATFA and WTO, the exemption of small scale US farmers and differences in domestic and foreign inspections likely constitute arbitrary applications of SPS measures which violates Article V of the SPS agreement.

8.3 Recommendation

Based on the findings of this study, it is recommended that trading partners should closely monitor the regulatory environment created by the FSMA and consider mounting challenges against the FSMA because the exemption of small scale farmers from US without scientific justification constitute an arbitrary application of SPS measures.

The use of antidumping to inhibit trade should be carefully reviewed. Countries are advised to challenge US fruit and vegetable import refusal behaviour as one that does not follow science, but rather is meant to provide economic protection in times of high unemployment and economic malaise.

Further, while the thesis concludes that foodborne disease incidence is rising and may be posing increasing risk to food safety in the US, it is recommended that the US prove that the level of risk posed by foodborne diseases is proportionate to the level of stringency that the implementation of the FSMA will provide.

8.4 Suggestions for future research

The study faced a major challenge in accessing monthly lobbying expenditures for the fruit and vegetable industry in US. It could be a major indicator of, and proxy for, political motivation. Future research would be improved if lobbying expenditures are used.

This study analysed political influence by modelling each country in single equations. Future research should consider the analysis in a panel data regression form such that the interactions of other countries can be assessed. Modelling the analysis in fixed and random effect models would increase the sample size and improve the efficiency of the estimates.

The econometric test for cointegration could also be further disaggregated into test for seasonal and deterministic cointegration in future research.

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Appendix

Table A4.3.1 Descriptive statistics

	REFMEX	REFCAN	REFCHI	IMPMEX	IMPCAN	IMPCHI	UNEMPL	ALERT	ANTID
Mean	46.16260	7.365854	22.85366	3.37E+08	77465854	7708171.	10.28195	4.878049	0.373984
Median	41.00000	5.000000	19.00000	3.00E+08	75000000	7608000.	9.800000	2.000000	0.000000
Maximum	187.0000	82.00000	100.0000	8.05E+08	1.86E+08	15187000	21.30000	45.00000	2.000000
Minimum	8.000000	0.000000	3.000000	63000000	12300000	1421000.	2.400000	0.000000	0.000000
Std. Dev.	27.51613	9.931956	16.09586	1.81E+08	37583066	3584273.	4.069882	7.010046	0.534059
Skewness	2.146707	4.795684	1.984688	0.569482	0.366270	0.051867	0.552354	3.124211	1.000982
Kurtosis	10.45330	32.11697	8.793544	2.479900	2.268703	1.952258	2.832864	14.68966	2.913379
Jarque-Bera	379.1738	4816.435	252.7706	8.034684	5.490968	5.681184	6.397618	900.4156	20.57875
Probability	0.000000	0.000000	0.000000	0.018001	0.064217	0.058391	0.040811	0.000000	0.000034
Sum	5678.000	906.0000	2811.000	4.15E+10	9.53E+09	9.48E+08	1264.680	600.0000	46.00000
Sum Sq. Dev.	92370.75	12034.54	31607.37	3.98E+18	1.72E+17	1.57E+15	2020.800	5995.171	34.79675
Observations	123	123	123	123	123	123	123	123	123

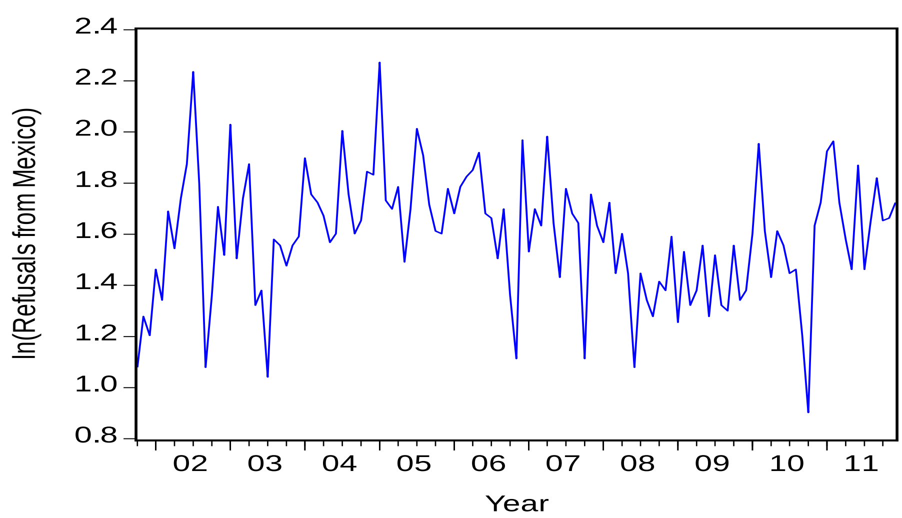

Fig A4.3.2.1 Import refusals from Mexico

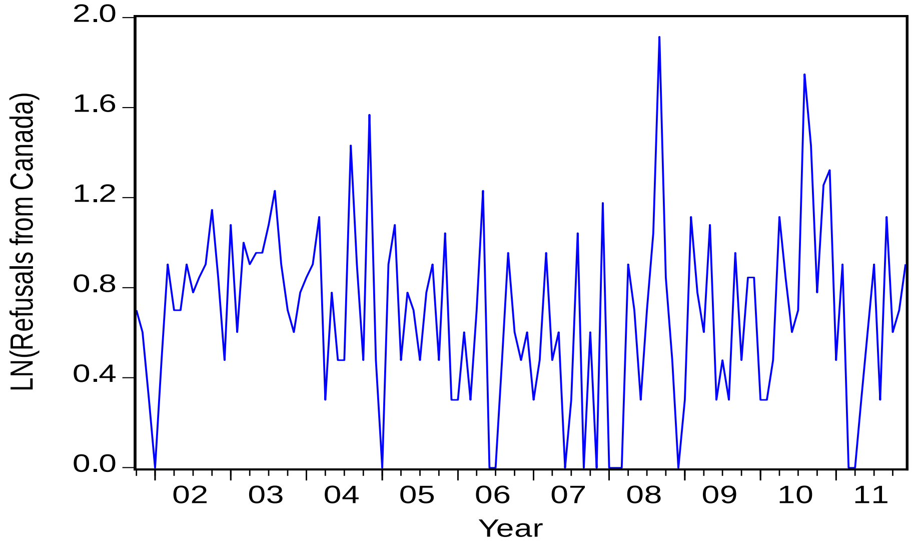

Fig A4.3.2.2 Import refusals from Canada

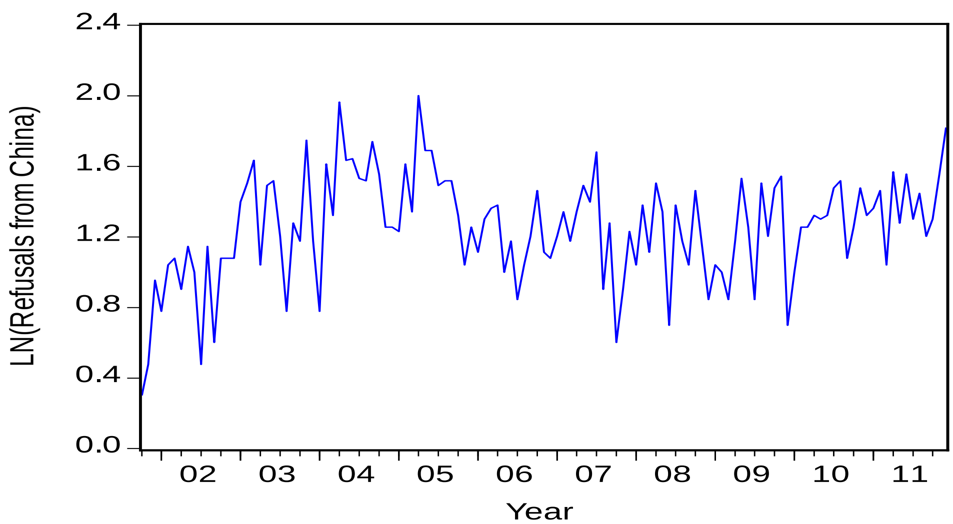

Fig A4.3.2.3 Import refusals from China

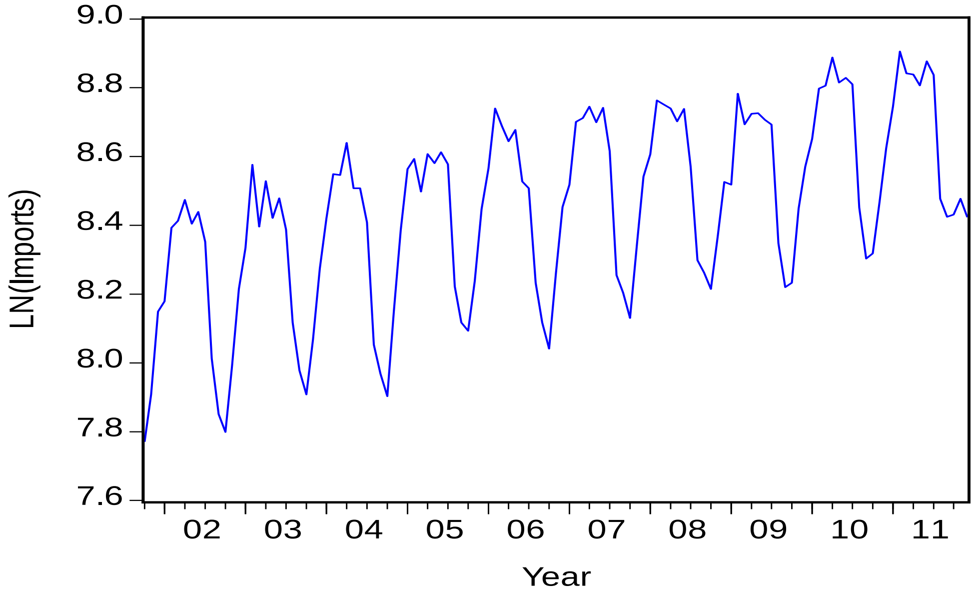

Fig A4.3.2.4 Value of fruit & vegetable imports from Mexico

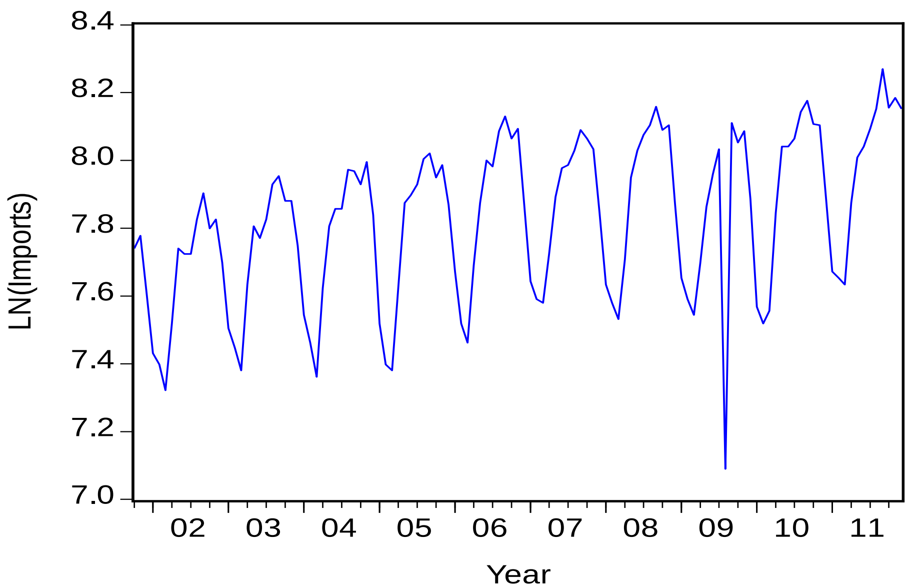

Fig A4.3.2.5 Value of fruit and vegetable imports from Canada

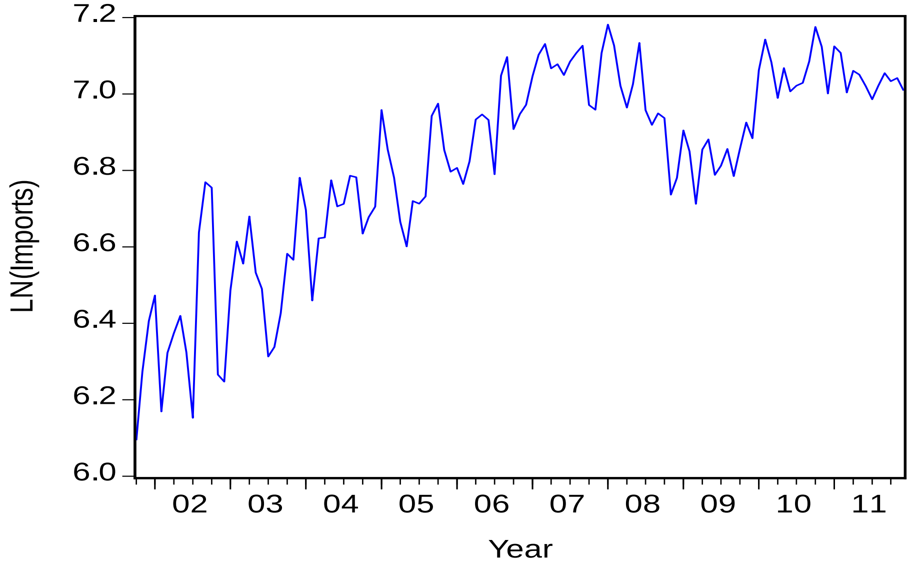

Fig A4.3.2.6 Value of fruit & vegetable imports from China

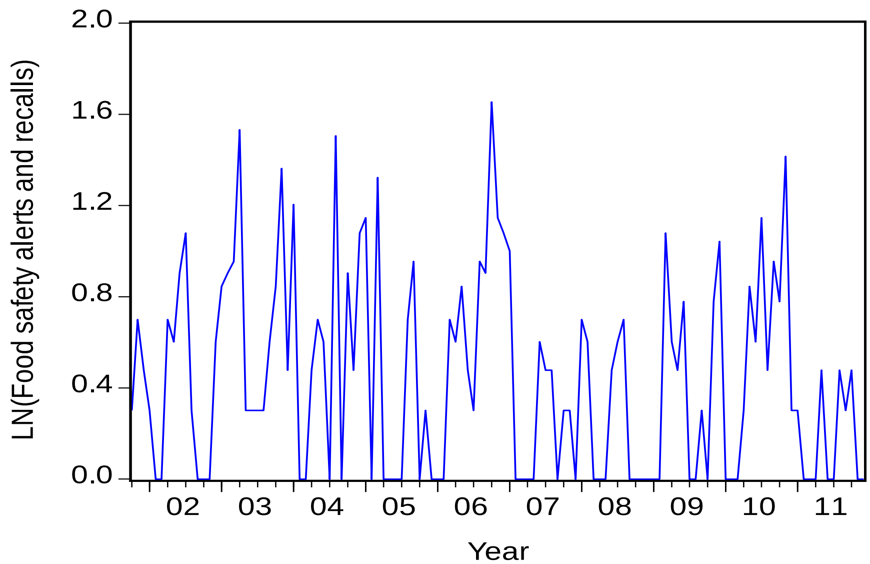

Fig A4.3.2.7 Number of food safety alerts and recalls

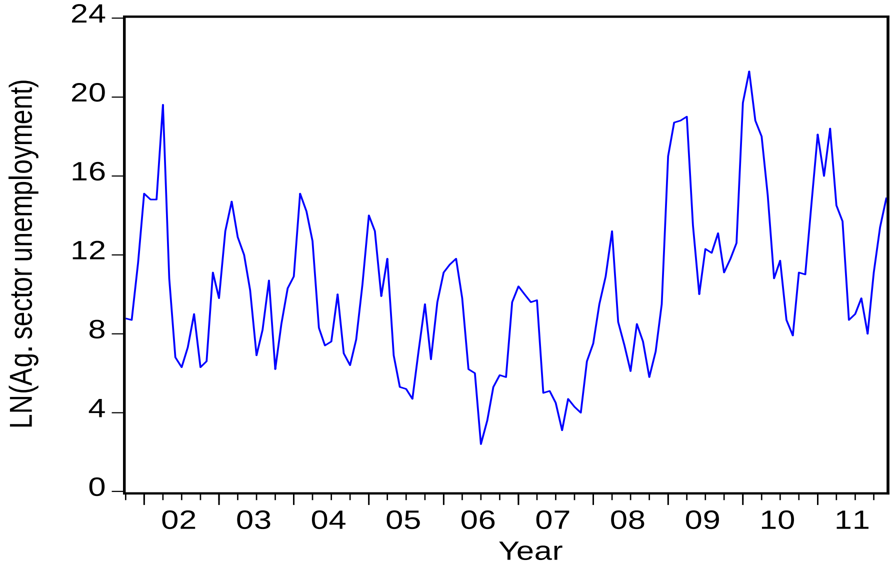

Fig A4.3.2.8 US Agricultural sector unemployment

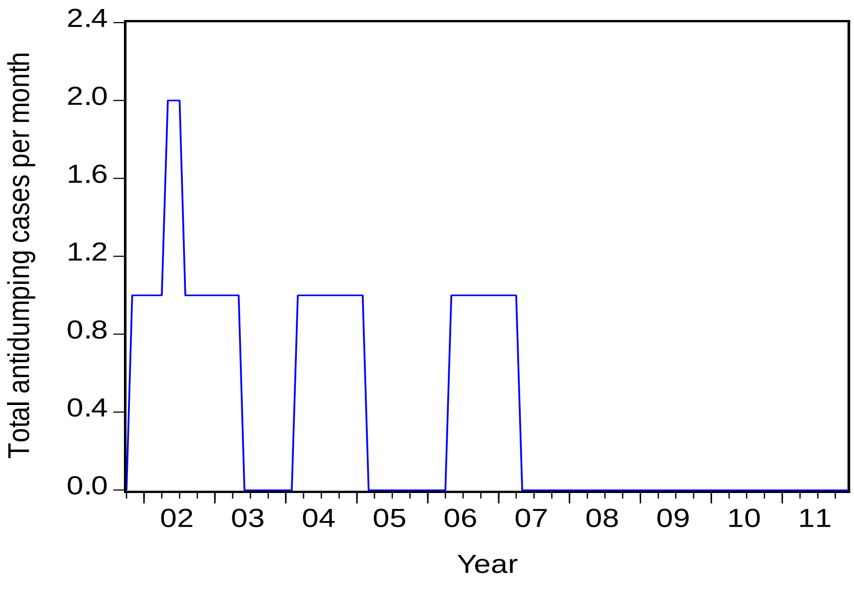

Fig A4.3.2.9 No. of antidumping cases against fruit and vegetables

Table A4.3.4.1.1 Cointegration test of import refusals equation for Mexico

Included variables: RMEX, IMPMEX, UNEMP, ALERT, ANTID

	Intercept		**Intercept and trend**		**No intercept nor trend**	
Rank	Eigenvalue	Trace stat.	Eigenvalue	Trace stat.	Eigenvalue	Trace stat.
0	50.13622**	122.3053***	86.32715***	217.9586***	86.327***	217.96***
1	36.51280	112.1691	43.92263	111.6314	43.922	111.631
2	26.69192	65.65628	30.34189	85.70877	30.341	85.708
3	23.19412	46.96436	23.25887	55.36688	23.258	55.367
4	13.16696	25.77024	16.64465	32.10801	16.646	32.108

****, **and * are significance at 1 %, 5% and 10% respectively*

Table A4.3.4.1.2 Cointegration test of import refusals equation for Canada

Included variables: RCAN, IMPCAN, UNEMP, ALERT, ANTID

	Intercept		***Intercept and trend***		**No intercept nor trend**	
Rank	Eigenvalue	Trace stat	Eigenvalue	Trace stat	Eigenvalue	Trace stat
0	68.44498**	173.9996***	70.44033***	205.2725*	70.740***	205.273***
1	39.55236	94.5546	43.90043	115.8321	43.900	115.832
2	21.12779	59.00228	35.94190	83.93171	35.942	83.931
3	17.18745	37.87449	19.51422	47.98981	19.514	47.981
4	12.47897	20.68704	17.18744	28.47559	17.187	28.476

****, **and * are significance at 1 %, 5% and 10% respectively*

Table A4.3.4.1.3 Cointegration test of import refusals equation for China

Included variables: RCHI, IMPCHI, UNEMP, ALERT, ANTID

	Intercept		**Intercept and trend**		**No intercept nor trend**	
Rank	Eigenvalue	Trace stat	Eigenvalue	Trace stat	Eigenvalue	Trace stat
0	69.17300**	176.5692**	89.77110***	212.7405***	30.856**	69.666**
1	41.01521	94.3962	42.11966	101.9694	23.984	39.813
2	24.64980	66.38102	29.67843	80.84976	10.215	18.885
3	20.85561	41.73122	22.31031	51.17133	6.900	8.669
4	10.95715	20.87561	14.53967	28.86102	1.769	1.769

****, **and * are significance at 1 %, 5% and 10% respectively*

Table A4.5.1.1 Lag order of import refusals equation for Mexico

Lag	**LogL**	**LR**	**FPE**	**AIC**	**SC**	**HQ**
0	-140.9741	NA	3.31e-08	2.642395	2.812301	2.711332
1	110.9532	467.8650	8.86e-10*	-0.981307*	0.377943*	-0.429816*
2	153.5884	73.85035	1.00e-09	-0.867651	1.680942	0.166395
3	192.3166	62.24166	1.23e-09	-0.684224	3.053711	0.832375
4	223.2058	45.78223	1.79e-09	-0.360818	4.566462	1.638336
5	260.1173	50.09421	2.41e-09	-0.144952	5.971670	2.336756
6	303.2797	53.18225	3.03e-09	-0.040709	7.265256	2.923553
7	380.2593	85.22736	2.21e-09	-0.540344	7.954965	2.906473
8	430.5235	49.36665	2.80e-09	-0.562920	9.121733	3.366452
9	488.0771	49.33170	3.45e-09	-0.715663	10.15833	3.696262
10	548.4982	44.23683	4.64e-09	-0.919610	11.14373	3.974870
11	693.2582	87.89001*	1.69e-09	-0.819611	10.62307	2.747424

* indicates lag order selected by the criterion

Table A4.5.1.2 Estimated VEC model of import refusals equation for Mexico

Sample (adjusted): 3 123
Standard errors in ( ) & t-statistics in [ ]

Cointegrating Eq:	CointEq1				
REFMEX(-1)	1.000000				
IMPMEX(-1)	-10.38601				
	(1.19799)				
	[-8.66955]				
UNEMP(-1)	- 3.352590				
	(1.146701)				
	[-2.92361]				
ALERT(-1)	-2.39345				
	(0.44291)				
	[-5.40351]				
ANTID(-1)	-0.634833				
	(0.58368)				
	[-1.08764]				
@TREND	0.033306				
C	82.21902				
Error Correction:	D(REFMEX)	D(IMPMEX)	D(UNEMP)	D(ALERT)	D(ANTID)
CointEq1	-0.024460	-0.039780	0.023097	0.001647	0.006795
	(0.01172)	(0.00553)	(0.00524)	(0.02264)	(0.01168)
	[2.08711]	[7.19057]	[4.40965]	[0.07277]	[0.58189]
D(REFMEX(-1))	-0.466034	-0.052782	0.053862	-0.057201	-0.004002
	(0.08522)	(0.04023)	(0.03808)	(0.16459)	(0.08490)
	[-5.46832]	[-1.31213]	[1.41428]	[-0.34753]	[-0.04714]
D(IMPMEX(-1))	0.455763	0.576323	0.247968	0.050022	0.143609
	(0.17163)	(0.08101)	(0.07670)	(0.33147)	(0.17099)
	[2.65546]	[7.11414]	[3.23303]	[0.15091]	[0.83988]
D(UNEMP(-1))	0.075515	-0.125015	-0.154833	-0.689634	0.096751
	(0.20569)	(0.09709)	(0.09192)	(0.39726)	(0.20492)
	[0.36712]	[-1.28764]	[-1.68443]	[-1.73600]	[0.47213]
D(ALERT(-1))	0.058808	0.039646	0.024184	-0.458379	0.053393
	(0.02189)	(0.02025)	(0.01917)	(0.08284)	(0.04273)
	[2.68652]	[1.95826]	[1.26172]	[-5.53340]	[1.24949]
D(ANTID(-1))	1.2074	0.016467	-0.038203	0.150128	-0.005766
	(0.21121)	(0.04175)	(0.03953)	(0.17084)	(0.08813)
	[5.7167]	[0.39439]	[-0.96644]	[0.87877]	[-0.06543]
C	0.001859	0.005998	-0.008486	0.000912	-0.018182
	(0.04585)	(0.02164)	(0.02049)	(0.08855)	(0.04568)
	[0.04055]	[0.27715]	[-0.41415]	[0.01030]	[-0.39803]
@TREND(1)	2.70E-05	-7.36E-05	0.000145	-0.000110	0.000147
	(0.00064)	(0.00030)	(0.00029)	(0.00124)	(0.00064)
	[0.04184]	[-0.24220]	[0.50462]	[-0.08815]	[0.22835]
R-squared	0.237168	0.427272	0.203635	0.235476	0.025017
F-statistic	5.018885	12.04306	4.127816	4.972049	0.414202

Table A4.5.1.3 Normality test of import refusals equation for Mexico

Component	Jarque-Bera	df	Prob.
1	1.268128	2	0.5304
2	2.905877	2	0.2339
3	1.319214	2	0.5171
4	571.9215	2	0.0000
5	112.3798	2	0.0000
Joint	689.7945	10	0.0000

Table A4.5.1.4 Serial correlation LM test of import refusals equation for Mexico

VEC Residual Serial Correlation LM Tests
H0: no serial correlation at lag order h
Date: 05/28/12 Time: 12:29
Sample: 2001M10 2011M12
Included observations: 121

Lags	LM-Stat	Prob
1	28.48011	0.2512
2	24.60190	0.4801
3	28.35790	0.2916
4	31.78819	0.1642
5	31.12077	0.1698
6	31.12101	0.1790
7	18.48075	0.7874
8	19.43650	0.7757
9	33.63280	0.1160
10	24.69522	0.4796
11	29.58694	0.2401
12	28.58532	0.2410

Table A4.5.1.5 Heteroskedasticity test of import refusals equation for Mexico

VEC Residual Heteroskedasticity Tests: Includes Cross Terms
Date: 05/28/12   Time: 12:21
Sample: 2001M10 2011M12
Included observations: 121

Joint test:

Chi-sq	df	Prob.
532.0717	525	0.4060

Individual components:

Dependent	R-squared	F(35,85)	Prob.	Chi-sq(35)	Prob.
res1*res1	0.309521	0.828500	0.9128	29.97199	0.8623
res2*res2	0.282448	0.754009	0.8659	28.27626	0.8563
res3*res3	0.233332	0.739126	0.8405	28.23321	0.7842
res4*res4	0.330062	1.196500	0.2496	39.93756	0.2600
res5*res5	0.201281	0.612011	0.9472	24.35497	0.9113
res2*res1	0.300336	1.042481	0.4263	36.34063	0.4060
res3*res1	0.305219	1.066880	0.3946	36.93155	0.3797
res3*res2	0.290813	0.995872	0.4900	35.18834	0.4593
res4*res1	0.354233	1.332184	0.1437	42.86220	0.1696
res4*res2	0.252444	0.820109	0.7407	30.54568	0.6830
res4*res3	0.320400	1.144961	0.3021	38.76845	0.3035
res5*res1	0.375752	1.461825	0.1204	45.46601	0.1108
res5*res2	0.245169	0.788798	0.7816	29.66540	0.7232
res5*res3	0.262974	0.866526	0.6763	31.81990	0.6224
res5*res4	0.280952	0.948911	0.5571	33.99520	0.5165

Table A4.5.2.1 Lag order of import refusals equation for Canada

Included observations: 112

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-127.5832	NA	2.61e-08	2.403272	2.573178	2.472208
1	80.60443	386.6342	1.52e-09*	-0.439365*	0.919885*	0.112126*
2	121.9900	71.68579*	1.76e-09	-0.303394	2.245199	0.730652
3	154.5808	52.37796	2.42e-09	-0.010371	3.727565	1.506229
4	191.9446	55.37852	3.13e-09	0.197418	5.124697	2.196572
5	229.0410	50.34511	4.19e-09	0.409982	6.526605	2.891691
6	259.2040	37.16510	6.65e-09	0.746358	8.052323	3.710620
7	316.5816	63.52525	6.88e-09	0.596757	9.092066	4.043574
8	371.9987	54.42749	7.95e-09	0.482166	10.16682	4.411537
9	421.2395	42.20637	1.14e-08	0.477867	11.35186	4.889792
10	489.1345	49.70884	1.34e-08	0.140456	12.20379	5.034936
11	592.2785	62.62314	1.02e-08	-0.108260	12.42628	4.550633

* indicates lag order selected by the criterion

Table A4.5.2.2 Estimated VEC model of import refusals equation for Canada

Included observations: 121 after adjustments
Standard errors in ( ) & t-statistics in [ ]

Cointegrating Eq:	CointEq1
REFCAN(-1)	1.000000
IMPCAN(-1)	-1.633905
	(0.21239)
	[-7.69306]
UNEMP(-1)	-1.282111
	(0.23797)
	[-5.38775]
ALERT(-1)	-0.267799
	(0.08610)
	[-3.11036]
ANTID(-1)	-0.103433
	(0.07233)
	[-1.43005]
@TREND	0.007018
C	13.00450

Error Correction:	D(REFCAN)	D(IMPCAN)	D(UNEMP)	D(ALERT)	D(ANTID)
CointEq1	-0.769446	0.224568	-0.030934	0.196677	-0.026242
	(0.13377)	(0.05318)	(0.03669)	(0.15198)	(0.07948)
	[-5.75217]	[4.22318]	[-0.84306]	[1.29409]	[-0.33017]
D(REFCAN(-1))	0.014259	-0.124264	0.047668	-0.009714	0.014743
	(0.10299)	(0.04094)	(0.02825)	(0.11702)	(0.06120)
	[0.13845]	[-3.03513]	[1.68731]	[-0.08301]	[0.24091]
D(IMPCAN(-1))	0.629207	0.023624	-0.276000	0.051781	0.044625
	(0.23799)	(0.09460)	(0.06528)	(0.27039)	(0.14140)
	[2.64389]	[0.24971]	[-4.22797]	[0.19150]	[0.31559]
D(UNEMP(-1))	0.122241	-0.281261	-0.097709	-0.473759	0.172134
	(0.34953)	(0.14012)	(0.09668)	(0.40047)	(0.20943)
	[0.34973]	[-2.00732]	[-1.01059]	[-1.18299]	[0.82191]
D(ALERT(-1))	0.14579	0.070457	0.022570	-0.431097	0.044742
	(0.06151)	(0.02922)	(0.02016)	(0.08351)	(0.04367)
	[2.3705]	[2.41150]	[1.11951]	[-5.16249]	[1.02453]
D(ANTID(-1))	0.138696	-0.029141	-0.015868	0.147570	0.000610
	(0.14668)	(0.05831)	(0.04023)	(0.16665)	(0.08715)
	[0.94557]	[-0.49978]	[-0.39440]	[0.88549]	[0.00700]
C	0.000330	-0.004797	-0.003187	0.001330	-0.014708
	(0.07679)	(0.03053)	(0.02106)	(0.08724)	(0.04563)
	[0.00430]	[-0.15715]	[-0.15132]	[0.01524]	[-0.32237]
@TREND	7.38E-05	0.000136	0.000102	-0.000123	9.89E-05
	(0.00108)	(0.00043)	(0.00030)	(0.00123)	(0.00064)
	[0.06838]	[0.31578]	[0.34503]	[-0.10057]	[0.15410]
R-squared	0.366273	0.232296	0.152923	0.253015	0.020917
F-statistic	9.330035	4.884591	2.914282	5.467818	0.344866

Table A4.5.2.3 Normality test of import refusals equation for Canada

Component	Jarque-Bera	df	Prob.
1	3.001631	2	0.2229
2	174.3493	2	0.0000
3	0.862459	2	0.6497
4	675.5058	2	0.0000
5	2.602187	2	0.2722
Joint	856.3214	10	0.0000

Table A4.5.2.4 Serial correlation LM test of import refusals equation for Canada

VEC Residual Serial Correlation LM Tests
H0: no serial correlation at lag order h
Date: 05/28/12 Time: 12:38
Sample: 2001M10 2011M12
Included observations: 121

Lags	LM-Stat	Prob
1	25.41110	0.4395
2	25.19133	0.4517
3	25.19093	0.4517
4	24.66586	0.4216
5	16.67354	0.8933
6	17.15578	0.8761
7	18.92435	0.8875
8	15.90000	0.9178
9	22.65598	0.5976
10	13.33233	0.9722
11	17.22291	0.8850
12	15.85177	0.8913

Table A4.5.2.5 Heteroskedasticity test of import refusals equation for Canada

VEC Residual Heteroskedasticity Tests: No Cross Terms (only levels and squares)

Date: 05/28/12 Time: 12:43

Sample: 2001M10 2011M12

Included observations: 121

Joint test:

Chi-sq	df	Prob.
187.8018	180	0.3298

Individual components:

Dependent	R-squared	F(12,108)	Prob.	Chi-sq(12)	Prob.
res1*res1	0.085680	0.843385	0.6060	10.36733	0.5838
res2*res2	0.071201	0.831794	0.5960	10.49537	0.5601
res3*res3	0.111602	1.130600	0.3434	13.50390	0.3335
res4*res4	0.105730	1.064070	0.3975	12.79328	0.3842
res5*res5	0.100001	1.000010	0.4541	12.10011	0.4377
res2*res1	0.130203	1.136902	0.1012	11.15454	0.4101
res3*res1	0.108335	1.093479	0.3730	13.10856	0.3612
res3*res2	0.037744	0.589904	0.9584	13.02101	0.3625
res4*res1	0.031456	0.292302	0.9895	3.806217	0.9867
res4*res2	0.047693	0.450737	0.9384	5.770886	0.9272
res4*res3	0.133340	1.384700	0.1842	16.13419	0.1852
res5*res1	0.032935	0.306511	0.9871	3.985151	0.9837
res5*res2	0.088255	0.871177	0.5781	10.67881	0.5566
res5*res3	0.041582	0.390474	0.9644	5.031416	0.9569
res5*res4	0.092987	0.922680	0.5272	11.25143	0.5075

Table A4.5.3.1 Lag order of import refusals equation for China

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-137.5298	NA	3.12e-08	2.580889	2.750796	2.649826
1	123.2980	484.3945	7.10e-10*	-1.201750*	0.157499*	-0.650260*
2	149.2686	44.98470	1.08e-09	-0.790510	1.758083	0.243535
3	175.9191	42.83119	1.65e-09	-0.391412	3.346524	1.125187
4	221.7366	67.90816	1.84e-09	-0.334583	4.592696	1.664571
5	257.6175	48.69551	2.52e-09	-0.100313	6.016309	2.381395
6	296.0742	47.38414	3.44e-09	0.087960	7.393926	3.052223
7	369.1883	80.94774	2.69e-09	-0.342649	8.152660	3.104168
8	428.7329	58.48130	2.89e-09	-0.530945	9.153707	3.398426
9	479.4095	43.43708	4.02e-09	-0.560884	10.31311	3.851042
10	572.3609	68.05371	3.03e-09	-1.190731	10.71761	3.548749
11	697.8222	76.17292*	1.56e-09	-1.171111	10.54157	2.665924

* indicates lag order selected by the criterion

Table A4.5.3.2 Estimated VEC model of import refusals equation for China

Included observations: 121 after adjustments
Standard errors in ( ) & t-statistics in [ ]

Cointegrating Eq:	CointEq1				
REFCHI(-1)	1.000000				
IMPCHI(-1)	-37.07205				
	(5.82129)				
	[-6.36836]				
UNEMP(-1)	-0.264101				
	(0.41284)				
	[-1.56321]				
ALERT(-1)	- 6.308861				
	(2.27896)				
	[-2.76831]				
ANTID(-1)	- 0.056059				
	(1.97333)				
	[- 0.02841]				
@TREND	-0.248285				
C	260.4409				
Error Correction:	**D(REFCHI)**	**D(IMPCHI)**	**D(UNEMP)**	**D(ALERT)**	**D(ANTID)**
CointEq1	-0.005008	0.009738	0.008111	-0.003590	-0.000729
	(0.00467)	(0.00175)	(0.00180)	(0.00766)	(0.00397)
	[-1.07261]	[5.56605]	[4.50425]	[-0.46839]	[-0.18386]
D(REFCHI(-1))	-0.494332	-0.002897	-0.059839	0.150659	0.024252
	(0.08278)	(0.03102)	(0.03193)	(0.13590)	(0.07033)
	[-5.97197]	[-0.09338]	[-1.87428]	[1.10864]	[0.34483]
D(IMPCHI(-1))	0.075918	0.060950	0.096267	-0.039184	0.200486
	(0.03280)	(0.08724)	(0.08979)	(0.38220)	(0.19780)
	[2.3145]	[0.69865]	[1.07212]	[-0.10252]	[1.01358]
D(UNEMP(-1))	0.327921	0.253845	0.141647	-0.772109	0.110186
	(0.23134)	(0.08669)	(0.08923)	(0.37980)	(0.19656)
	[1.41747]	[2.92806]	[1.58745]	[-2.03292]	[0.56057]
D(ALERT(-1))	0.082215	-0.020883	-0.025859	-0.422593	0.055514
	(0.02489)	(0.02057)	(0.02117)	(0.09012)	(0.04664)
	[3.3031]	[-1.01521]	[-1.22137]	[-4.68936]	[1.19030]
D(ANTID(-1))	0.134666	0.020515	-0.028907	0.162429	0.004412
	(0.10240)	(0.03837)	(0.03950)	(0.16812)	(0.08701)
	[1.31507]	[0.53459]	[-0.73189]	[0.96616]	[0.05071]
C	0.025301	0.014589	-0.001432	-0.002922	-0.019969
	(0.05369)	(0.02012)	(0.02071)	(0.08815)	(0.04562)
	[0.47121]	[0.72503]	[-0.06917]	[-0.03315]	[-0.43770]
@TREND	0.000161	-0.000152	4.76E-05	-6.44E-05	0.000159
	(0.00075)	(0.00028)	(0.00029)	(0.00124)	(0.00064)
	[0.21344]	[-0.53729]	[0.16390]	[-0.05206]	[0.24840]
R-squared	0.295251	0.246237	0.189046	0.244804	0.030599
F-statistic	6.762965	5.273509	3.763155	5.232869	0.509549

Table A4.5.3.3 Normality test of import refusals equation for China

Component	Jarque-Bera	df	Prob.
1	3.977419	2	0.1369
2	12.49575	2	0.0019
3	225.5272	2	0.0000
4	2.324467	2	0.3128
5	580.0192	2	0.0000
Joint	824.3441	10	0.0000

Table A4.5.3.4 Serial correlation LM test of import refusals for China

VEC Residual Serial Correlation LM Tests
H0: no serial correlation at lag order h
Date: 05/28/12 Time: 12:55
Sample: 2001M10 2011M12
Included observations: 121

Lags	LM-Stat	Prob
1	24.06276	0.5157
2	22.78968	0.6548
3	20.31132	0.7139
4	29.15844	0.2573
5	23.89168	0.5256
6	31.77453	0.1646
7	32.12412	0.1853
8	21.56084	0.6610
9	28.29883	0.2943
10	24.53049	0.4889
11	25.62654	0.4277
12	26.11269	0.4210

Table A4.5.3.5 Heteroskedasticity test of import refusals for China

VEC Residual Heteroskedasticity Tests: No Cross Terms (only levels and squares)
Date: 05/28/12 Time: 13:00
Sample: 2001M10 2011M12
Included observations: 121

Joint test:

Chi-sq	df	Prob.
177.2414	180	0.5442

Individual components:

Dependent	R-squared	F(12,108)	Prob.	Chi-sq(12)
res1*res1	0.075140	0.731201	0.7182	9.091927
res2*res2	0.070886	0.686650	0.7611	8.577231
res3*res3	0.033699	0.313868	0.9856	4.077584
res4*res4	0.060744	0.582056	0.8525	7.350069
res5*res5	0.116887	1.191216	0.2986	14.14327
res2*res1	0.031120	0.289076	0.9900	3.765516
res3*res1	0.118366	1.208313	0.2867	14.32224
res3*res2	0.033581	0.312727	0.9859	4.063256
res4*res1	0.093567	0.929034	0.5211	11.32166
res4*res2	0.147828	1.561246	0.1140	17.88717
res4*res3	0.067259	0.648985	0.7958	8.138383
res5*res1	0.068588	0.662746	0.7833	8.299116
res5*res2	0.069051	0.667557	0.7789	8.355208
res5*res3	0.092733	0.919901	0.5299	11.22068
res5*res4	0.097863	0.976312	0.4760	11.84143

Table A5.4.4.1 Serial correlation test in *Salmonella* incidence

Breusch-Godfrey Serial Correlation LM Test:

F-statistic	1.543807	Prob. F(12,176)	0.112477
Obs*R-squared	18.18991	Prob. Chi-Square(12)	0.110045

Test Equation:
Dependent Variable: RESID
Method: Least Squares
Date: 05/27/12 Time: 16:19
Sample: 1995M02 2010M12
Included observations: 191
Presample missing value lagged residuals set to zero.

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	3003.651	4331.550	0.693435	0.4890
SAM(-1)	-12.83210	18.56363	-0.691249	0.4903
YEAR	11.18168	16.39232	0.682129	0.4961
RESID(-1)	12.77213	18.56291	0.688046	0.4923
RESID(-2)	1.761853	2.421212	0.727674	0.4678
RESID(-3)	0.247625	0.324531	0.763023	0.4465
RESID(-4)	-0.076119	0.088788	-0.857305	0.3924
RESID(-5)	-0.157819	0.079870	-1.975936	0.0497
RESID(-6)	-0.050337	0.082368	-0.611122	0.5419
RESID(-7)	-0.120708	0.082291	-1.466836	0.1442
RESID(-8)	-0.101297	0.082917	-1.221666	0.2235
RESID(-9)	-0.086911	0.083294	-1.043421	0.2982
RESID(-10)	0.052228	0.083461	0.625777	0.5323
RESID(-11)	-0.006016	0.083971	-0.071646	0.9430
RESID(-12)	0.080156	0.083034	0.965343	0.3357

R-squared	0.095235	Mean dependent var	1.95E-14
Adjusted R-squared	0.023265	S.D. dependent var	285.6096
S.E. of regression	282.2677	Akaike info criterion	14.19887
Sum squared resid	14022811	Schwarz criterion	14.45428
Log likelihood	-1340.992	F-statistic	1.323263
Durbin-Watson stat	1.994866	Prob(F-statistic)	0.197595

Table A5.4.4.2 White Heteroskedasticity test in *Salmonella* incidence

White Heteroskedasticity Test:

F-statistic	1.640223	Prob. F(4,186)	0.165909
Obs*R-squared	6.507709	Prob. Chi-Square(4)	0.164305

Test Equation:
Dependent Variable: RESID^2
Method: Least Squares
Date: 05/28/12 Time: 13:24
Sample: 1995M02 2010M12
Included observations: 191

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	155060.7	59714.90	2.596683	0.0102
SAMONELLA(-1)	-152.1335	153.4313	-0.991541	0.3227
SAMONELLA(-1)^2	0.078695	0.111189	0.707766	0.4800
@Time	-2083.751	1320.102	-1.578478	0.1162
(@(Time)^2	13.05230	6.678229	1.954455	0.0521

R-squared	0.034072	Mean dependent var	81145.79
Adjusted R-squared	0.013299	S.D. dependent var	248743.9
S.E. of regression	247084.3	Akaike info criterion	27.69868
Sum squared resid	1.14E+13	Schwarz criterion	27.78381
Log likelihood	-2640.224	F-statistic	1.640223
Durbin-Watson stat	1.994229	Prob(F-statistic)	0.165909