

**THE ECONOMIC IMPACT OF FREE TRADE
AGREEMENTS WITH ASIA ON THE US
PORK INDUSTRY**

by

LINDSEY AHLEN

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Approved by:

Major Professor
Allen Featherstone

ABSTRACT

For the past 25 years, Free Trade Agreements (FTA) in Asia have been increasing. This allows for a potential expansion of exports into Asia for a variety of goods. However usually these agreements have not covered agricultural products. The most recent multilateral agreement currently includes agricultural products and agricultural trade. U.S. pork exports have been on the rise with Asian countries. Trade openness with Asian countries allows U.S. pork companies to gain a market in the region. This thesis estimates the economic impact that FTA's and multilateral agreements have on pork exports, through the level of open markets measured by Freedom House. Using regression analysis, this research examines the determinants to U.S. pork exports, where trade openness is a major independent variable. Pork is a popular meat preference in East Asia. A regression analysis was estimated to determine the shift along the demand curve of U.S. pork exports to three East Asian countries, China, Japan, and South Korea. Overall all three countries showed their trade openness being weakly associated with the U.S. pork export demand to that particular country during the years of 1995–2013.

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CHAPTER I: INTRODUCTION

This research examines the determinants that affect pork exports in Asia.

Agricultural policy, tariffs, and protectionist concerns, all play a role in the movement of the demand for pork in East Asian regions. The importance that pork has on East Asia is important to consider. Pork is an agricultural product that has a higher demand in East Asia than beef. The major substitute for pork in East Asia is poultry. A major inspiration for this research was the Trans Pacific Partnership (T.P.P.), a multilateral trade agreement that is agreed to benefit exporting businesses by eliminating many tariffs. While trade agreements often exclude agriculture, in this specific trade deal, nearly all tariffs for U.S. farm products are to be eliminated (Gerwin 2015). The significance of agreements such as the T.P.P. to U.S. pork sales in the Asian region can be important due to the potential impact on growth in pork demand. Asia is becoming more open to FTAs. The impact trade openness has on the agricultural industry is measured with regression analysis. The research incorporates other variables and discusses their impact on the demand for pork exports to three large East Asian economies, China, Japan, and South Korea with varying levels of trade openness. The goal of multilateral agreements, similar to the T.P.P., is to avoid bilateral agreements, and the “Asian noodle bowl” that bilateral agreements in this region have created (Kawai and Wignaraja 2013). An economic analysis of the impact that trade openness has on demand for pork is important to discuss at this time when FTAs are increasing in the region.

Using a time series linear regression, this research seeks to analyze the determinants of U.S. pork exports from 1995 to 2013. “FTAs as trade policy instruments in the region, were largely absent until 1990s” (Kawai and Wignaraja 2013, xiii). The development of

FTAs within the East Asian region was minimal until today, when it is the leading region in FTA development. The literature on economic measurements of FTAs is minimal but authors Kawai and Wignaraja discuss the impact they have on domestic and international trade economies (Kawai and Wignaraja 2011).

Supply and demand theory lays out the economic model that this research uses as a foundation. In a domestic market, the increase in price leads to a decrease in goods demanded. In the international market, when there is an increase in domestic price this can increase exports to that country. “Global meat consumption continues to increase...the projected growth rates of exports from major exporters of pork, are 1.6 percent per year, respectively. During this period, exports rise \$1.0 million for pork” (USDA 2014, 38).

With use of Freedom House rankings for trade openness for the select East Asian countries, the openness of a country is measured as a percentage. This focus of data is on East Asia and trade policies within this region, China constitutes 16.3% of world GDP, Japan is 4.4% of world GDP putting them in the top tier, while South Korea is rising and at a 1.7% of world GDP (Quandl 2015). According to Kawai and Wignaraja, Japan and South Korea are among the richest economies in the world per capita income (Kawai and Wignaraja). Japan and South Korea are key participants in world trade negotiations due to their economic status, and large import driven economies. China’s participation in trade has grown since 1990 as well.

The objective of this thesis is to determine the impact of Free Trade Agreements (FTAs) and trade openness on U.S. pork exports to China, Japan, and South Korea from 1995 to 2013. Higher trade openness is assumed to have a positive relationship with U.S. pork exports.

1.1 Importance of Pork

Pork consumption is a fast rising commodity in Asia. “In the projections, (by the USDA), of pork imports by China and Mexico each surpass those of Russia. Since 2009, China’s pork imports have risen sharply and are projected to continue rising steadily” (USDA 2014, 40). The preference for pork in Asia has had a positive impact on U.S. pork companies. Tariff reductions for specific countries could continue to increase exports. China is the largest consumer of pork products in the world. Pork is in high demand based on the culture and income levels, and chicken and beef provide potential substitutes. “Per capita pork consumption is projected to rise 6.6 kg by 2023/24, more than three times the increase in poultry (2.7 kg) and more than seven times the increase in beef (0.85 kg)” (USDA 2014, 77). This projected increase by the USDA shows how important pork is to a growing world population.

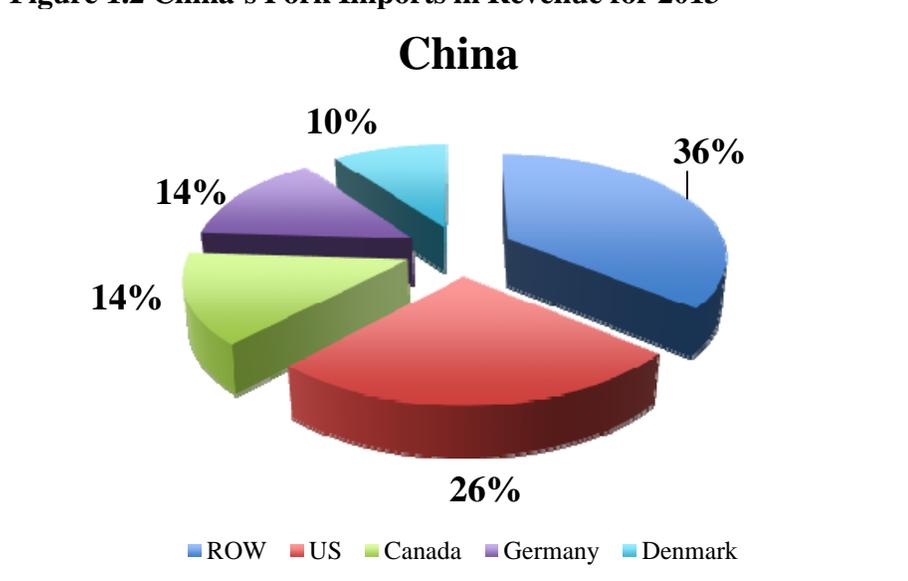
Figure 1.1 East Asian Pork and Beef Imports from 1990 – 2015 in million metric tons



Source: (USDA 2014)

In East Asia, Japan is the largest pork market for U.S. companies, China is not far behind and South Korea is steadily rising. While the most recent year's observation fell, the overall trend is an increase in exports to these countries. In 2013, China imported \$19.1 billion worth of animal products 5.8% of which was pig meat of which 26% comes from the U.S. Japan imported \$22.2 billion of animal products where 18% was pig meat, of which 39% comes from the U.S. South Korea imported \$1.86 billion of animal products, 11% of which was pig meat of which 33% came from the U.S (AtlasMedia 2015). (Figure 1.2, 1.3, 1.4).

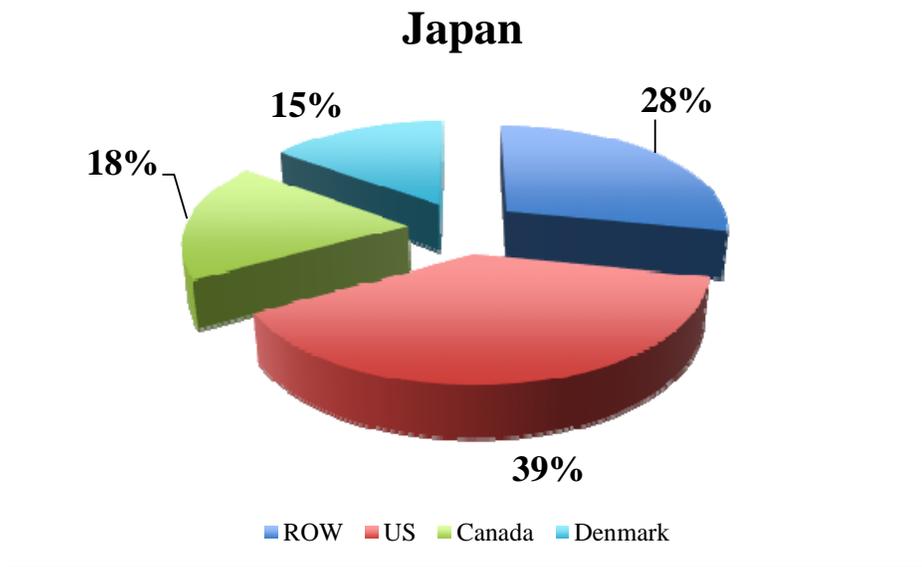
Figure 1.2 China's Pork Imports in Revenue for 2013



Source: (AtlasMedia 2015)

China's major suppliers of pork include the U.S., but also Canada, Germany, and Denmark (Figure 1.2).

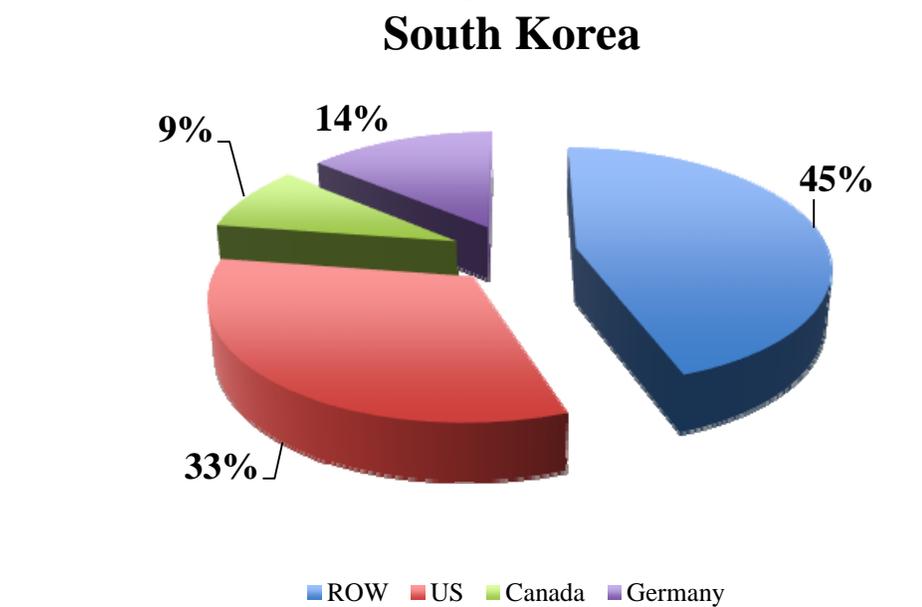
Figure 1.3 Japan's Pork Imports in Revenue for 2013



Source: (AtlasMedia 2015)

Japan imports most from the U.S., exceeding the rest of the world (Figure 1.3). Canada and Denmark are also large suppliers of pork to Japan.

Figure 1.4 South Korea's Pork Imports in Revenue for 2013



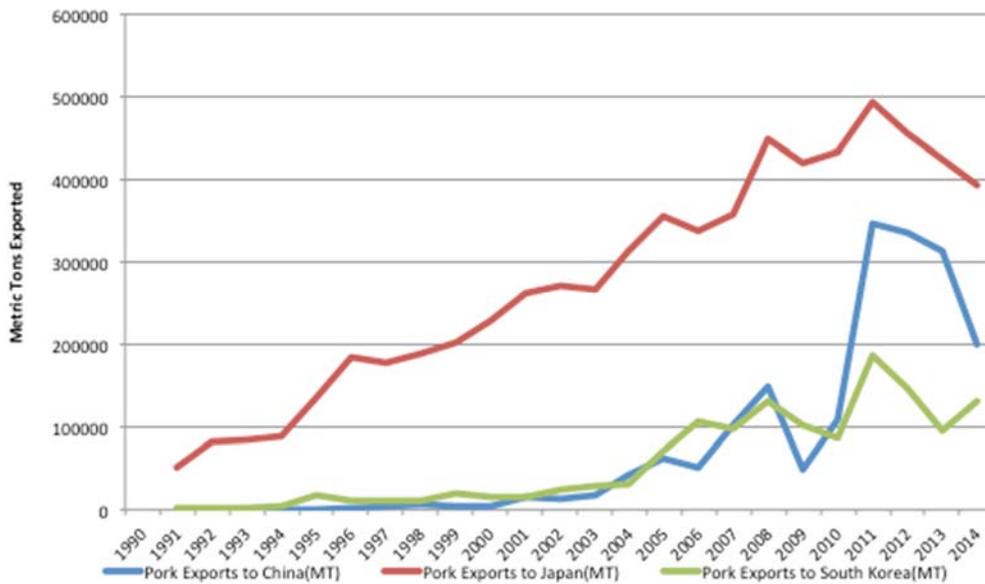
Source: (AtlasMedia 2015)

South Korea's pork is supplied by the U.S., but also Canada and Germany (Figure 1.4).

The U.S. is the largest supplier of pork to each of the countries discussed in this research.

China has highest consumption of pork in the world (Amponsah 2003, 260), and they import 5.8% of the 3.19 million metric tons imported by East Asia in 2013. The 2015 levels of pork imports for Japan are 1,277 million metric tons, China 822 million metric tons, and South Korea 431 million metric tons (USDA 2014, p. 52). Total U.S. pork exports for 2015 are estimated to be 5,444 million metric tons. Japan is the largest importer of pork and projected to maintain this position in the future. (USDA 2014, p. 40). Japan is the third largest economy in the world, as well as being part of the Pacific Rim nations, their demand for pork is especially important to U.S. pork industries. "While USDA projects robust increases in China's meat production, meat imports are also projected to rise. Pork imports are expected to rise about 50 percent, by 2023. The United States, Canada, and European Union are the main suppliers of pork and breeding stock to China" (USDA 2014, 40). Figure 1.5 examines U.S. pork exports to each country from the U.S. Japan is the leading importer of U.S. pork. China overtook South Korea around 2010 but has faltered. South Korea hit a similar peak, although South Korea's imports are increasing for the past few years.

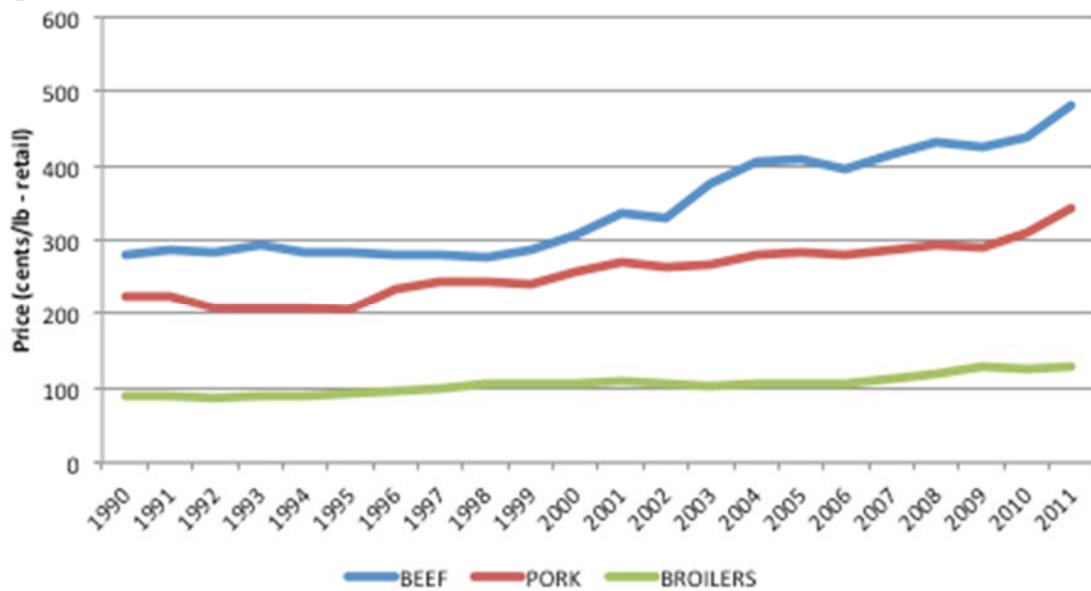
Figure 1.5 U.S. Pork Exports to China, Japan, and South Korea from 1990 – 2014 in metric tons



Source: (FAS 2015)

Pork is also a very efficient meat for larger populations. Pork tends to be cheaper than beef from 1960 to 2011 (Figure 1.6). Chicken provides a cheaper substitute when the dollar is strong. Not only are exports generally increasing, in East Asia the price of pork is a competitive factor to impact pork consumption.

Figure 1.6 US Pork, Chicken, and Beef Prices (cents/lb) 1990 – 2011



Source: (NationalChickenCouncil 2015)

According to National Chicken Council, the average cent per pound at retail price of pork has been less expensive than beef since the 1960, while both have increased in price, pork still remains the cheaper meat. Chicken price remains relatively steady with a slight increase, but not as great of an increase as with beef and pork. Because chicken price is low, it provides for a cheaper alternative for lower income countries. As incomes rise, pork becomes an alternative. With the preference for pork as a staple meat for events, dinners, and outings, access to American pork is important. FTAs could provide easier access.

1.2 Free Trade Agreements (FTAs)

When East Asia started to open up to free trade with western countries, an expansion of exports, logistics, policy, and growth came to industries ready for this economic and political shift. Asia is a “world leader with 71 FTAs and more under development” (Kawai and Wignaraja 2013, p. xiv). Where Japan has been open for a

period of time, they are now seeking to participate in negotiations concerning policies like the Trans-Pacific Partnership. South Korea, having been a smaller economy, has grown to one of the largest in East Asia with the help of trade agreements within the region and with the western world. “New data...show that FTA preference use has risen significantly by 2011 to reach 61 percent of total exports in Thailand and 31 percent of total exports in Vietnam” (Kawai and Wignaraja 2013, xiv).

Asian countries are aware of the benefits that free trade agreements can bring to a region. However, many countries see agreements differently depending on their economies of scale. Larger countries see agreements as a burden when it involves smaller countries. Smaller countries try to convince larger countries to include them in multilateral agreements to gain the benefits of that trade agreement (Irwin 2015). Smaller economies have more to gain, as a voice for their farmers, an option to trade with other nations, increasing exports, and maintaining their export to import ratio. Larger countries seek free trade agreements with large countries for rights to a percentage of their trade imports.

China, in order to protect their domestic market “adopted a system of tariffs as high as 43%, restrictive import licensing and distribution practices, and complicated arbitrary sanitary and phytosanitary (SPS) requirements, virtually shutting its door to U.S. pork exports” (Amponsah 2003, p. 260). This was economically costly to the Chinese pork industry considering China’s inability to efficiently provide the feed for domestically supplied pigs with domestic feed production. So China became the largest soybean importer. Feed costs are a large percentage of production, making the pig meat supplied locally in China more expensive. “In commercialized hog production, feed cost is about 60% of the total production cost” (Amponsah 2003, p. 262). Limitations on domestic

production encourages importation of goods at a lower price, however heavily influenced by subsidies.

Many efforts have been made through the past 30-40 years to promote free trade throughout the East Asian and Pacific Rim region. In 1999, Chinese and American leaders signed the U.S. – China WTO Accession Agreement in Beijing. This allowed for the U.S to export to China. This made U.S. pork producers eager to enter into a fast growing Chinese market. This agreement is not an FTA, but merely U.S. support of China's accession into the WTO, helping to lower tariffs and phase out certain restrictive policies. Also, the General Agreement for Tariffs and Trade (GATT) has motivated trade liberalization to be a significant to the increase of international competition and forcing countries to compete (Lall, Featherstone and Norman 2002, 1485). China is one of the 23 founding members of the GATT, and its participation is crucial. The last round took place in 2001, and countries continue to work towards additional trade deals. The Asia Pacific Economic Cooperation (APEC) was established in 1989 to promote free trade throughout the region. The Association of Southeast Asian Nations (ASEAN) is an intergovernmental organization that seeks economic growth among Southeast Asian countries. ASEAN facilitates trade blocs such as the Asian Free Trade Area (AFTA) signed in 1992 and has been growing and adding participants since then. These efforts show an initiative by governments to open trade in the region.

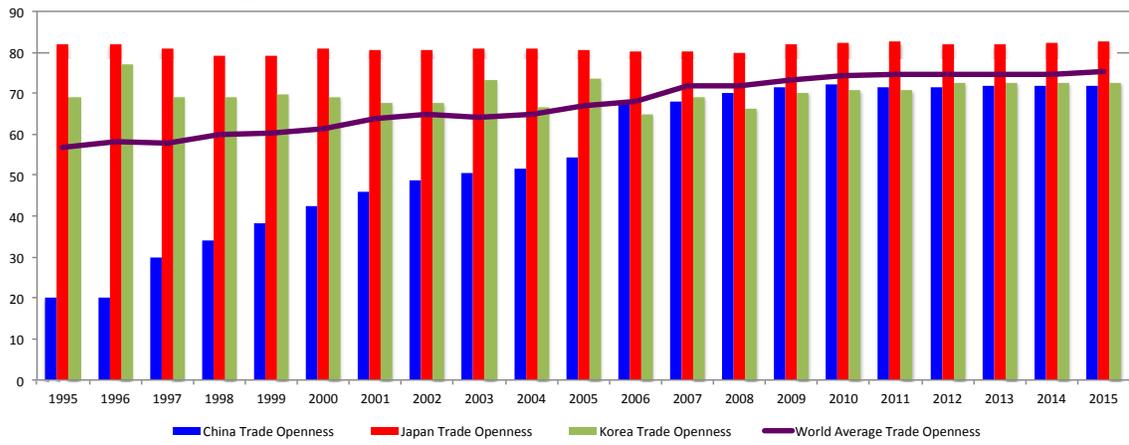
Asia first opened its doors to the U.S. in 2004 with the U.S.-Singapore Free Trade Agreement, and even more recently in 2012 with U.S. – Republic of Korea Free Trade Agreement (KORUS FTA). This agreement was particularly focused on commodities such as automobiles and U.S. beef exports. “Low margins of preference, administrative costs

and delays associated with rules of origin (ROO) and other export documentation, and non-tariff measures in partner economies were the other reasons cited for non-use of FTAs” (Kawai and Wignaraja 2013, p. xiv). “The literature shows that the coverage of agricultural trade differs markedly among current Asian FTAs. Agricultural products are often substantially excluded from such agreements based on pressure from powerful farm lobbies or social concerns regarding poverty in rural areas” (Kawai and Wignaraja 2013, p. xiv). These concerns are important to larger economies in East Asia. When a country’s economy is of a larger scale, the debate whether to domestically produce or import is considered. China is hesitant to engage in trade agreements with the West and this hesitancy delays growth for U.S. agricultural firms.

In Figure 1.5, China, Japan and South Korea’s trade openness is measured along with the overall world trade openness from 1995 - 2015. The percentage of economic freedom is measured by Freedom House. Freedom House bases their measurement on four pillars of economic freedom; rule of law, limited government, regulatory efficiency, and open markets. Each pillar is weighted equally. Freedom House uses the Index of Economic Freedom to access data to determine the score of each of the four pillars (FreedomHouse 2015).

South Korea is the only country with a trade agreement with the U.S. Japan has maintained the highest percentage of trade openness, for the longest period. China’s increasing trade openness is significant. For the pork industry in particular, only 5% of Smithfield’s exports go to China (SmithfieldTownHall 2015). One major initiative taking place is the Trans Pacific Partnership and a key driver to its importance is the inclusion of the world’s third largest economy, and number one U.S. pork importer, Japan.

Figure 1.7 Trade Openness Trend from 1995-2015 for China, South Korea, Japan, and World Average



Source: Freedom House

CHAPTER II: LITERATURE REVIEW

Free Trade Agreements (FTAs) have been important for many different regions. The Asia Pacific region is involved in free trade agreements among themselves and other regions of the world. The rising preference of FTAs by Asian economies has sparked opportunities for American companies. The Trans Pacific Partnership (TPP) is a trade agreement involving the Asian Pacific region. One reason why this trade agreement is important to the agricultural industry is because FTAs typically did not consider the agriculture sector but this agreement is specifically covering agricultural commodities. The previous lack of agricultural coverage is often due to strong farm lobbies and concerns regarding self-sufficiency. Agriculture and food access could be used as a weapon if political tensions were to rise. Countries are often very protective over their raw commodities, especially ones with historical episodes of food shortages.

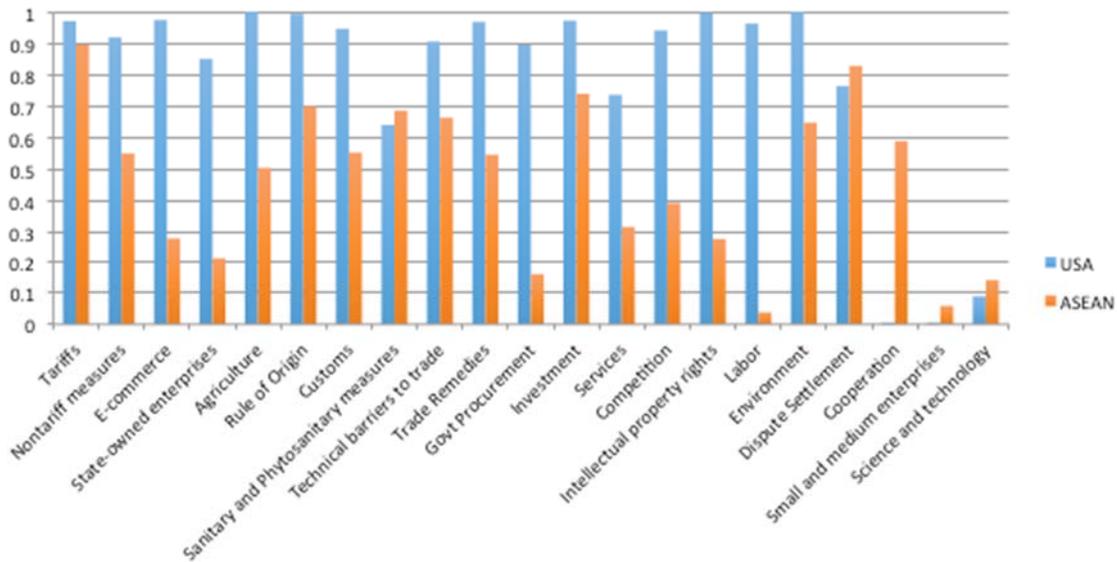
Kawai and Wignaraja have outlined the rising preference of FTAs in the region and how there is little economic research that examines the impacts it has had on different sectors of the economy. According to Kawai and Wignaraja there are six key challenges associated with Asian FTAs that are 1) increasing enterprise-level use of FTAs, 2) tackling the Asian noodle bowl, 3) promoting comprehensive coverage of agricultural trade, 4) facilitating services-trade liberalization, 5) increasing WTO-plus elements, and 6) forming a region-wide FTA (p.17). Comprehensive coverage of agricultural trade has been a difficulty. Asia may be U.S. agriculture's next growing opportunity.

FTAs are fairly new to the Asian region. Kawai and Wignaraja state that Asian economies prefer bilateral agreements rather than the complicated multilateral agreements that Western economies use. Kawai and Wignaraja suggest that because Asian economies

are new to implementing FTAs that “previous limited empirical evidence (particularly with patterns of Asian FTAs and their business impacts) has made it difficult to establish the validity or lack thereof of these concerns”(p. 3). This concern has lessened now that Japan is participating in T.P.P. negotiations. The increase in FTAs in Asia from 3 to 22 from 2000 to 2005 and further to 71 by 2012 is economically significant (p. 7).

Petri and Plummer of the Peterson Institute for International Economics discuss the multilateral agreement and multiple FTA's that T.P.P. fosters that “could yield annual global income gains of \$295 billion (including \$78 billions for the United States) and offers a pathway to free trade in the Asia Pacific with potential gains of \$1.9 trillion” (p.1). Multilateral agreements are encouraged because it allows as many possible participants to achieve the greatest possible gains from trade (Irwin 2015). Petri and Peterson portray the importance of U.S. agricultural products in the U.S. with an average score of agreements at 100 percent, twice that of ASEAN, at 50 percent (Figure 2.1). For ASEAN, no issue's score exceeds the U.S., except for science and technology. ASEAN considers SMEs and cooperation as major issues.

Figure 2.1 Average Score of Provisions on Major Issues



Source: (A.Petri and Plummer 2012, 4)

Petri and Plummer project the export gains with T.P.P. for various economies, and they are substantial. For 2025, they project export gains for the U.S. to be at \$2.8 billions of dollars (p.7). The results offer strong support for U.S. interest in Asia Pacific free trade (p. 8). Petri and Plummer believe to continue to adopt new members, maintain high standards and allow full Asia-Pacific economic integration, and forming a collegial dialogue that connects T.P.P. and Asian tracks, would be beneficial for the T.P.P.

Amponsah, Qin and Peng find that “these agreements (referring to GATT and Agreement on Agriculture) started the process of reducing trade-distorting subsidies and import barriers in the agricultural sector” (p. 259). Amponsah, Qin and Peng review the process that China underwent to adapt to WTO standards. Reduction of trade distorting domestic subsidies is a commitment China follows through with. By eliminating trade barriers, China opens itself further to the Western economy. However, the U.S. is not the only supplier of pork in China. China has a domestic pork industry. The main challenge for pork production in China is subsidized feed (p. 262). The government subsidizes pork

production by operating food mills at a loss. This way of producing pork leaves China with no choice but to import. Reductions in trade barriers open China up to trade, and the costly production of domestically produced pork encourages China to import an alternative source for pork. The sooner the U.S. can enter the pork market, the sooner they can establish a competitive advantage among domestic suppliers.

Lall, Featherstone, and Norman explain that productivity growth in the Caribbean was positively associated with civil, economic, and political liberty (p. 213). Although the study determined if productivity is greater in higher or lower income countries, an underlying observation is that trade policies do have an impact on economic growth. Lall, Featherstone and Norman refer to Olson (1996) who suggested that institutions and policies are likely to be particularly important in explaining currently observed trade patterns (p. 216). This suggestion that policy has an impact on economic growth can be applied to FTA's being a variable in the movement of U.S. pork exports. When focusing on a region without many FTAs, it is hard to measure the impact. However, taking into consideration countries with varying degrees of trade openness for the past 25 years can give a holistic perspective of the impact FTA's and the level of trade openness has on economic growth within the U.S. pork industry for the region. With Lall, Featherstone, and Norman's research neither the convergence nor the endogenous growth theory could fully explain the patterns of growth. However the results were more closely correlated with Olson (1996), where growth patterns can be explained by difference in the types of policies and institutions adopted by countries (p. 226). With more data this research could seek specific policy implications on regional economic growth for importers and exporters.

CHAPTER III: CONCEPTUAL MODEL

3.1 Introduction

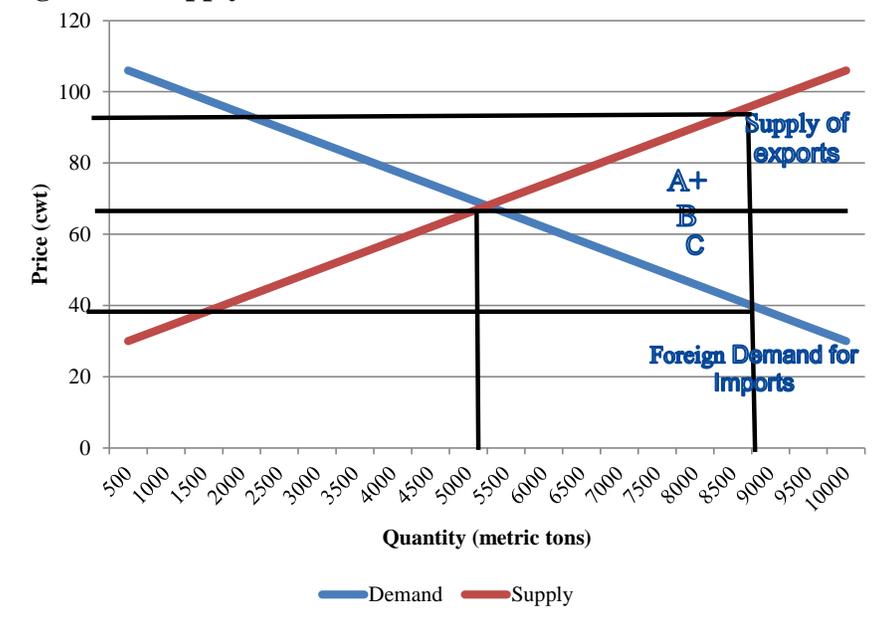
In this chapter, the theory behind the relationship between the level of U.S. pork exports to East Asia and trade openness among three different East Asian countries is discussed. East Asian imports come from the U.S. pork industry and this relationship is analyzed using supply and demand. The relationship between importing countries and exporting countries is a key component to understanding the results of this research.

3.2 Theory

The theory supporting the regression analysis of export demand for pork will be the supply and demand of large exporting countries. Where increases in certain variables may be expected to have an impact on demand domestically, this theory will be applied to the international market where export subsidies, tariffs, embargoes, and policy impact supply and demand. The main focus of this research is the impact of trade openness on the demand of U.S. pork abroad. Trade openness is measured by Freedom House, and considers trade agreements and levels of imports and exports across borders, referring to each of the four pillars (2015). The relationship between policy and economics is a complex one, and can be endogenous, where price and quantity demanded are determined simultaneously. Trade policy in particular has a direct impact on where and how an economy grows. Concerning the market for pork between the United States and East Asia, trade agreements are few but increasing. The determinants of U.S. exports includes multiple factors, such as income, exchange rate, U.S. price of feed, quantity of pork, chicken, and beef demanded, trade openness, and population. When income increases, consumers are more likely going to purchase a normal good. Pork is considered a normal

good in East Asia. As the increase for normal goods continues the quantity supplied increases as well as the quantity demanded while the price decreases (Figure 3.1).

Figure 3.1 Supply and Demand Curve for International Market for Pork



Source: (Pugel 2012, p. 244)

If free trade supplies an export subsidy of \$55, with a world price at \$65, this drives the cost down in the international market to \$40. As demand increases from the equilibrium of 5500 metric tons of pork to 9,000 metric tons of pork, the price for the importing country decreases from \$65 cwt to \$40 cwt (Figure 3.1). This decrease in price for exported goods to the importing country carries over to the domestic consumer. The domestic buyer pays \$95, where the importer pays \$40, distorting trade. The trade relationship among the exporting country's producer gains, while the consumer suffers a loss due to a higher price, and the importing country's consumer gains while the importing country's producer suffers

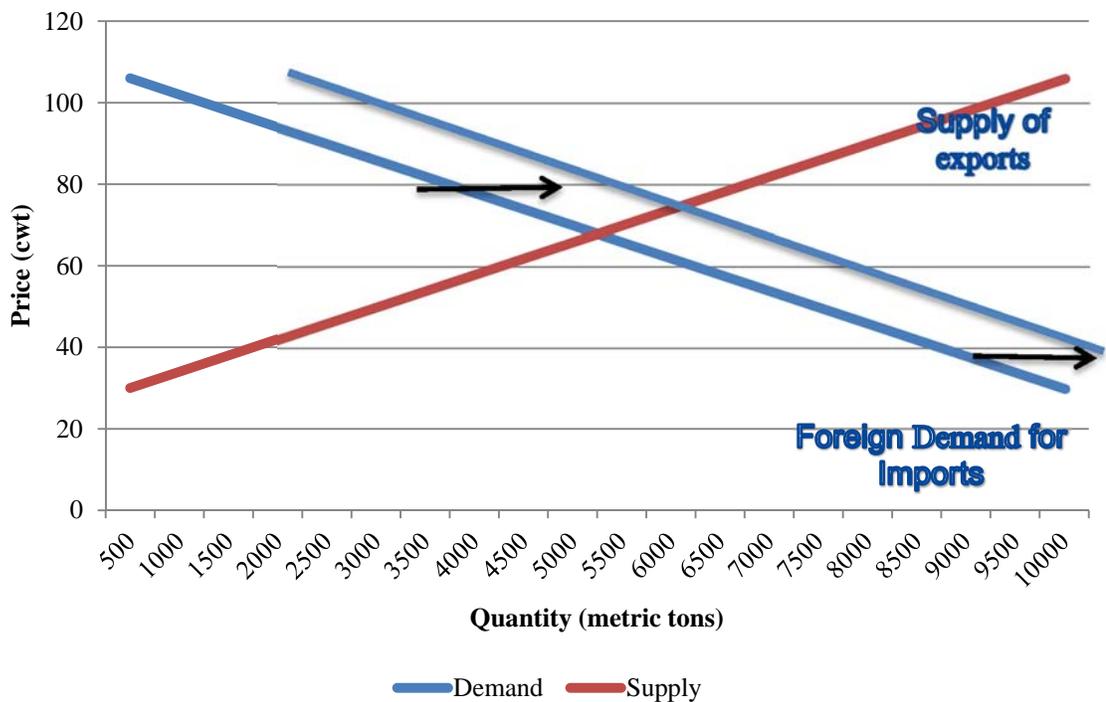
a loss to competition. Overall trade increase overall satisfaction because the options are still available and it is a consumer's choice in a market economy that trade allows. When determinants such as population and exchange rate are considered, it is easier to measure the gains and losses to producers and consumers of importing and exporting countries. The U.S. is one of the primary exporters of fresh and packaged pork. With an expansion of exports for the pork industry and the U.S. being one of the primary suppliers to East Asia, gains for U.S. producers of pork is expected to grow. The area $A + B + C$ is the net loss to the world. Therefore, if this area increases with a decrease in foreign demand and a price decrease and export subsidy increase, where supply increases, this inefficiency grows and the loss to the world becomes greater. An increase in foreign demand, without price protection, increases the loss. An increase in foreign demand can decrease the loss with price protection. Policy can be used rather than trade distorting export subsidies.

3.3 Model

The dependent variable that will be explained in this time series linear regression analysis will be U.S. pork exports from 1995 to 2013 per country. To analyze the movement of exports, multiple independent variables, such as the U.S. price of feed, and levels of trade openness for each East Asian country are considered. Other independent variables considered are the quantity of pork chicken and beef demanded in each country, viable substitutes to pork in this part of the world. An increase in the price of feed will cause domestic pork production to become costly and therefore decrease domestic supply and increase domestic price. On the international level, it is possible this would result in an increase in demand by importing countries when the production costs are high domestically, or in China as well. The income and population of importing countries has an

impact on how much pork is exported as well. The dollar dominated exchange rate can have a negative impact on the amount of pork demanded in other countries. The income levels of these three countries could positively impact the demand for U.S. pork (Figure 3.2). The movement of the demand curve to the right results in a decrease to the area representing net loss to the world. Where the exporting producer gains, the exporting country's consumer would suffer a loss, however with price protection the exporting country's consumers would not suffer as much of a loss. Free trade is considered to increase gains for the exporting and importing countries, where the losses are not as large.

Figure 3.2 Supply and Demand Curve when Demand for Pork increases



This research analyzes the impact FTAs, or trade openness has on the demand and supply curves if the demand curve shifts to the right. The countries of China, Japan, and South Korea are studied.

Conceptual Model for China

Exports $Q_s = f(\text{US corn price, exchange rate})$

Exports $Q_d = f(\text{beefquantitychina, pigquantitychina, chickenquantitychina, trade openness, china income, china population})$

China $Q_e = f(\text{US cornprice, exchange rate, } Q_b, Q_c, Q_p, \text{ trade openness, income, population})$

Conceptual Model for Japan

Exports $Q_s = f(\text{US cornprice, exchange rate})$

Exports $Q_d = f(\text{beefquantityjapan, pigquantityjapan, chickenquantityjapan, trade openness, japan income, japan population})$

Japan $Q_e = f(\text{US cornprice, exchange rate, } Q_b, Q_c, Q_p, \text{ trade openness, income, population})$

Conceptual Model for South Korea

Exports $Q_s = f(\text{US cornprice, exchange rate})$

Exports $Q_d = f(\text{beefquantitysk, pigquantitysk, chickenquantitysk, trade openness, South Korea income, South Korea population})$

South Korea $Q_e = f(\text{US cornprice, exchange rate, } Q_b, Q_c, Q_p, \text{ trade openness, income, population})$

It is expected that U.S. feed price is expected to have a positive relationship with U.S. pork exports. The price of corn, used as feed for hogs, plays a role in exports because it contributes to the cost of production. When the cost of production is higher, domestic supply decreases. Import demand could increase due to a decrease in supply in China.

When the production of pork increases, price will be less and import demanded and consumption are expected to increase.

Trade openness for each country has an expected positive relationship with U.S. pork exports into that specific country. With trade liberalization, tariffs and taxes are relaxed to allow for free trade among countries. When free trade occurs, the exporting country is more competitive with the local supplier of a similar or substitute product. Importing countries tend to have an increase in demand of export commodities when the imported goods are cheaper and efficiently distributed.

The quantity of pork demanded within each country will also be a factor and have an expected positive impact on U.S. pork exports. When the quantity demanded within a country increases, more needs to be supplied. With limitations on domestic supply, countries look towards imported goods to fulfill demand.

The quantity of chicken and beef have an expected negative impact on the U.S. pork exports to East Asia because as the demand for chicken within a country increases that can cause lower demand for the substitute product which is pork, therefore imported pork from countries such as the U.S. decrease.

Country income has an expected positive relationship with the amount of U.S. pork exports, into China, Japan, and South Korea. As a normal good, pork maintains the position when income increases more of the normal good is purchased. However there is a limit and when income increases past a certain level, more luxury goods, such as beef, may be purchased.

Country population has an expected positive relationship with U.S. pork exports. The more consumers there are in a country, the more likely the demand for pork is higher.

The exchange rate measures strength of the foreign currency against the dollar. The higher the exchange rate, the more foreign currency it will take for each dollar, meaning when the dollar is strong this lowers export volumes. Therefore the exchange rate is expected to have a negative impact on U.S. pork exports.

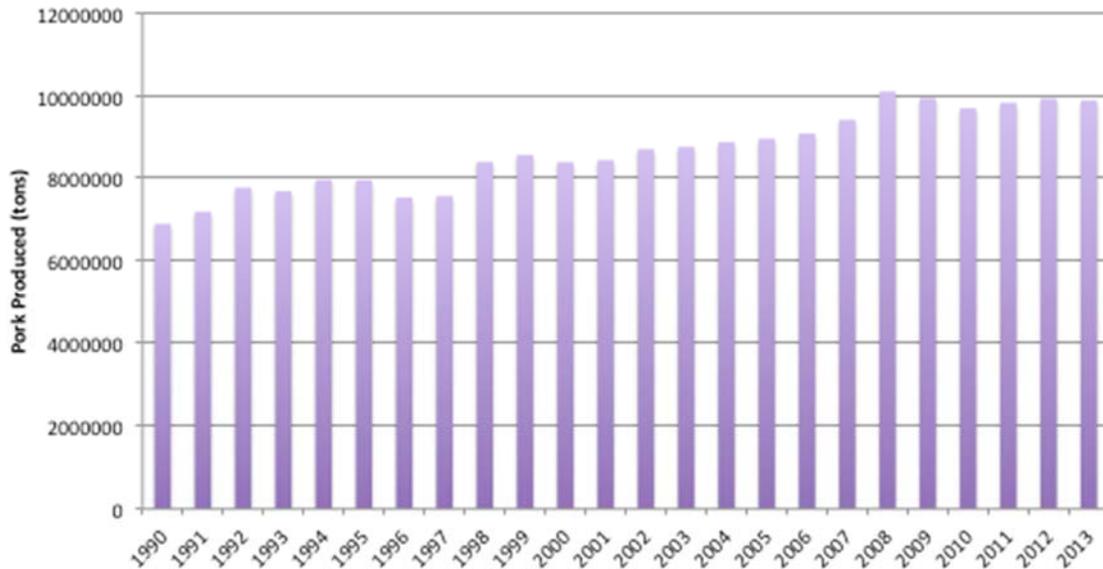
CHAPTER IV: DATA AND METHOD

4.1 Data

The variables used in this research are U.S. feed price, country trade openness, pork quantity demanded, chicken and beef quantity demanded, country income, country population, and country exchange rate. The data gathered for this research is from the Food and Agricultural Organization (FAO), the US Department of Agriculture (USDA), Atlas Media (AtlasMedia 2015), Oanda (Oanda 2015), Quandl Economics (Quandl 2015), Freedom House, World Bank, and the World Factbook.

The dependent variable in each regression model is U.S. pork exports to each country, measured in metric tons, from the Foreign Agricultural Service (FAS 2015). This research examines the variables that have a statistically significant relationship with the dependent variable. Pork demanded within each country is examined, however the demand for pork for each country is met by many different countries besides the U.S. The U.S. is the largest supplier of pork to each of the countries according to Figures 1.2, 1.3, and 1.4 in Chapter 1. U.S. pork production is measured in tons and is from the Food and Agricultural Organization (FAO 2015). The trend of U.S. pork production from 1990 – 2013 is graphed in Figure 4.1. Generally there is an increase in production, having plateaued for the time being at around 10,000,000 tons after and spiking in 2008.

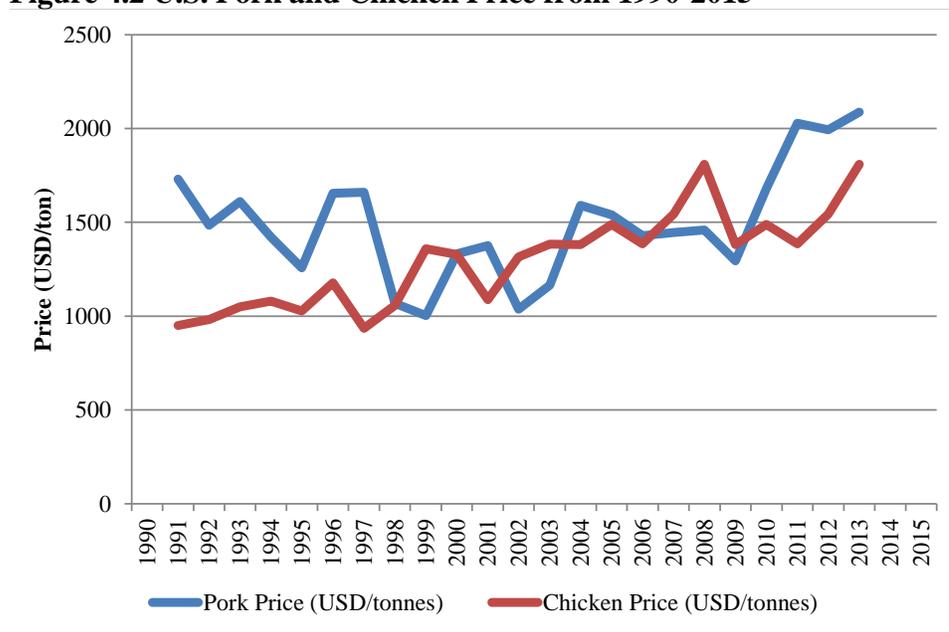
Figure 4.1 U.S. Production of Pork from 1990 – 2013



Source: (FAO 2015)

Prices for pork and chicken are derived from Food and Agricultural Organization (FAO) in USD per ton. Chicken is a viable substitute for pork. Pork prices and chicken have increased. The average pork price is \$4,901 USD/ton while the standard deviation for pork price is \$297 USD/ton. The maximum is \$2,087 USD/ton while the minimum is \$1,002 USD/ton. The average chicken price is \$1,241 USD/ton while the standard deviation is \$240 USD/ton.

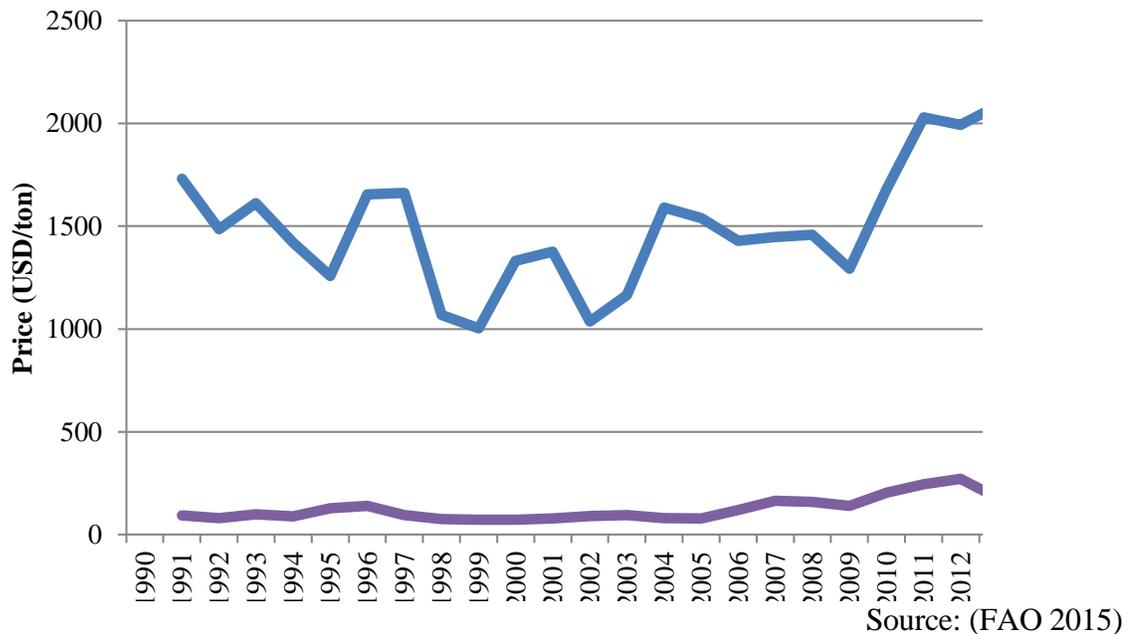
Figure 4.2 U.S. Pork and Chicken Price from 1990-2015



Source: (FAO 2015)

Feed prices according to FAO seem to stay at a fairly low level. (Figure 4.3). They maintain an average price of \$124 USD/ton, and the standard deviation is low at \$56 USD/ton.

Figure 4.3 U.S. Pork and Corn Prices from 1990 – 2015



For the regression analysis for each country, the quantities demanded of pork, chicken and beef in each country are used as a proxy for price due to the limited price data.

The data for each country is summarized in Tables 4.1, 4.2, and 4.3.

China 4.2.1

U.S. exports to China have an average of 85,288 metric tons per capita with a standard deviation of 117,251 metric tons per year (Table 4.1). Trade openness for China averaged 54.5% with a standard deviation of 18.22%. Income for China between 1995 and 2013 has an average of \$1,960 per capita with a standard deviation of \$1,567 per capita.

The population of China has been increasing with an average number of people is at 1,290,000,000 and a standard deviation of 46,400,000. The exchange rate for the Chinese renmimbi has an average of R7.48, with a standard deviation of R0.87. The quantity of pork produced in China has an average of 40,300,000 tons with a standard deviation of 7,263,455 tons. The quantity of chicken produced in China averages 9,241,272 tons with a

standard deviation of 2,198,393 tons. The quantity of beef produced in China averaged 5,031,797 tons with a standard deviation of 1,124,717 tons.

Table 4.1 Summary of China Model Data Characteristics from 1995 - 2013

Variable	Units	Mean	Std Dev	Minimum	Maximum
US Pork Exports to China	metric tons	85287.6	117251.9	359.3	346570.9
Corn price	USD/ton	131.1	59.78	72	271
Chinese yen	Renmimbi	7.4	0.87	6.14	8.27
Qd of Beef	tons	5,031,797	1,124,717	2,586,186	6,380,135
Qd of Chicken	tons	9,241,272	2,198,393	5,557,796	12,790,840
Qd of Pork	tons	40,300,000	7,263,455	29,800,000	52,900,000
China Trade Openness	%	54.5	18.22	20	72.2
China Income	\$	1959.98	1566.71	519.52	5469.98
China Population	#	1,290,000,000	46,400,000	1,200,000,000	1,364,270,000

Japan 4.2.2

U.S. exports to Japan averaged 313,221 metric tons per year with a standard deviation of 111,128 metric tons per year (Table 4.2). Trade openness for Japan has an average of 80.96% with a standard deviation of 1.04%. The average income for the Japanese during this time period is \$30,331 with a standard deviation of \$3,753. Japan's average population within this time period is 127,000,000 with a standard deviation of 827,622. The Japanese yen has an average of ¥106.98 with a standard deviation of ¥14.81. The quantity of pork produced in Japan averaged 1,271,270 tons with a standard deviation of 24,013 tons. The quantity of chicken produced in Japan averaged 1,300,474 tons with a standard deviation of 90,754 tons. The quantity of beef produced in Japan averaged 512,082 tons with a standard deviation of 29,893 tons.

Table 4.2 Summary of Japan Model Data Characteristics from 1995 - 2013

Variable	Units	Mean	Std Dev	Minimum	Maximum
US Pork Exports Japan	metric tons	313221.1	111128.2	134630.6	493824.3
Corn price	USD/ton	131.1	59.78	72	271
Japan Yen	Yen	106.98	14.81	79.69	130.76
Qd of Beef	tons	512,082	29,893	450,656	596,676
Qd of Chicken	tons	1,300,474	90,754	1,192,981	1,448,515
Qd of Pork	tons	1,271,270	24,013	1,231,125	1,309,698
Japan Trade Openness	%	80.96	1.04	79	82.6
Japan Income	\$	30331.56	3753.34	25047.36	38240.80
Japan Population	#	127,000,000	827,622	125,000,000	128,000,000

South Korea 4.2.3

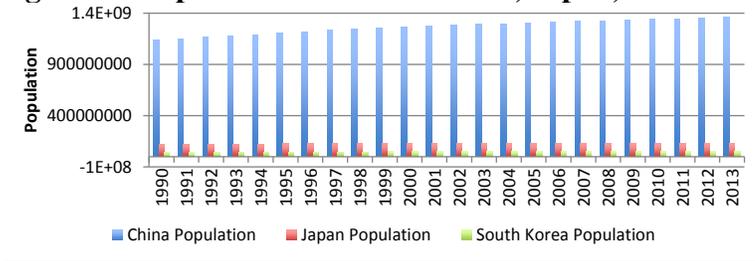
The rising importance of U.S. Pork exports to South Korea from 1995-2013 averaged 63,479 metric tons per year with a standard deviation of 54,705 metric tons per year. South Korean trade openness has an average of 69.98%, greater than Chinese average trade openness, not as high as Japan's. The standard deviation for trade openness in South Korea is 2.89%, slightly more than Japan's, but not as high as China's. South Korean income has an average of \$13,639 per capita with a standard deviation of \$4,556 per capita. South Korea's population averaged 47,900,000 with a standard deviation of 1,525,353. South Korea's population is lower than Japan's and China's with a greater standard deviation than Japan's. The South Korean won averaged W1,138, with a standard deviation of W121.

Table 4.3 Summary of South Korea Model Data Characteristics from 1995 - 2013

Variable	Units	Mean	Std Dev	Minimum	Maximum
US Pork Exports S. Korea	metric tons	63479.59	54705.51	9896.7	186426.3
Corn price	USD/ton	131.1	59.78	72	271
Korean Won	Won	1138.34	121.33	922.84	1396.6
Qd of Beef	tons	261,125	59,445	185,452	375,784
Qd of Chicken	tons	461,034	96,870	349,089	616,174
Qd of Pork	tons	972,145	90,572	798,710	1,149,480
S. Korea Trade Openness	%	69.98	2.89	65	77
S. Korea Income	\$	13639.19	4556.00	6260.14	21095.53
S. Korea Population	#	47,900,000	1,525,353	45,100,000	50,200,000

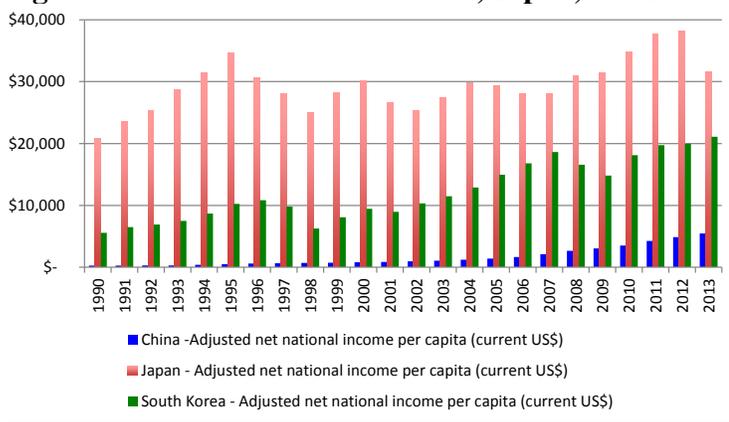
U.S. pork exports to this region boomed in 2011. The exchange rate shows that, mainly in Japan, when the dollar was fairly weak the U.S. Pork exports were at a maximum. Incomes have increased throughout the past 25 years. South Korea's has a more wealthy population than China, but vastly smaller population. While Japan maintains the highest income levels throughout this period, and they maintain their population, they also demonstrated the highest import level of U.S. pork. South Korea is the only country increasing U.S. pork imports during most recent years.

Figure 4.4 Population Trend for China, Japan, and South Korea from 1990-2015



Source: (WorldBank 2015)

Figure 4.5 Income Levels for China, Japan, and South Korea from 1990 -2015



Source: (WorldBank 2015)

Japan is the third largest economy in the world. Japan's participation in free trade agreements may bring opportunities to U.S. pork industries. With Japan's late entry into negotiations for the Trans-Pacific Partnership, this leads to a viable link between a promising East Asian economy and the U.S. economy.

South Korea is a major importer of American products and agricultural goods. Since the US-South Korea (KORUS FTA) Free Trade Agreement in 2012, South Korea has maintained free trade with the U.S., especially in agricultural goods. Overall South Korea imports an abundance of their food from other countries. There is an immediate increase in trade due to the KORUS in 2012, however it was not evident in U.S. pork exports. In 2013, South Korea imported \$7.33 billion worth of animal products, 11% of which was pig meat (AtlasMedia 2015) with 95,476 metric tons from the U.S. Similar to China, South Korea has also experienced a steady increase in income.

4.3 Regression Method

The theoretical relationship that policies have with the economies of certain countries can better be explored with regression analysis. A time series linear regression analyzes the time period of the U.S. pork industry in East Asia from 1995 - 2013. By including trade openness of these three countries it is examined if their trade openness has a positive or negative relationship with U.S. pork exports as a whole. This period of time is important because Asia began to increase participation in FTAs in the early 1990s. As Asian countries have begun trade negotiations among themselves and the Western economies, the economic measurement of the impact FTAs have is critical to understanding the external forces to agricultural and commodity growth. In a regression analysis many variables and their relationship to the dependent variable are considered. A regression analysis helps determine the applicability of our theory. Regression is “used to make quantitative estimates of economic relationships that previously have been completely theoretical in nature” (Studenmund p. 5).

Regression analysis takes into account three different countries and economies in the East Asian region, and relates them to U.S. pork industry. The different models will reflect the levels of trade openness ranked by Freedom House. The increase in trade is expected to have a positive impact on the amount of U.S. pork exports to the region.

CHAPTER V: RESULTS

5.1 Introduction

Regression analysis was used to examine the relationship between the dependent variable, US Pork Exports, and the independent variables. This regression is analyzed with the two-sided hypothesis at the 5% significance level. The t-statistic does not render the theory incorrect or correct but explains the statistical significance within that confidence level. Price elasticity of demand is measured to examine the responsiveness of the dependent variable to price.

5.2 Results

5.2.1 China

The R-squared for the China model is 92% and the adjusted R-squared is 84%. The constant for this model is -8,577,883.

Table 5.1 China Regression Results 1995-2013

Variables	Coefficients	T-Stat	P-Value
US Feed Price	858.48	1.41	0.19
China Trade	-3459.69	-0.94	0.37
Qs Pork	-0.05	-3.36	0.01
Qs Chicken	0.14	2.17	0.06
Qs Beef	-0.2	-1.82	0.1
China Income	10.37	0.15	0.88
China Population	0.008	2.93	0.019
Chinese Renimimbi	-35419.07	-0.74	0.48

U.S. feed price had the expected positive relationship with U.S. pork exports to China. For every dollar increase in feed price, U.S. exports of pork to China increase by 858 metric tons. U.S. feed price is not statistically significant with a p-value of 19%, China's trade openness has an unexpected negative relationship with the dependent variable. For every percent increase in trade openness China experiences, U.S. pork exports to China decrease

3,459 metric ton per capita. China's trade openness variable is not statistically significant with a p-value of 37%.

The quantity of pork produced in China has the expected negative relationship with U.S. pork exports to China. For every ton increase in supply of pork by China, there is a .05 metric ton decrease in U.S. exports to China. This variable is statistically significant with a p-value of 0.01%. The quantity of chicken produced in China has a positive relationship with U.S. pork produced in China. For every ton increase in production of chicken, there is a 0.14 metric ton increase in U.S. pork demanded in China. This variable is not statistically significant at the 5% level, but it is at the 10% level. The quantity of beef produced in China has a negative relationship with U.S. pork exports to China. For every ton increase in beef produced in China, there is a 0.2 metric ton decrease in demand for pork in China. This variable is not statistically significant at the 5% level, however it is statistically significant at the 10% with a p-value of 10%.

China's income has the expected positive relationship to U.S. pork exports to China. For every dollar increase in per capita income, there is a 10 metric ton increase in U.S. pork exports to China. China's income variable is not statistically significant, with a p-value of 88%. The Chinese population has a positive relationship with U.S. pork exports to China. For every person added to the Chinese population there is an increase of 0.008 metric tons of U.S. pork exports to China. The population variable in this model is statistically significant with a p-value of 1%, indicating strong statistical significance at the 5% level. The Chinese renminbi exchange rate variable has the expected negative impact on U.S. pork exports to China. For every increase in renminbi, there is a 35,419 metric ton

per capita decrease in U.S. pork exports to China. The renmimbi was not statistically significant with a p-value of 48%.

Major correlations among variables exist in the Chinese model between China's production of beef with production of chicken at 97%, production of pork at 96%, trade openness at 97%, and population at 98%. China's supply of chicken is highly correlated with the supply of pork at 98%, trade openness at 97%, and population at 98% as well. Trade openness is also highly correlated with population at 98%. These correlations show strong relationships between variables indicating higher risk of multicollinearity for the China model (Table 5.2).

Table 5.2 Correlation of China Model

	U.S.Pork Exports to China	US Feed Price	Ren	Qs Beef	Qs Chicken	Qs Pork	Trade	Income
U.S.Pork Exports to China	1							
US Feed Price	0.8233	1						
Chinese Renimimbi	-0.0749	-0.746	1					
Qs Beef	0.625	0.454	-0.839	1				
Qs Chicken	0.727	0.592	-0.899	0.977	1			
Qs Pork	0.721	0.641	-0.941	0.96	0.988	1		
China Trade	0.652	0.54	-0.897	0.978	0.975	0.975	1	
China Income	0.858	0.852	-0.931	0.807	0.903	0.921	0.845	1
Chinese Pop	0.69	0.547	-0.897	0.989	0.986	0.984	0.986	0.862

Overall the Chinese model does not quantitatively support the theory that a country's trade openness has a positive significant relationship with U.S. pork exports to China. If trade were to become even more open for a longer period of time the statistical significance of this variable might change.

5.2.2 Japan

The Japan model found different results for the relationship of the independent variables on U.S. pork exports to Japan. Japan has had a longer and more consistent trade openness with the U.S. The Japan model has an R-squared of 96% and an adjusted R-squared of 93%. The constant for the Japan model is estimated at -3,394,511 metric tons.

Table 5.3 Japan Regression Results 1995 - 2013

Variables	Coefficients	T-Stat	P-Value
US Feed Price	531.09	1.34	0.209
Japan Trade	-12056.86	-1.05	0.319
Qs Pork	-0.42	-0.91	0.383
Qs Chicken	0.29	1.28	0.229
Qs Beef	-0.52	-1.36	0.202
Japan Income	-14.68	-0.92	0.38
Japan Population	0.05	2.32	0.043
Japan Yen	-5913.42	-1.47	0.172

In Table 5.3, the Japan Model results show that the U.S. feed price variable had the expected positive relationship with U.S. pork exports to Japan. For every dollar increase in U.S. feed price, there is a 531 metric ton per capita increase of U.S. pork exported to Japan. U.S feed price is not statistically significant with a p-value of 20%.

Japan trade openness has the unexpected negative relationship with U.S. pork exports to Japan. For every percent increase in Japanese trade openness there is a 12,056 metric ton per capita decrease in U.S. exports to Japan. The statistical significance of this variable is not strong with a p-value of 32%.

The quantity of pork produced in Japan has a negative relationship with U.S. pork exports to Japan. For every ton increase in quantity of pork produced in Japan, there is a 0.42 metric ton decrease in U.S. pork exports to Japan. This variable is not statistically significant with a p-value of 38%. The quantity of chicken demanded in Japan has a

positive relationship with U.S. pork exports to Japan. For every ton increase in chicken produced in Japan, there is a 0.29 metric ton increase of U.S. pork exports to Japan. This variable is not statistically significant as well with a p-value of 22%. The quantity of beef produced in Japan has the a negative relationship with U.S. pork exports to Japan. For every ton increase in beef produced in Japan there is a 0.52 metric ton decrease in U.S. pork exports to Japan. This variable is also not statistically significant with a p-value of 20%.

Japan's income has an unexpected negative relationship with U.S. pork exports to Japan. For every dollar increase in income, there is a 15 metric ton per capita decrease in U.S. pork exports to Japan. This variable is not significant at the 5% level, with a p-value of 38%. Japan's population has the expected positive relationship with U.S. pork exports to Japan. For every person added to the population, there is a 0.05 metric ton per capita increase in U.S. pork exports to Japan. This variable is statistically significant at the 5% level with a p-value of 4%, with the expected sign. Japan's yen has the expected negative relationship to U.S. pork exports to Japan. Where for every increase in yen, there is a 5,913 metric ton per capita decrease in U.S. exports to Japan. This variable is not statistically significant at the 5% level in the Japan model with a p-value of 17%.

For the Japan model there is a high correlation between U.S. feed price and demand for chicken in Japan at 83% and with Japan's income at 83% as well. This model does not have the high risk for multicollinearity as the China model (Table 5.4).

Overall the Japan model does not support the theory of a positive relationship between Japan's trade openness and U.S. pork production. The country's trade openness variable is not statistically significant however. The Japan model demonstrates there are

other variables determining U.S. pork exports to Japan, though the model is very weak statistically.

Table 5.4 Correlation of Japan Model

	U.S.Pork Exports to Japan	US Feed Price	Yen	Qs Beef	Qs Chicken	Qs Pork	Trade	Income
U.S.Pork Exports to Japan	1							
US Feed Price	0.725	1						
Japanese Yen	-0.632	-0.811	1					
Qs Beef	-0.497	-0.028	-0.144	1				
Qs Chicken	0.864	0.831	-0.686	-0.234	1			
Qs Pork	0.063	0.356	-0.468	0.431	0.38	1		
Japan Trade	0.365	0.625	-0.773	0.129	0.469	0.405	1	
Japan Income	0.544	0.834	-0.976	0.21	0.619	0.438	0.758	1
Japan Pop	0.835	0.326	-0.238	-0.695	0.592	-0.231	0.033	0.117

5.2.3 South Korea

South Korea is a rising economic power in East Asia along with having a fairly open trade with western economies. They are a major potential market for meat exporters. Also South Korea's 2012 Trade Agreement with the U.S. is expected to support the relationship among trade policy and noted U.S. exports. The South Korea model has an R-squared of 92% and an adjusted R-squared of 85%. The constant for this model is -1,243,517.

Table 5.5 South Korea Regression Results 1995-2013

Variables	Coefficients	T-Stat	P-Value
US Feed Price	177.78	0.78	0.457
South Korea Trade	-125.05	-0.05	0.964
Qd Pork	-0.11	-1.54	0.162
Qd Chicken	-0.07	-0.2	0.845
Qd Beef	0.11	0.81	0.441
South Korea Income	6.35	1.2	0.263
South Korea Population	0.03	1.4	0.2
South Korea Won	78.18	0.81	0.441

U.S. feed price has an unexpected positive relationship with U.S. pork exports to South Korea. For every dollar increase in price of feed, there is a 178 metric ton per capita increase of U.S. pork exports to South Korea. This variable in the South Korea model is not statistically significant with a p-value of 45%.

South Korean trade openness has an unexpected negative relationship with U.S. pork exports to South Korea. For every percent increase in South Korean trade openness, there is a 125 metric ton per capita decrease in U.S. pork exports to South Korea. However, this variable is not statistically significant with a p-value of 96%. This could be an indication that trade agreements no longer impact the trade of pork, because South Korea is an economically open nation, for a longer period of time.

The quantity of pork produced in South Korea has a negative relationship with U.S. pork exports to South Korea. For every ton increase in pork supplied by South Korea, there is a 0.11 metric ton decrease in U.S. pork exports to South Korea. This variable is not statistically significant with a p-value of 16%. The quantity of chicken produced in Japan has the expected negative relationship with U.S. pork exports to Japan. For every ton increase in chicken produced there is a 0.07 metric ton decrease in U.S. pork exports to South Korea. This variable is not statistically significant at the 5% level with a p-value of 84%. The quantity of beef produced in South Korea has an unexpected positive relationship with U.S. pork exports to South Korea. For every ton increase in beef demanded in South Korea, there is a 0.11 metric ton increase in U.S. pork exports to South Korea. This variable is also not statistically significant with a p-value of 44%.

South Korean per capita income has the expected positive relationship with U.S. pork exports to South Korea. For every dollar increase in income in South Korea, there is a

6.35 metric ton per capita increase in U.S. pork exports to South Korea. South Korean population also has the expected positive relationship with U.S. pork exports to South Korea. For every person added to the population there is a 0.03 metric ton per capita increase in U.S. pork exports to South Korea. For the South Korean won, this variable had the unexpected positive relationship with U.S. pork exports to South Korea. For every increase in won, there is a 78 metric ton per capita increase in U.S. pork exports to South Korea. South Korean income, population and exchange rate were not statistically significant at the 5% level. Overall, the statistical significance of the model is low.

Some variables in the South Korea model are highly correlated. The quantity of chicken produced in South Korea is correlated with South Korean income at 92%. The U.S. feed price is correlated with quantity of chicken produced in South Korea at 83% and with South Korean income at 79%. Overall there is high risk for multicollinearity in the South Korean model (Table 5.6).

Table 5.6 Correlation for South Korea Model

	U.S.Pork Exports to South Korea	US Feed Price	Won	Qs Beef	Qs Chicken	Qs Pork	Trade	Income
U.S.Pork Exports to South Korea	1							
US Feed Price	0.79	1						
South Korean Won	-0.19	-0.08	1					
Qs Beef	-0.17	-0.08	0.4	1				
Qs Chicken	0.92	0.83	-0.17	-0.16	1			
Qs Pork	0.16	0.05	-0.43	-0.2	0.25	1		
South Korean Trade	-0.14	0.12	-0.08	0.01	0.005	-0.1	1	
South Korean Income	0.9	0.79	-0.29	-0.43	0.92	0.26	-0.05	1
South Korean Pop	0.82	0.56	-0.54	-0.3	0.83	0.51	-0.21	0.81

Overall the South Korean model does not support the theory that a country's trade openness has a positive relationship with the U.S. pork exports to that country. However,

the significance of a country's trade openness in this model is not strong and South Korea is a rising economy.

CHAPTER VI: CONCLUSION AND IMPLICATIONS

6.1 Conclusion

Overall, U.S. pork demand for China, Japan and South Korea is not statistically impacted by trade openness within the country. A growing free trade trend and projected numbers could show different results. Overall through the past 18 years trade openness has not had an economic impact on the flow of U.S. pork exports to these countries. As the data suggests, the trend for trade and pork continue to rise and as trade increases, the exporting country's producers gain. For the South Korea model the trade openness variable for the country was not statistically significant indicating that there has been trade for the time period of this research. For South Korea trade openness had a small negative relationship with U.S. pork demand, and for Japan and China a negative relationship with U.S. pork demand.

The results of each country's regression analysis show an overall responsiveness to multiple variables. Statistically significant variables varied among countries. The Japan model is more responsive to income and the China model is more responsive to the quantity of pork produced and population.

Each country's regression model shows a positive relationship between country population and the level of U.S. exports to that country. The Japan and China models show a positive relationship between quantity of chicken produced in that country and the level of U.S. pork exports to that country while the quantity of pork produced for each has a negative relationship. As pork produced in Japan and China and South Korea increases, the level of U.S. pork imported decreases.

The comparison of these models is difficult considering it takes each variable's relationship into account given others are constant. When in reality other variables impact each other and the dependent variable as well. Both supply and demand are taken into account to capture the perspective of the U.S. producer and Chinese, Japanese, or South Korean consumer. The quantity produced, without respect to origin, measures the supply of pork in each country subjectively and is included in model, along with each country's variables such as population, income, and trade openness. The U.S. feed price is included in the demand portion of the equation along with the exchange rate.

For the past 25 years, East Asia has increased participation in policies involving trade with the western world. Trade openness of China, Japan and South Korea has increased, and imports of U.S. pork to East Asia as a whole have also increased. Taking into consideration the percentage of GDP each of these countries holds within the region, and their economic importance to the agricultural industry, the levels of trade openness and U.S. pork exports are positively associated with exports looking at the graphs. However, the regression analysis shows that the relationship for each country is not statistically significant from 1995 - 2013. Imports of pork in East Asia reached around 3.2 million metric tons, doubling that of beef imports. Japan is the leading country for U.S. pork exports in the world, more than 30% of the pig meat imported by Japan is from the U.S., China, and South Korea have similar percentages of pork imports from the U.S.

6.2 Implications

This research has the potential to move in many different directions. A wider country analysis can better encompass the actual demand for the region, where three countries may not be able to realistically represent the more than 20 countries that are

present and participating in the region. Different variations of pricing to better gauge the supply and demand movements could be compared with this method. Pricing in each of the countries could be applied to the U.S. pork imports to that country and domestic pork consumption as well. Also an analysis of the domestic pork industry in China could allow a good comparison. When looking to China to export pork, the U.S. needs to consider its competition and be aware of China's agricultural competitiveness.

A major implication that could be beneficial to the U.S. pork industry and other agricultural industries is a projection for future demand, related to trade openness. How much could the potential Trans Pacific Partnership impact the demand for pork. This research discusses the impact trade openness has had on the region. Petri and Plummer estimate the dollar sales of T.P.P, but the quantity demanded could allow industries to become even more efficient in demand planning and allow for a higher competitive advantage in those countries.

WORKS CITED

- A.Petri, Peter, and Michael G Plummer. 2012. "The Trans-Pacific Partnership and Asia-Pacific Integration: Policy Implications." *Peterson Institute for International Economics* 12-16.
- Amponsah, William A. 2003. "China as a Potential Market for U.S.Pork Exports." *Review of Agricultural Economics* 259-269.
- AtlasMedia. 2015. *Atlas Media*. Accessed November 09, 2015.
<http://atlas.media.mit.edu/en/profile/country/kor/>.
- Champagne-Urbana, University of Illinois. 2015. *Farmdoc*. November 09. Accessed November 09, 2015.
farmdoc.illinois.edu/manage/uspricehistory/us_price_history.html.
- Elms, Deborah Kay. 2014. "Social Science Research Network." *Social Science Research Network*. January 01. Accessed November 09, 2015.
<http://papers.ssrn.com/sol3/papers.cfm?abstractis=2375056>.
- ERS. 2015. *US Department of Agriculture, Economic Research Service*. Accessed November 09, 2015. <http://www.ers.usda.gov/data-products.aspx>.
- FAO. 2015. *Food and Agriculture Organization*. November 09. Accessed November 09, 2015. <http://faostat3.fao.org/home/E>.
- FAS. 2015. *Foreign Agricultural Service*. November 09. Accessed November 09, 2015.
apps.fas.usda.gov/gats/ExpressQuery1.aspx.
- FreedomHouse. 2015. *Freedom House*. November 09. Accessed November 09, 2015.
<http://www.heritage.org/index/ranking>.
- Gerwin, Ed. 2015. "'Small Businesses with a Big Stake in the Pacific Trade Deal'." *Wall Street Journal*, November 27: A15.
- Irwin, Douglas A. 2015. *International Trade Agreements*. November 09. Accessed November 09, 2015.
www.econlib.org/library/Enc/InternationalTradeAgreements.html.
- Kawai, Masahiro, and Ganeshan Wignaraja. 2011. *Asia's Free Trade Agreements*. Northampton, MA: Edward Elgar Publishing Inc.
- Kawai, Masahiro, and Ganeshan Wignaraja. 2013. *Patterns of Free Trade in Asia*. Policy Studies 65, Institute of Southeast Asian Studies, Honolulu: East-West Center.

- Kenichi, Kawasaki. 2014. "The Relative Significance of EPAs in Asia-Pacific." *REITI Discussion Paper Series 14-E-009*. January 01. Accessed November 09, 2015. www.reiti.go.jp/en/.
- Lall, Pooran, Allen M Featherstone, and David W Norman. 2002. "Productivity Growth in the Western Hemisphere (1978-94): The Caribbean in Perspective." *Journal of Productivity Analysis* (Kluwer Academic Publishers) 213-231.
- NationalChickenCouncil. 2015. *National Wholesale and Retail Prices for Chicken, Beef, and Pork*. November 09. Accessed November 09, 2015. <http://www.nationalchickencouncil.org/about-the-industry/statistics/wholesale=and=retail-prices-for-chicken-beef-pork/>.
- Oanda. 2015. *Oanda - Historical Exchange Rates*. November 09. Accessed November 09, 2015. <http://www.oanda.com/currency/historical-rates/>.
- Pugel, Thomas A. 2012. *International Economics*. Vol. 15. New York, NY: Mcgraw-Hill Irwin.
- Quandl. 2015. *Quandl Economics*. November 09. Accessed November 09, 2015. <http://www.quandl.com/collections/economics/gdp-as-a-share-of-world-gdp-at-ppp-by-country>.
- SmithfieldTownHall. 2015. "Smithfield Town Hall." *Smithfield Foods*. Kansas City: Smithfield, November 14.
- Studenmund, A.H. 2011. *Using Econometrics: A Practical Guide*. Vol. 6. Boston, MA: Pearson.
- USDA. 2014. "US Agricultural Projections to 2023." *USDA Long Term Projections, Economic Research Service*. February 01. Accessed November 09, 2015. <http://www.ers.usda.gov/media/1279470/occ141.pdf>.
- Wikipedia. 2015. *Wikipedia*. November 09. Accessed November 09, 2015. www.wikipedia.com.
- WorldBank. 2015. *World Bank*. November 09. Accessed November 09, 2015. <http://data.worldbank.org/>.
- WorldFactbook. 2015. *World Factbook*. November 09. Accessed November 09, 2015. <http://www.cia.gov/library/publications/the-world-factbook/>.