THE IMPACT OF INCREASED INCOME ON IMPORTS OF VALUE-ADDED PRODUCTS IN MIDDLE INCOME COUNTRIES

By

KIMBERLY SMITH

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Oklahoma State University

Stillwater, Oklahoma

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Thesis Approved:

Robert L. Dehlman

Thesis Adviser

Rodney B. Holcomb

Brian Adams

Timothy J. Pettibone

Dean of the Graduate College

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TABLE OF CONTENTS

Chapter Page

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

CHAPTER I

INTRODUCTION

Historically, the United States has been an exporter of bulk commodities. The country's vast farmland, favorable climate, and well-developed infrastructure give the United States a comparative advantage in producing and exporting bulk commodities. In the 1970s, the United States was able to take advantage of the boom in commodity exports. However, a recent trend in U.S. agricultural commodity exports has been the shift from the market for bulk commodities to the market for value-added products. This new trend is being referred to as the industrialization of U.S. agriculture. Value-added food products are raw or preprocessed commodities whose value has been increased through the addition of ingredients or processes that make them more attractive to the buyer or more useable by the consumer.

As a result of the United States agricultural industry production capability exceeding national consumption, the United States agricultural industry is highly dependent on export markets to sustain prices and revenues. Export revenues accounted for 20 to 30 percent of U.S. farm income for the past thirty years. (ERS/USDA, 2002) Since value-added products capture a larger scope of the economic activity than bulk commodities through the multiplier effect, it would also be beneficial to the United

States' agricultural industry to identify new markets to export value-added products. For example, the pork industry in North Carolina contributes $0.80 to other industries for every $1.00 of income earned by the pork industry (Zering, Brandt, Roka, Vukina, 1996). For every job created by the pork industry 3.5 more jobs are created in other industries (Zering, Brandt, Roka, Vukina, 1996).

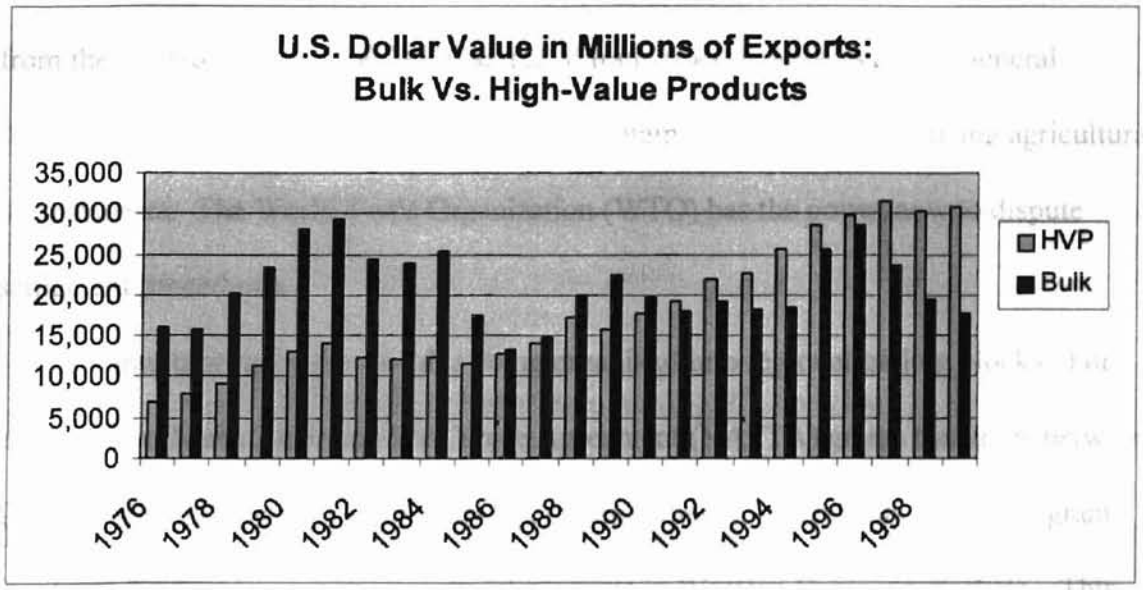
According to Mark Drabenstott, Vice President and Economist, Federal Reserve Bank of Kansas City, this shift to value-added products is not new, but it has been reinforced in recent years. In spite of gains in value-added products, nearly half the U.S. exports are still in bulk commodities. Drabenstott states that by contrast, "only a quarter of the world food trade is in bulk commodities, down from 38 percent two decades ago". Over that period, world trade in bulk commodities has been unchanged, while value-added products have grown nearly 70 percent. As of the fiscal year of 1991, the United States value-added exports exceeded bulk exports in dollar value for the first time. Value-added exports have continued to exceed bulk exports through the 1990s and are expected to continue to grow. In the fiscal year of 1999, value-added exports account for 64 percent of total U.S. agricultural exports, while bulk exports account for 36 percent. (Drabenstott, 1995)

The sharp increase in both world and U.S. exports of value-added products can be assessed to economic factors, trade liberalization, and technology developments. These developments encouraged the consumption of value-added products as compared to bulk products.

Economic Factors

The first factor contributing to the increase in world and U.S. exports of value-added products is the growing world economy. For example, the rapid economic growth in Asia and Mexico economies contribute to the increased desire for value-added products.

Figure I-1. U.S. Dollar Value in Millions of Exports: Bulk Vs. High-Value Products



Source: USDA, Foreign Agricultural Trade of the U.S. Calendar Year, Various Issues

As consumers' per capita income raises in countries throughout the world, consumers' diets are changing from a grain-based diet to a more diverse diet, which includes a variety of meats, fresh fruits, and vegetables (Barkema, 1991). In some countries, this rising consumer demand for different agricultural products could be met through the development of a more diverse domestic agricultural industry. However, land constraints and rising environmental costs are major limitations in boosting domestic production in many densely populated countries.

Trade Liberalization

The second factor contributing to the increased demand in value-added products is trade liberalization. Recent extensive trade policy changes have made it more economically feasible for consumers to purchase such things as meats, fresh fruits, breads, and vegetables from different countries. For instance, the Beef-Citrus Agreement with Japan and a similar agreement with South Korea lowered the cost of meat imports from the United States. Another example of trade liberalization is a new General Agreement on Tariffs and Trade (GATT). It contains provisions for reducing agricultural trade barriers. The World Trade Organization (WTO) has the power now to dispute settlement procedures.

Simultaneously, the world is being organized into regional trading blocks. For example, the North American Free Trade Agreement (NAFTA) grants free trade between Canada, Mexico, and the United States. Correspondingly, agreements in Europe grant free trade for East European agricultural products in Western European markets. This promotes more trade among member countries.

Technology Developments

Through technology developments, it is now feasible to make long distance shipments of chilled meat. Some of these developments include the reduction of microbial contamination in slaughterhouses, the development of vacuum packing, and the refrigerated shipping containers used in the processing and transportation of chilled meat.

According to Dr. Dermot Hayes of Iowa State University, the transportation cost

of shipping boxed pork to Japan is now equal to the transportation cost of its feed-grain equivalent (Hayes, 1998).

General Objective

The general objective of this research is to analyze U.S. exports of value-added wheat, soybeans, pork, and beef products to middle-income countries and determine if middle-income countries are potential viable markets for U.S. exports.

Specific Objective

The specific objective of this study is to develop an Almost Ideal Demand System (AIDS) and to determine the elasticities of demand for value-added products.

Middle-Income Developing Countries

In most studies, middle-income developing countries are classified on the basis of gross domestic product per capita. In this study, middle-income countries are classified according to the following criteria:

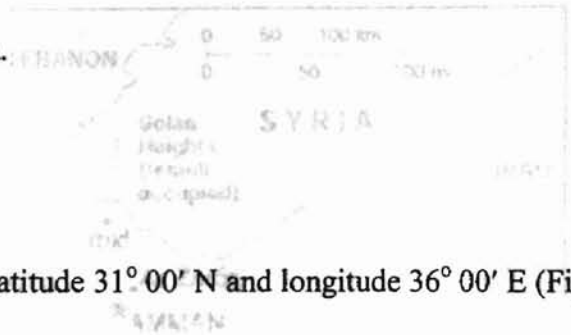
"1. GNP per capita in 1985 (U.S. dollars) range from $1,500 to $8,000.

2. The country shows positive annual average growth rate GNP per capita during 1980-1985.

3. Population of more than 2.5 million in the middle of 1988."

Based on the above criteria, middle-income countries include Jordan, Malaysia, Mexico, Singapore, South Korea, Korea, Hong Kong, Taiwan, Algeria, and Israel. (Lee 1989)

Due to data limitations, the countries included in this study are Jordan, Malaysia, Mexico, Singapore, and South Korea.



Jordan

Jordan is located at latitude 31° 00′ N and longitude 36° 00′ E (Figure I.2). The population in 2000 was estimated to be 4.9 million. In 2000, the population composition under the age 15 was 38%, between the ages of 15 to 64 was 59%, and 3% of the population was 65 years and older. So this left a labor force of 1.15 million with 300,000 employed abroad. The population growth rate was 3.1% in 2000.

In 2000, Jordan's population was not very diverse with 98% of the population Arab, 1% Circassian, and 1% Armenian. When religion demographics are used, 96% of the population is Sunni Muslim and 4% is Christian. The official language is Arabic.

At the present time, arable land in Jordan is a limited resource because of limited natural water resources, over grazing, and soil erosion. This makes Jordan very dependent upon imports. Currently, GDP growth rate is 2% and GDP per capita is $3,500. (http://www.odci.gov/cia/publications/factbook/geos/jo.html)

Figure I-2. Map of Jordan

Source: The World Fact Book
(http://www.odci.gov/cia/publications/factbook/geos/jo.html)

Malaysia

Malaysia is located at latitudes 2° 30′ N and longitudes 112° 30′ E (Figure I.3). The population in 2000 was estimated to be 21.7 million. In 2000, the population composition under the age 15 was 35%, between the ages of 15 to 64 was 61%, and 4% of the population was 65 years and older. So this left a labor force of 9.3 million. The population growth rate was estimated to be 2.01% in 2000.

Malaysia's population consists of many different ethnic groups most of which are Malay and indigenous (58%). The rest of the population is 26% Chinese, 7% Indian, and 9% other. There are a variety of religions practiced in Malaysia. They included Islam,

Buddhism, Daoism, Hinduism, Christianity, and others (http:www.odci.gov/cia/publications/factbook/geos/my.html).

Currently, Malaysia's economy is on an up-turn after the worst recession since the country's independence in 1957. In 1999, GDP growth rate was 5% and GDP per capita was at $10,900.

Figure I-3. Map of Malaysia

Source: The World Fact Book
(http://www.odci.gov/cia/publications/factbook/maps/my-map.jpg)

Mexico

Mexico is located at latitude 23° 00′ N and longitude 102° 00′ W (Figure I.4). The population in 2000 was estimated to be 100 million. In 2000, the population composition under the age 15 was 34%, between the ages of 15 to 64 was 62%, and 4% of the population was 65 years and older. So this left a labor force of 38.6 million. The population growth rate was estimated to be 1.53% in 2000.

Mexico's population consists of a variety of ethnic groups which include Mestizo (60%), Amerindian (30%), white (9%), and other (1%). The religion demographics are not very diverse with 89% of the population Roman Catholic, 6% Protestant, and 5% other.

Figure I-4. Map of Mexico

Source: The World Fact Book
(http://www.odci.gov/cia/publications/factbook/maps/mx-map.jpg)

Currently, Mexico is a free market economy. The GDP growth rate is 3.7%. The GDP per capita is $8,500. Mexico's strong export sector is a leading force in that country's economy recovery.

Singapore

Singapore is located at latitude 1° 22′ N and longitude 103° 48′ E (Figure I.5). The population in 2000 was estimated to be 4.1 million. In 2000, the population composition under the age 15 was 18%, between the ages of 15 to 64 was 75%, and 7%

of the population was 65 years and older. So this left a labor force of 1.932 million. The population growth rate was estimated to be 3.54% in 2000.

Figure I-5. Map of Singapore

Source: The World Fact Book
(http://www.odci.gov/cia/publications/factbook/maps/sn-map.jpg)

Singapore's population is not very diverse with 77% of the population Chinese, 14% Malay, 7.6% Indian, and 1.4% other. There are a variety of religions practiced in Singapore, which include Buddhist (Chinese), Muslim (Malays), Christian, Hindu, Sikh, Taoist, and Confucianist. Singapore has four official languages that include Chinese, Malay, Tamil, and English.

Singapore is a highly developed free market economy with the fifth largest GDP in the world. The GDP per capita is $27,800 and the GDP real growth rate is 5.5%. Singapore's successful economy can be contributed to a corruption-free business environment, stable prices, and large exports in electronics and chemicals.

South Korea

South Korea is located at latitude 37° 00′ N and longitude 127° 30′ E (Figure I.6). The population in 2000 was estimated at 47.4 million. In 2000, the population composition under the age 15 was 22%, between the ages of 15 to 64 was 71%, and 7% of the population was 65 years and older, so this left a labor force of 22 million. The population growth rate was estimated to be 0.93% in 2000.

South Korea's ethnic population is homogeneous with the exception of about 20,000 Chinese. There are a variety of religions practiced in South Korea. They include Christian, Buddhist, Confucianist, Shamanist, and Chondogyo. The official language is Korean, but English is taught in junior high and high school.

South Korea's economy has achieved remarkable success over the last three decades. Three decades ago the GDP was comparable to countries in Africa. Today, the GDP per capita is $13,300 and the GDP growth rate is 10%. South Korea's success can be contributed to a system of close government/business ties.

Figure I-6. Map of South Korea

Source: The World Fact Book
(http://www.odci.gov/cia/publications/factbook/maps/ks-map.jpg)

CHAPTER II

LITERATURE REVIEW

INTRODUCTION

The purpose of this literature review is to examine current methods used to study import demand. The literature review will introduce and discuss the disadvantages and the advantages of three methods currently used to estimate import demand. The methods to be discussed are the Linear Expenditure System (L.E.S.), the Rotterdam Model, and the Almost Ideal Demand System (A.I.D.S.).

Linear Expenditure System

Park, Holcomb, Raper, and Capps applied a Linear Expenditure System to test the hypothesis that commodity demand projections should be based on individual income rather than on average income. Using the National Food Consumption Survey (1987-1988) twelve food groups were analyzed according to two income levels. They concluded that if the emphasis of policy analysis is centered on poverty status then policy makers should utilize demand parameter estimates using observations indigenous to this group, and not average estimates for the whole population. (Park et. al., 1996)

Rotterdam Model

Seale, Sparks, and Burton used a Rotterdam import allocation model to estimate the import demand of fresh apples from the United States, geographic locations which are Canada, Hong Kong, Singapore, and the United Kingdom. These countries import 56% of all fresh apples exports of the United States in 1987. The period that was analyzed for this study was 1962 through 1987. The export suppliers for the four different markets chosen for this study were. South Africa, U.S., and Rest of the World (ROW) for Canada; Australia, China, US, and the ROW for both Hong Kong and Singapore; and Australia, France, New Zealand, U.S., and ROW for the United Kingdom. The Rotterdam Model fit reasonably well for the four importing countries. The results concluded that fresh apple suppliers to Hong Kong, Canada, Singapore, and the United Kingdom (except Australia in the United Kingdom market) should increase apple exports if expenditure for imported fresh apples in these markets increases. Apples that were more expenditure elastic than the United States in these four markets were from South Africa to Canada and from Australia to Singapore. Also, United States apples tend to be more price elastic than the other apples with the exception of Australia apples in the Singapore market. (Seale, Sparks, and Buxton,1992).

A.I.D.S. Model

In 1980, Deaton and Muellbauer developed a new demand model referred to as an Almost Ideal Demand System (A.I.D.S.). This demand model has several advantages over the Rotterdam and Translogs models. Some advantages are it gives an arbitrary

first-order approximation to a demand system; it satisfies the axioms of choice; it aggregates over consumers without invoking parallel linear Engel curves; it has a functional form which is consistent with household-budget data; it is simple to estimate, and eliminates the need for non-linear estimation; and it can test the restriction of homogeneity and symmetry through linear restrictions and fixed parameters. While the Rotterdam and Translogs models possess some of these desirable qualities none of these models possess them simultaneously. (Deaton and Muellbauer, 1980)

Blanciforti and Green estimated an Almost Ideal Demand System (A.I.D.S) for four food groups and compared these estimates with a Linear Approximate of an Almost Ideal Demand System (L.A./A.I.D.S.) and a Linear Expenditure System (LES) (Blanciforti and Green, 1983). They concluded that the AIDS model has some advantages over the linear expenditure system. The AIDS model avoids the unrealistic approximate proportionality relationship between income and own-price elasticities that LES may exhibit. Also, the AIDS model allows income elasticities to decrease as budget shares decrease for necessities such as food. The LA/AIDS model advantage over the AIDS model is its ease of estimation. The LA/AIDS model estimates the magnitudes of elasticities reasonably well.

Eales and Unnevher applied an Almost Ideal Demand System (AIDS) to estimate two meat demand systems (Eales and Unnevher, 1988). The first system is an aggregate meat demand model that includes aggregate chicken, beef, and pork; the second system is a disaggregated meat demand model that disaggregates chicken into whole birds and parts/processed parts, and beef into hamburger and table cuts. Using Zellner's seemingly unrelated regression technique, Eales and Unnevher estimated two dynamic almost ideal

demand systems, one for an aggregate meats and one for disaggregated meat products, using annual data covering 1965-1985 (Zellner, 1962).

Also, Eales and Unevher showed by using tests for weak separability that consumers choose among meat products rather than meat aggregates such as beef or chicken. They concluded that the change in chicken demand has been ongoing for the past twenty years while the change in beef demand occurred after 1974. Also, results revealed that most beef-chicken cross-price substitution takes place between inferior goods, hamburger and whole birds, while a change in preferences since 1974 led to the substitution of chicken parts for beef table cuts. Eales and Unnevher conclude that if demand of chicken in part replaced the demand for beef this was due purely to health concerns it would have led to the growth in whole birds and decline in hamburger, which their research failed to prove. They believe that the shift in demand was due to the need of consumers for convenience in addition to health concerns. (Eales and Unnevher, 1988)

A Linear Approximate Almost Ideal Demand System (L.A./A.I.D.S.) was applied by Hayes, Wahl, and Williams to estimate a meat demand system for Japan. The model was used to test three hypotheses regarding meat consumer behavior in Japan.(Hayes, Wahl, and Williams, 1990) The first hypothesis tested was that fish is not separable from meat in Japan and should be included in the Japanese meat system. To test this hypothesis, they developed a test for quasi-separability for the LA/AIDS model. The test concluded that the assumption of weak separability between meats and fish in Japan is a correct assumption. The second hypothesis tested was that the native beef breed for Japan (Wagyu) is a perfect substitute for imported beef. Hayes, Wahl, and Williams tested this hypothesis by estimating the cross-price elasticites for Wagyu beef compared

to imported beef. They concluded that Wagyu and imported beef are not perfect substitutes. Wagyu beef is actually preferred over imported beef. The final hypothesis tested was that all meats are net substitutes in consumption in Japan. They concluded that the only consistent substitutability is between chicken and both imported-quality beef and pork.

Mdafri and Brorsen also applied an Linear Approximate/Almost Ideal Demand System (LA/AIDS) to estimate demand elasticities for beef, mutton, poultry, and fish in Morocco. This model is useful because most policy analysis tools used for Morocco are based on subjective measurements. They concluded that demand for poultry or beef is elastic. While, mutton is consider a luxury good and poultry, beef, and fish are normal goods. (Mdafri and Brorsen, 1993)

CHAPTER III

DATA AND METHOD

This chapter presents the data and method used to estimate demand elasticities for U.S. beef, wheat, soybeans, and pork products to middle-income countries.

Model Formulation

Data limitations limit estimation capabilities of demand functions for middle-income countries. However, data for U. S. exports to middle-income countries is available. To achieve proper estimation of import demand one would require all the data necessary for a traditional import demand function.

The demand model selected as the basis for this study is the Almost Ideal Demand System (AIDS). This demand system has several advantages over other demand models. Some advantages include: it is easy to estimate, the functional form is consistent with household budget data; and it allows one to aggregate over consumers using non-linear Engel curves. Another reason the AIDS model is more desirable is that budget shares allow the researcher to be unconcerned about quantity. For example imports and exports to different countries change dramatically depending on tariffs, cartels, and local customs,

quantity can have a dramatic effect on the Rotterdam and Linear Expenditure system but it does not affect the AIDS model.

The general form of the AIDS model is as follows:

$$W_i = \alpha_i + \sum_{j=1}^{n} \gamma_{ij} \ln P_j + \beta_i \ln(X / P) \qquad (1)$$

Where W_i = the average budget share for the ith commodity,

P_j = nominal price of the jth commodity,

X = expenditure on all commodities in separable group,

i *and* j = commodities in a separable group (e.g. bulk wheat, flour, other wheat products, bulk soybeans, soybean meal, and soybean oil),

γ_{ij} = are the price coefficients between the ith and jth commodities,

β_i = the expenditure coefficient for the ith commodity,

P = the price index, which is defined as:

$$\ln P = \alpha_0 + \Sigma_i \alpha_i \ln P_i + \tfrac{1}{2} * \Sigma_i \Sigma_j \gamma_{ij} \ln P_i \ln P_j; \qquad (2)$$

A separable group can be defined as when the conditional ordering on goods in the group is independent of consumption levels outside the group. (Deaton and Muellbauer 1998)

The index P from equation (2) makes equation (1) a non linear system of equations. To avoid nonlinear systems estimation, Stone's Index is used as an approach for P as suggested by Deaton and Muellbauer, 1980.

Stone's Index is = $$\ln P^* = \sum_{i=1}^{n} W_i \ln P_i \qquad (3)$$

Substituting P^* from equation (1) by the Stone's index in equation (3) makes the equation the Linear Approximation or The Almost Ideal Demand System (LA/AIDS) (Blanciforti and Green, 1983)

For demand theory to held, the following restrictions are imposed on the model:

$$\sum_{i=1}^{n} \alpha_i = 1, \ \sum_{i=1}^{n} \gamma_{ij} = 0, \ \sum_{i=1}^{n} \beta_i = 0 \text{ (Adding up)} \quad (4)$$

$$\Sigma_j \gamma_{ij} = 0 \text{ (Homogeneity)} \quad (5)$$

$$\gamma_{ij} = \gamma_{ji} \text{ (Slulsky symmetry)} \quad (6)$$

The LA/AIDS model is estimated using Zellner's seemingly unrelated regression method (Zellner, 1962). the LA/AIDS model was estimated with the homogeneity and symmetry constraints imposed. The separable group expenditure share (W_i's) sum to one so the adding up condition is built into the model.

Model and Variable Specifications, and Procedures

Variable Specifications

Wheat, Soybeans, Wheat Products, and Soybean Products.

For each country, U.S. wheat and soybean imports were divided into six categories correlated to the degree of value-added to the products. The categories were bulk wheat, bulk soybeans, wheat flour, soybean meal, other wheat products (including bulgur wheat), and soybean oil.

Table III-1. Description of First Separable Group

Variable	Unit Value	Brief Description
Bulk Wheat	Metric Ton, U.S. Dollar	Bulk Form Products
Wheat Flour	Metric Ton, U.S. Dollar	Semi-Processed Products
Other Wheat Products, Bulgur Wheat	Metric Ton, U.S. Dollar	Highly Processed Products
Bulk Soybeans	Metric Ton, U.S. Dollar	Bulk Form Products
Soybean Meal	Metric Ton, U.S. Dollar	Semi-Processed Products
Soybean Oil	Metric Ton, U.S. Dollar	Highly Processed Products

Source: http://www.ers.usda.gov/db/FATUS

Live Cattle, Live Swine, Beef Products and Swine Products.

For each country, U.S. beef and pork imports were divided into six categories correlated to the degree of value-added to the products. The categories were live cattle, live swine, fresh or frozen beef, fresh or frozen pork, preserved or prepared beef, and preserved or prepared swine.

Table III-2. Description of Second Separable Group

Variable	Unit Value	Brief Description
Live Swine	Metric Ton, U.S. Dollar	Bulk Form Products
Fresh or Frozen Pork	Metric Ton, U.S. Dollar	Semi-Processed Products
Preserved or Prepared Pork	Metric Ton, U.S. Dollar	Highly Processed Products
Live Cattle	Metric Ton, U.S. Dollar	Bulk Form Products
Fresh or Frozen Beef	Metric Ton, U.S. Dollar	Semi-Processed Products
Preserved or Prepared Beef	Metric Ton, U.S. Dollar	Highly Processed Products

Source: http://www.ers.usda.gov/db/FATUS

Model Specifications and Procedures

In this study, one separable group for each country, was composed of bulk wheat, wheat flour, and other wheat products (including bulgur wheat), bulk soybeans, soybean meal, and soybean oil. The second separable group for each country, was composed of live cattle, fresh or frozen beef, preserved or prepared beef, live swine, fresh or frozen pork, preserved or prepared pork for each country. The first LA/AIDS model for bulk wheat, wheat flour and other wheat products (including bulgur wheat), bulk soybeans, soybean meal and soybean oil for each country, using P^* rather than P, in the study is specified as:

$$W_i = \alpha_i + \sum_{j=1}^{n} \gamma_{ij} \ln P_j + \beta_i \ln(X / P^*) \qquad (7)$$

The second LA/AIDS model for live cattle, fresh or frozen beef, preserved or prepared beef, live swine, fresh or frozen pork for each country, using P^* rather than P, is also specified in equation (7).

Taking into account the adding up condition, the co-variance matrix is singular and, therefore one equation must be dropped. In the first system, the deleted variable was preserved or prepared pork for each country. In the second system, the deleted variable was soybean oil for each country. The parameter estimation is the same regardless of which variable is deleted. The missing parameter can be calculated by using the adding up restriction in equation (4).

If no cross-equation restrictions are imposed, the LA/AIDS model can be estimated using Ordinary Least Squares (OLS) (Deaton and Muellbaur,1981). Since symmetry and homogeneity of zero in prices and expenditures were imposed on the two

systems for each country, a Seemingly Unrelated Regression (SUR) procedure in Shazam was used to estimate the parameters of the system. Price expenditure elasticities are calculated for each of the six categories from estimated share values. Elasticities for preserved or prepared pork and soybean oil are calculated from predicted share values.

Marshallian and Hicksian elasticities are calculated from the estimated parameters of the LA/AIDS model as follows:

$$\varepsilon_{ii} = -1 + \gamma_{ii} / W_i - \beta_i \tag{8}$$

$$\varepsilon_{ij} = \gamma_{ij} / W_i - \beta_i * W_j / W_i \tag{9}$$

$$\varepsilon_{ii}^* = -1 + \gamma_{ii} / W_i + W_i \tag{10}$$

$$\varepsilon_{ij}^* = \gamma_{ij} / W_i + W_j \tag{11}$$

where ε_{ij} denotes Marshallian elasticities and the ε^*_{ij} denotes Hicksian elasticities.

Expenditure elasticities are computed as follows:

$$\eta_j = 1 + \beta_j + W_i \tag{12}$$

Marshallian elasticities reflect the change in the quantity demanded for a good when price changes, holding nominal income constant. Marshallian elasticities represent both an income and substitution effect. Hicksian elasticities reflect the change in quantity demanded for a good, holding real income constant (utility). Hicksian elasticities represent the substitution effect. Hicksian elasticities demonstrate consumer's gross willingness to pay and the consumer's surplus from the provision of another good.

Data

U.S. export data for live cattle, fresh or frozen beef, preserved or prepared beef, live swine, fresh or frozen pork, and preserved and prepared swine by country was obtained from the USDA's Foreign Agricultural Trade data collection by quantity and value. The data for bulk wheat, wheat flour, other wheat products (including bulgur wheat), bulk soybeans, soybean meal, soybean oil was also obtained from the USDA's Foreign Agricultural Trade data collection. Other wheat products category was calculated by dividing export value by the export quantity. All of the data is in calendar years. Annual time series data from 1975 to 1999 was used. The Consumer Price Index (CPI) was obtained from International Financial Statistics of International Monetary Fund (IMF) in various issues, and 1990 was used as a base year.

CHAPTER IV

RESULTS

Wheat and Soybean Category

The Wheat and Soybean Category includes bulk wheat, bulk soybean, wheat flour, soybean meal, other wheat products, and soybean oil. These correspond to bulk-type, semi-processed, and highly processed products, respectively.

Results of the Wheat and Soybean LA/AIDS Model for Mexico

In Table IV-1, the parameter estimates of the LA/AIDS model are given for bulk wheat, bulk soybeans, wheat flour, soybean meal, other wheat products, and soybean oil. Results indicate that some of the price and expenditure coefficients are significant. The R^2 for the estimated demand system is high (0.9057); indicating most of the variability in the budget shares (dependent variables) is explained by the independent variables. Table IV-2 presents the Marshallian and Expenditure elasticites for the demand system. As expected in economic demand theory, negative signs for own-price elasticites are found for bulk wheat, bulk soybeans, and soybean oil. The own price elastcities for wheat flour, other wheat products, and soybean meal are positive. As expected in economic demand theory, positive signs for expenditure elasticities are found in bulk wheat, wheat flour,

other wheat products, bulk soybeans, and soybean meal categories. The expenditure elasticity for soybean oil category is negative. The categories of wheat flour and soybean meal has estimated expenditure elasticities between zero and one indicating these products are normal goods. The Hicksian or compensated elasticities (Table IV-3) indicate whether the categories are net substitutes or net complements. Thirteen out of the thirty of the cross-prices elasticities are negative indicating the income effect out weighs the substitution effect in thirteen out of the thirty cases in this study. Eighteen out of the twenty cross prices Hicksian elasticities are positive (Table IV-3). Positive cross-prices elasticities are net substitutes.

Beef and Pork Category

The Beef and Pork Category includes live cattle, live swine, fresh or frozen beef, fresh or frozen pork, preserved or prepared beef, and preserved and prepared pork. These correspond to bulk-type, semi-processed, and highly processed products, respectively.

Results of the Beef and Pork LA/AIDS Model for Mexico

In Table IV-4, the parameter estimates of the LA/AIDS model are given for live cattle, live swine, fresh or frozen beef, fresh or frozen pork, preserved or prepared beef, and preserved and prepared pork. Results indicate that some of the price and expenditure coefficients are significant. The R^2 for the estimated demand system is high (0.9042); indicating most of the variability in the budget shares (dependent variables) is explained by the independent variables. Table IV-5 presents the Marshallian and Expenditure

elasticites for the demand system. As expected in economic demand theory, negative signs for own-price elasticites are found for all of the categories. As expected in economic demand theory, positive signs for expenditure elasticities are for all of the categories. The categories of live swine, fresh or frozen pork, and live cattle have estimated expenditure elasticities between zero and one indicating these products are normal goods. The Hicksian or compensated elasticities (Table IV-6) indicate whether the categories are net substitutes or net complements. Fourteen out of the thirty of the cross-prices elasticities are negative indicating the income effect out weighs the substitution effect in fourteen out of the thirty cases in this study. Nineteen out of the twenty cross prices Hicksian elasticities are positive (Table IV-6). Positive cross-prices elasticities are net substitutes.

Results of the Beef and Pork LA/AIDS Model for Korea

In Table IV-7, the parameter estimates of the LA/AIDS model are given for live cattle, live swine, fresh or frozen beef, fresh or frozen pork, preserved or prepared beef, and preserved and prepared pork. Results indicate that some of the price and expenditure coefficients are significant. The R^2 for the estimated demand system is high (0.9879); indicating most of the variability in the budget shares (dependent variables) is explained by the independent variables. Table IV-8 presents the Marshallian and Expenditure elasticites for the demand system. As expected in economic demand theory, negative signs for own-price elasticites are found for fresh and frozen pork, preserved and prepared beef, live cattle, and fresh and frozen beef. The own price elastcities for live swine and preserved and prepared beef are positive. As expected in economic demand theory,

positive signs for expenditure elasticities are found in fresh and frozen pork, preserved and prepared beef, live cattle, and fresh and frozen beef. The expenditure elasticities for live swine and preserved and prepared beef categories are negative. The categories of preserved and prepared beef and live cattle has estimated expenditure elasticities between zero and one indicating these products are normal goods. The Hicksian or compensated elasticities (Table IV-9) indicate whether the categories are net substitutes or net complements. Eleven out of the thirty of the cross-prices elasticities are negative indicating the income effect out weighs the substitution effect in eleven out of the thirty cases in this study. Twenty out of the twenty cross prices Hicksian elasticities are positive (Table IV-9). Positive cross-prices elasticities are net substitutes.

Parameter Estimator for Mexico is Bulk Wheat, Soybeans, Wheat Flour, Soybean Meal, Soybean Oil, and other Wheat Products

Table IV-1. Parameter Estimates of the LA/AIDS Model, Mexico's Bulk Wheat, Soybeans, Wheat Flour, Soybean meal, Other Wheat Products, and Soybean Oil, 1970-1999.

	CONST	BW	WF	OWP	BS	SM	SO
Bulk Wheat	-2.8509 (-0.8162)	0.217049 (0.5012)	0.002977 (0.2486)	0.0050 (1.057)	-0.0904 (-0.5685)	-0.0170 (-0.3356)	0.0384 (0.4981)
Wheat Flour	0.0249 (0.8659)	0.0015 (0.2486)	0.0092 (2.105)	0.0002 (0.0940)	0.0043 (0.2047)	-0.0092 (-0.6633)	-0.0060 (-0.6516)
Other Wheat Products	-0.0017 (-0.0745)	0.0050 (1.057)	0.0002 (0.0940)	0.0042 (3.337)	-0.0280 (-1.951)	0.0167 (1.885)	0.0019 (0.2579)
Bulk soybeans	-0.5669 (-0.9139)	-0.0904 (-0.5685)	0.0043 (0.2047)	-0.0280 (-1.951)	0.5854 (1.529)	-0.3490 (-1.843)	-0.1222 (-0.6880)
Soybean Meal	0.3411 (1.499)	-0.0170 (-0.3356)	-0.0092 (-0.6633)	0.0167 (1.885)	-0.3490 (-1.843)	0.2794 (2.249)	0.0791 (1.067)
Soybean Oil	1.5286	0.0384 (0.4981)	-0.0060 (-0.6516)	0.0019 (0.2579)	-0.1222 (-0.6880)	0.0791 (1.067)	0.0088 (0.0627)

*significance at 5% level
**significance at 1% level
Const= Constant, BW=Bulk Wheat, WF=Wheat Flour, OWP=Other Wheat Products, BS=Bulk Soybeans, SM=Soybean Meal, SO=Soybean Oil, Expend=Expenditures

T-Values are in parentheses

Table IV-2. Marshallian Demand Elasticities of the LA/AIDS Model, Mexico's Bulk Wheat, Soybeans, Wheat Flour, Soybean meal, Other Wheat Products, and Soybean Oil, 1975-1999.

	BW	WF	OWP	BS	SM	SO	EXP
Bulk Wheat	-0.657	0.008	0.029	-0.646	-0.118	0.216	1.166488
Wheat Flour	0.248	0.377	0.023	0.712	-1.366	-0.894	0.898779
Other Wheat Products	1.183	0.036	0.007	-6.741	3.982	0.459	1.073511
Bulk soybeans	-0.896	-0.141	0.006	-0.165	0.895	-0.548	1.110548
Soybean Meal	-0.139	-0.091	0.167	-3.359	1.801	0.801	0.820016
Soybean Oil	0.698	-0.074	0.031	-0.938	1.169	-0.801	-0.08531

Table IV-3. Hicksian Demand Elasticities of the LA/AIDS Model, Mexico's Bulk Wheat, Soybeans, Wheat Flour, Soybean meal, Other Wheat Products, and Soybean Oil, 1975-1999.

	BW	WF	OWP	BS	SM	SO
Bulk Wheat	-0.461	0.016	0.034	0.108	-0.001	0.303
Wheat Flour	0.399	0.383	0.027	1.293	-1.275	-0.827
Other Wheat Products	1.364	0.044	0.011	-6.047	4.090	0.539
Bulk soybeans	0.028	0.013	-0.039	0.552	-0.440	-0.115
Soybean Meal	-0.001	-0.085	0.170	-2.829	1.883	0.862
Soybean Oil	0.683	-0.074	0.030	-0.993	1.161	-0.808

Parameter Estimator for Mexico's Live Swine, Fresh

and Frozen Pork, Preserved and Prepared Pork,

Live Cattle, Fresh and Frozen Beef,

and Preserved and Prepared Beef

Table IV-4. Parameter Estimates of the LA/AIDS Model, Mexico's Live, Fresh, Preserved Pork and Beef, 1975-1999.

	CONST	LS	FP	PP	LC	FB	PB	EXP
Live Swine	0.0934 (0.7570)	-0.0227 (-1.635)	-0.0180 (-1.318)	-0.0020 (-0.1843)	0.0183 (0.8535)	0.0231 (1.081)	0.0012 (0.5879)	-0.0064 (-0.7908)
Fresh & Frozen Pork	0.2307 (0.6373)	-0.0180 (-1.318)	-0.0817 (-1.760)	-0.0210 (-1.321)	0.0449 (0.6223)	0.0768 (1.434)	-0.0010 (-0.3778)	-0.0069 (-0.2929)
Preserved & Prepared Pork	-0.0313 (-0.2409)	-0.0020 (-0.1843)	-0.0210 (-1.321)	0.0154 (0.9089)	0.0363 (1.415)	-0.0273 (-1.146)	-0.0014 (-0.5272)	0.0065 (0.7783)
Live Cattle	2.9567 (4.327)**	0.0183 (0.8535)	0.0449 (0.6223)	0.0363 (1.415)	-0.0174 (-0.1020)	-0.0835 (-0.7448)	0.0014 (0.3237)	-0.1468 (-3.166)**
Fresh & Frozen Beef	-2.2236 (-4.640)**	0.0231 (1.081)	0.0768 (1.434)	-0.0273 (-1.146)	-0.0835 (-0.7448)	0.0091 (0.08818)	0.0018 (0.4558)	0.1514 (4.963)**
Preserved & Prepared Beef	-0.0259	0.0012	-0.0010	-0.0014	0.0014	0.0018	-0.0021	0.0021

Table IV-5. Marshallian Demand Elasticities, Mexico's Live, Fresh, Preserved Pork and Beef, 1975-1999.

	LS	FP	PP	LC	FB	PB	EXP
Live Swine	-1.682	-0.515	-0.054	0.652	0.758	0.039	0.804075
Fresh & Frozen Pork	-0.106	-1.479	-0.123	0.286	0.468	-0.006	0.959177
Preserved & Prepared Pork	-0.061	-0.600	-0.588	0.900	-0.791	-0.038	1.177556
Live Cattle	6.157	0.089	0.105	-0.889	0.048	-0.172	0.694919
Fresh & Frozen Beef	0.066	0.187	-0.120	-0.568	-1.118	0.003	1.549985
Preserved & Prepared Beef	0.207	-0.237	-0.258	0.069	0.211	-1.369	1.376355

Table IV-6. Hicksian Demand Elasticities, Mexico's Live, Fresh, Preserved Pork and Beef, 1975-1999.

	LS	FP	PP	LC	FB	PB
Live Swine	-1.656	-0.380	-0.025	1.038	0.979	0.043
Fresh & Frozen Pork	-0.074	-1.317	-0.088	0.748	0.732	0.000
Preserved & Prepared Pork	-0.022	-0.402	-0.544	1.466	-0.466	-0.032
Live Cattle	0.071	0.262	0.112	-0.555	0.102	0.009
Fresh & Frozen Beef	0.117	0.447	-0.062	0.178	-0.692	0.012
Preserved & Prepared Beef	0.252	-0.005	-0.207	0.731	0.590	-1.361

Parameter Estimator for Korea's Live Swine, Fresh and
Frozen Pork, Preserved and Prepared Pork, Live
Cattle, Fresh and Frozen Beef, and
Preserved and Prepared Beef

Parameter Estimator for Korea's Live Swine, Fresh and Frozen Pork, Preserved and Prepared Pork, Live Cattle, Fresh and Frozen Beef, and Preserved and Prepared Beef

Table IV-7. Parameter Estimates of the LA/AIDS Model, Korea's Live, Fresh, Preserved Pork and Beef, 1975-1999.

	CONST	LS	FP	PP	LC	FB	PB	EXP
Live Swine	0.1709	0.0105	0.0263	0.0025	0.0048	-0.0380	-0.0062	-0.0073
	(2.244)*	(0.7872)	(1.660)	(0.5396)	(0.6646)	(-2.093)*	(-0.5631)	(-1.744)
Fresh & Frozen Pork	-0.2328	0.0263	-0.0509	0.0095	0.0110	0.0588	-0.0547	0.0196
	(-1.26)	(1.66)	(-1.375)	(1.461)	(0.7099)	(1.390)	(-3.310)**	(2.095)*
Preserved & Prepared Pork	0.0518	0.0025	0.0095	0.0042	0.0030	-0.0137	-0.0056	-0.0017
	(1.829)	(0.5396)	(1.461)	(0.7547)	(1.227)	(-2.016)	(-1.287)	(-1.067)
Live Cattle	0.2885	0.0048	0.0110	0.0030	-0.0413	0.0165	0.0061	-0.0110
	(1.28)	(0.6646)	(0.7099)	(1.227)	(-0.9663)	(0.3901)	(0.5918)	(-0.6704)
Fresh & Frozen Beef	-0.0527	-0.0380	0.0588	-0.0137	0.0165	-0.0680	0.0444	0.0470
	(-0.1863)	(-2.093)*	(1.390)	(-2.016)	(0.3901)	(-1.014)	(2.149)*	(2.527)*
Preserved & Prepared Beef	0.7743	-0.0062	-0.0547	-0.0056	0.0061	0.0444	0.0160	-0.0465

Table IV-8. Marshallian Demand Elasticities of the LA/AIDS Model, Korea's Live, Fresh, Preserved Pork and Beef, 1975-1999.

	LS	FP	PP	LC	FB	PB	EXP
Live Swine	3.626	11.726	1.163	2.758	-14.488	-2.650	-2.20082
Fresh & Frozen Pork	0.400	-1.796	0.141	0.106	0.696	-0.840	1.299024
Preserved & Prepared Pork	0.178	0.670	-0.708	0.236	-0.873	-0.390	0.884889
Live Cattle	1.402	0.027	0.054	-1.190	-0.165	0.081	0.946329
Fresh & Frozen Beef	-0.056	0.082	-0.021	0.010	-1.148	0.065	1.069548
Preserved & Prepared Beef	-0.372	-3.170	-0.304	0.960	4.657	0.028	-1.85778

Table IV-9. Hicksian Demand Elasticities of the LA/AIDS Model, Korea's Live, Fresh, Preserved Pork and Beef, 1975-1999.

	LS	FP	PP	LC	FB	PB
Live Swine	3.621	11.581	1.132	2.305	-15.974	-2.685
Fresh & Frozen Pork	0.403	-1.711	0.160	0.374	1.573	-0.819
Preserved & Prepared Pork	0.180	0.728	-0.695	0.418	-0.276	-0.375
Live Cattle	0.026	0.119	0.029	-0.995	0.755	0.046
Fresh & Frozen Beef	-0.054	0.153	-0.006	0.230	-0.425	0.082
Preserved & Prepared Beef	-0.376	-3.292	-0.331	0.578	3.403	-0.002

CHAPTER V

SUMMARY AND CONCLUSIONS

Conclusions

This research uses the LA/AIDS model to estimate price and expenditure elasticities for U.S. export value-added wheat, soybeans, beef, and pork products to middle-income countries. Jordan, Malaysia, Mexico, Singapore, and South Korea were countries classified as middle-income countries. However, Jordan, Malaysia, Singapore, and the wheat and soybean portion of South Korea were excluded from the empirical estimations because of data limitations. This chapter presents the summary and conclusions for wheat and soybean category for Mexico and the beef and pork category for Mexico and South Korea.

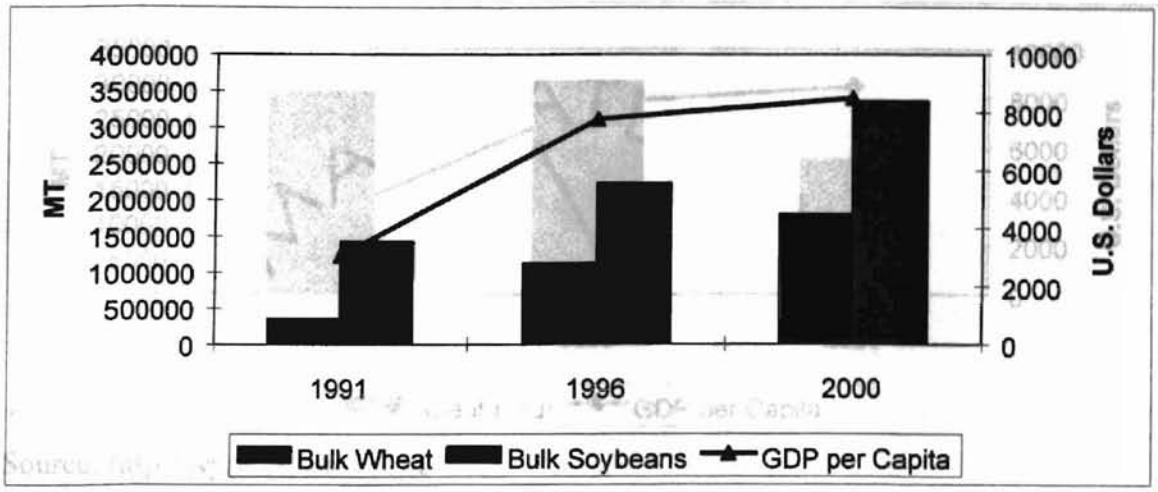
Summary of Mexico's Results

A distinctive relationship has developed between the United States and Mexico in the terms of agricultural trade within the last several years. With the development and implementation of a free trade agreement between the North American Countries (NAFTA), the future of agriculture among these countries has changed. Traditionally, the United States has dominated Canada & Mexico in the terms of production of a majority

of agricultural products. The focus of this research has been to develop a LA/AIDS model that measures Mexico's (middle-income countries) ability as there income rises to be a feasible market for value-added products for U.S. exports.

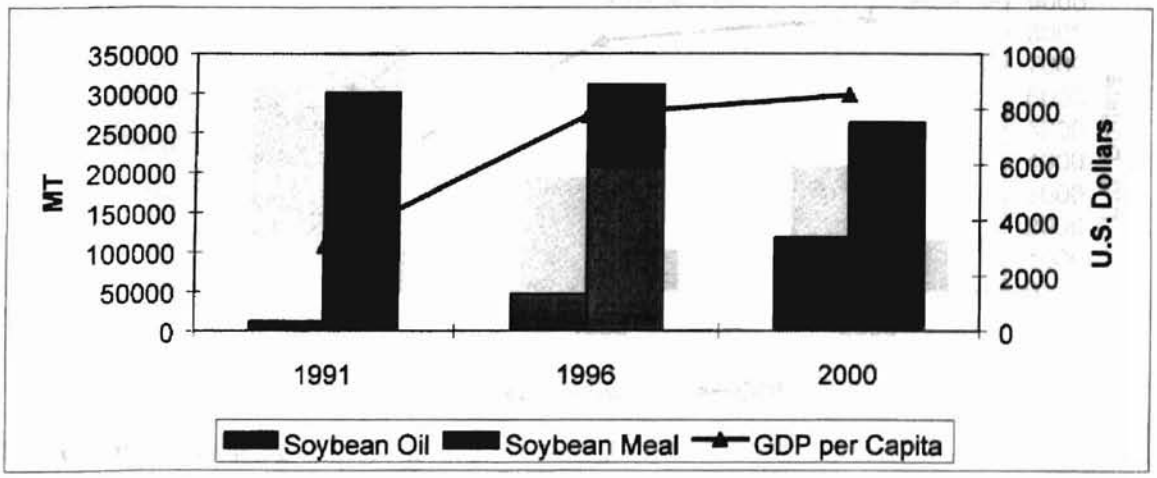
The LA/AIDS model's expenditure elasticites neither confirmed or rejected the null hypothesis as consumers' income rises in Mexico they desire more value-added products. The expenditure elasticities for all the products confirmed all of the products were normal goods. Figure V-1, Figure V-2, and Figure V-5 shows as consumers' income raised bulk wheat, bulk soybean, soybean meal, soybean oil, beef products, and pork products imports rose. Figure V-5 can be contributed to a large increase in the demand for U.S. beef and pork products to Mexico because of there low price, high quality, convenience, and attractive packaging. Figure V-3 and Figure V-4 shows as consumers' income raised wheat flour, live cattle, and live swine imports declined. Figure V-1 and Figure V-3 is indication that Mexico has developed their milling industry. As most middle-income countries economics grow they tend to develop milling industries (Lee 1989). In 1993, the United States agricultural exports to Mexico were $3.6 billion while Mexico exports to the United States were $2.7 billion. In 1999, the United States agricultural exports to Mexico were $5.6 billion while Mexico exports to the United States were $4.9 billion. The trade surplus of agricultural products to Mexico is narrowing.

Figure V-1 Bulk Wheat and Soybeans Exports to Mexico



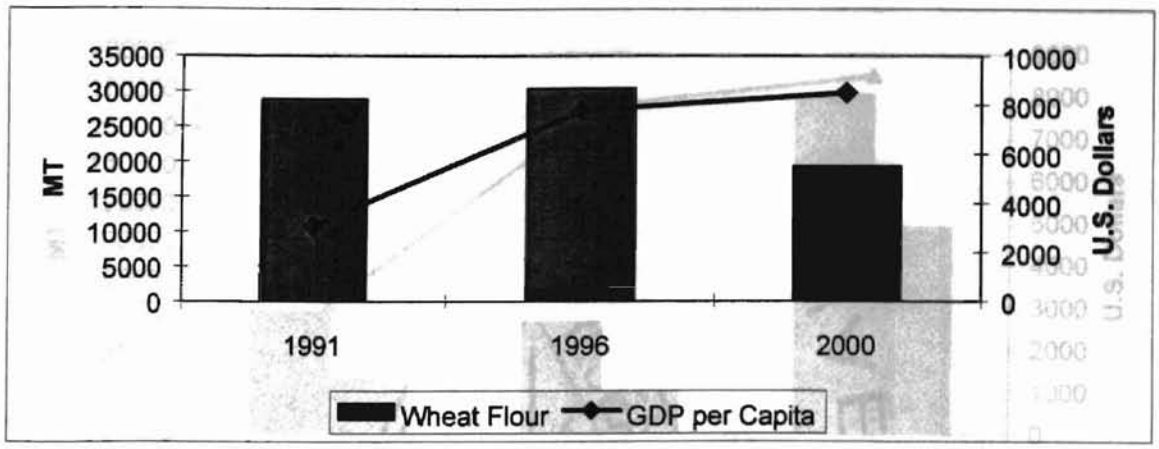
Source: http://www.ag-stats.com/

Figure V-2. Soybean Meal and Oil Exports to Mexico



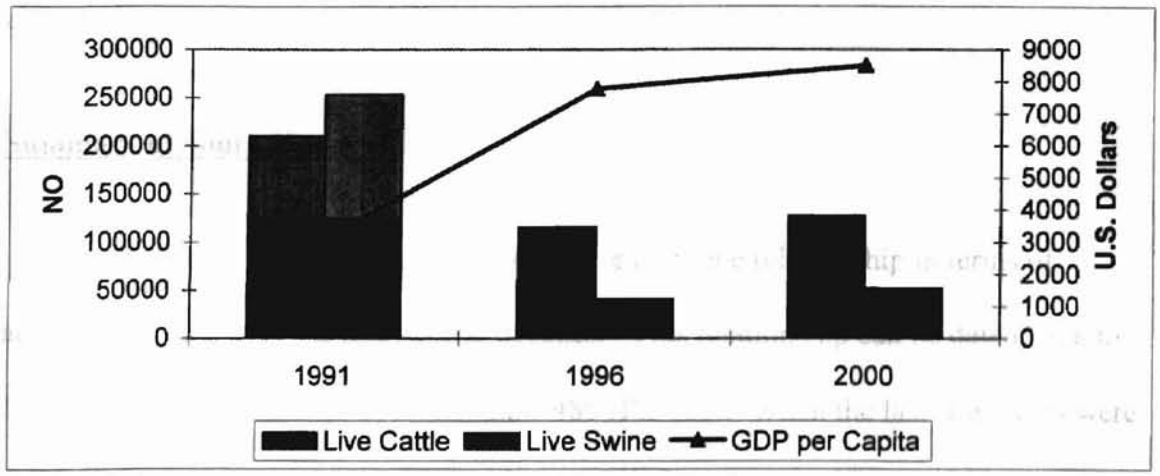
Source: http://www.ag-stats.com/

Figure V-3. Wheat Flour Exports to Mexico



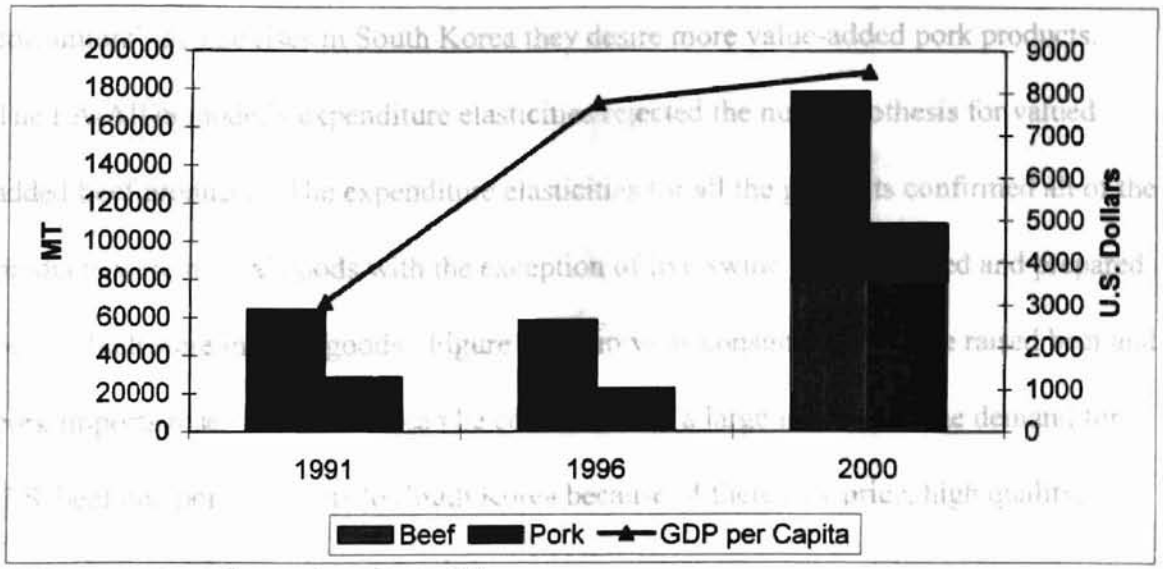
Source: http://www.ag-stats.com/

Figure V-4. Live Cattle and Swine Exports to Mexico



Source: http://www.ag-stats.com/

Figure V-5. Beef and Pork Exports to Mexico



Source: http://www.ag-stats.com/

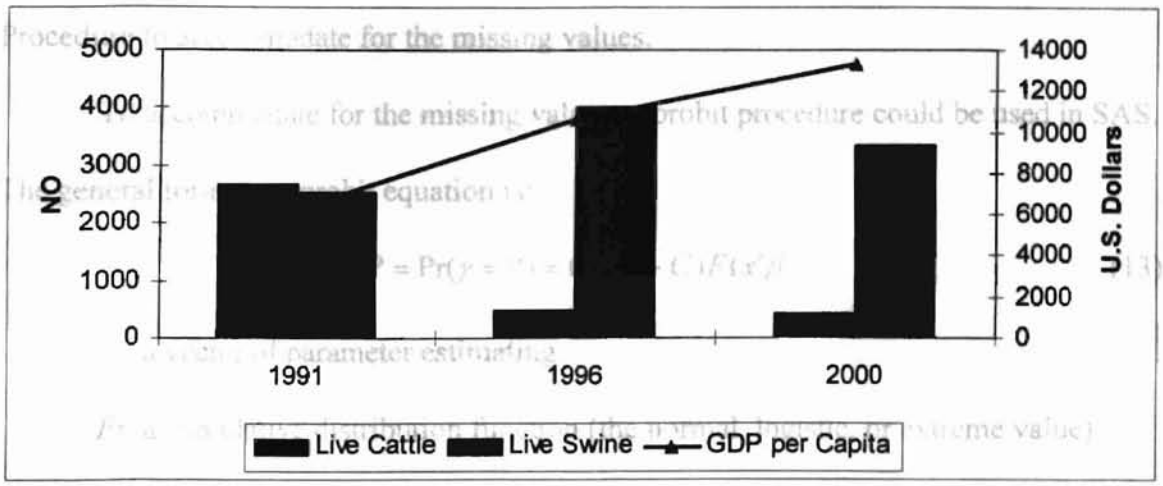
Summary of South Korea's

The United States and South Korea have a unique relationship in terms of agricultural trade over the last several decades. This relationship can be dated back to 1955 with the development of Public Law 480 (PL 480). When the last shipments were delivered under PL 480 in the early 1980s, South Korea had developed into a top commercial market for U.S. agricultural products. Today, the United States accounts for 32.5% of all agricultural imports to South Korea and South Korea is the fourth largest exporting of agricultural products overseas. The focus of this research has been to develop a LA/AIDS model that measures South Korea's (middle-income countries) ability as there income rises to be a feasible market for value-added products for U.S. exports

The LA/AIDS model's expenditure elasticites confirmed the null hypothesis as consumers' income rises in South Korea they desire more value-added pork products. The LA/AIDS model's expenditure elasticities rejected the null hypothesis for valued added beef products. The expenditure elasticities for all the products confirmed all of the products were normal goods with the exception of live swine and preserved and prepared beef, which were inferior goods. Figure V-7 shows as consumers' income raised beef and pork imports rose. Figure V-7 can be contributed to a large increase in the demand for U.S. beef and pork products to South Korea because of there low price, high quality, convenience, and attractive packaging.

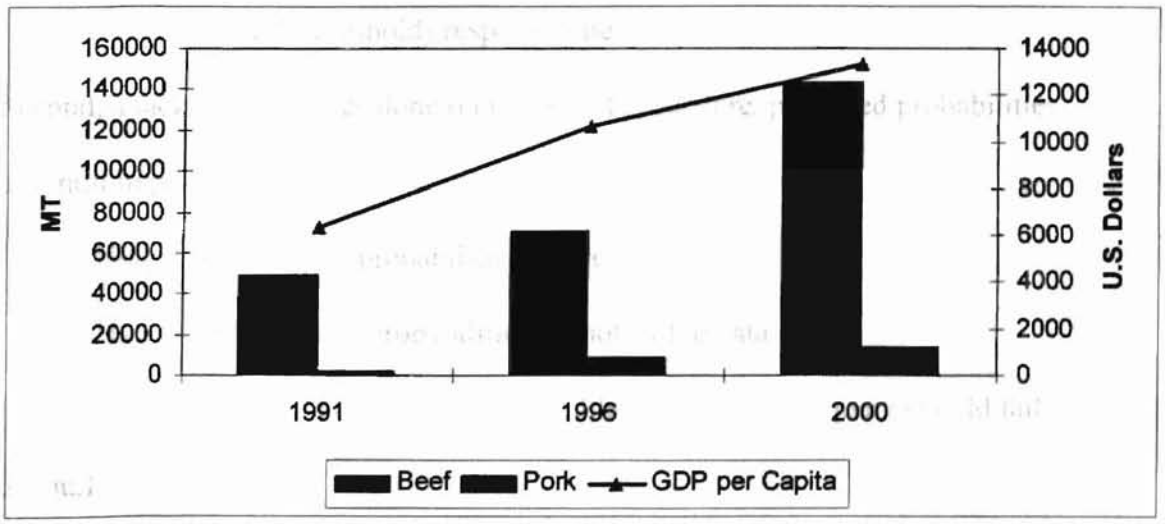
Agricultural imports play an important role in supplementing South Korea's domestic agricultural production. South Korea has abandoned the production of many crops such as wheat, millet, sorghum and cotton. Meat products accounted for 24% of all agricultural imports to South Korea. In 2000, South Korea's agricultural imports accounted for $8 million while agricultural exports made up $1.3 million. This is mainly attributed to the re-processing agricultural imports to value-added exports. This strategy for agricultural imports could explain the strange results for preserved and prepared beef in South Korea. (ERS/USDA, 2002) Figure V-6 shows as consumers' income raised live cattle and live swine imports declined.

Figure V-6. Live Cattle and Swine Exports to South Korea



Source: http://www.ag-stats.com/

Figure V-7. Beef and Pork Exports to South Korea



Source: http://www.ag-stats.com/

Recommendations for Future Research

The major limitation in this research study was data limitations. The different countries models for the value-added products were unable to calibrate because of missing values. This is due to the fact that price data was not reported for any examined country during the calendar year for which there was no commodities exported. A

suggestion for a future research would be to use the Heckman Two-Stage Estimation Procedure to accommodate for the missing values.

To accommodate for the missing values, a probit procedure could be used in SAS. The general form for a probit equation is:

$$P = \Pr(\gamma = 0) = C + (1 - C)F(x'\beta) \tag{13}$$

β= a vector of parameter estimating

F= a cumulative distribution function (the normal, logistic, or extreme value)

χ= a vector of explanatory variables

P= the probability of a response

C= the natural (threshold) response rate

Second, a lack of fit test was done on the probit procedure, predicted probabilities. The null hypothesis was:

Ho: the modeled probabilities fit the data.

H_A: The modeled probabilities do not fit the data.

The Pearson Chi-Square and the Likelihood Ratio Chi-Square should fail to reject the null hypothesis.

Then, the probit procedure can be used to attain the estimates for $Y_{2i.}$ This allows the calculation of the estimated inverse Mill's ratio.

The general form of the inverse Mill's ration is:

$$\hat{m}_i = \frac{\hat{\sigma}_2 (2\pi)^{-1/2} \exp\left(-\left(x'_{2i}\hat{\beta}_2/\hat{\sigma}_2\right)^2/2\right)}{\int_{x'_{2i}\hat{\beta}_2/\hat{\sigma}_2}^{\infty} (2\pi)^{-1/2} \exp\left\{-q^2/2\right\} dq} \tag{14}$$

Finally the inverse Mill's ratio can be inserted in the Ordinary Least Squares (OLS) regression to obtain the $\varepsilon(\gamma_i \mid x_i)$ (missing values).

The general form of the OLS regression is:

$$y_{1i} = x_{1i}\beta_1 + c\hat{m}_i + u_{1i} \tag{15}$$

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VITA 2

Kimberly Marie-Kathryn Smith

Candidate for the Degree of

Master of Science

Thesis: THE IMPACT OF INCREASED INCOME ON IMPORTS OF VALUE ADDED PRODUCTS IN MIDDLE INCOME COUNTRIES

Major Field: Agricultural Economics

Biographical:

Personal Data: Born in Daytona Beach, Florida, May 12, 1977, the daughter Marshall and Sharon Smith.

Education: Graduated from Claremore High School, Claremore, Oklahoma in May 1995; received Bachelor of Science degree in Agricultural Economics with a Marketing and Business Option in May 1999. Completed the requirements for the Master of Science degree with a in Agricultural Economics at Oklahoma State University in December 2002.

Experience: Employed by Oklahoma State University, Department of Agricultural Economics as graduate teaching and research assistant, August 1999-June 2001. Employed by Oklahoma Gas & Electric Company, Energy Resources as Energy Analyst II from June 2001-present