IMPORT DEMAND FOR GOAT MEAT, SHEEP AND LAMB, AND OTHER LESSER MEAT BY THE UNITED STATES

by

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(Under the Direction of Jack E. Houston)

ABSTRACT

American diets, especially meat consumption, have changed dramatically over the past decade. There has been a shift away from red meats towards white meats. These changes are not in isolation; they seem to be in line with dietary changes worldwide. Changes in consumption patterns in the United States have mainly been prompted by the current wave of population diversity, as well as the health consciousness of the American population. These factors have created a favorable environment for goat meat. This thesis investigates the import demand elasticity for goat meat, along with sheep and lamb, and other lesser meats as a system of minor meats. Due to lack of local production data on goat meat, import data was utilized to determine the import demand. The Generalized Composite Commodity Theorem was employed to test for separability of imports from local production. It was determined that import demand for goat meat and sheep and lamb are both price inelastic and luxury goods, which implies that import demand does not vary much with changes in import prices.

INDEX WORDS: Food Consumption, Import Demand, Minor Meats, Goat Meat, Ethnic Community, Separability, LA/AIDS Demand System

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CHAPTER 1

INTRODUCTION

American consumers are among the best fed in the world, and animal protein is a major constituent in their diets. Americans' diets are diverse, and many species of animals are consumed, with beef, pork and poultry being the most important. Recently, goat meat has become a component in some Americans' diets. Goat meat is consumed widely in many countries of the world, particularly in developing countries; however, consumption of goat meat is limited in the United States (Locasio and Degner, 1988). Historically, in the United States, the primary purpose of goats has been fiber production, milk production or brush control. This historical bias is represented in current goat numbers found within the country. Of the two to five million goats in the United States, approximately two million are considered fiber goats, one million are milk goats, and one-half million are "meat goats". In general, the meat goat industry is unorganized and is not well defined. Few official statistics are kept and much of the available information found on the number of animals, the demand for goat meat, and the retail price of goat meat is contradictory in nature. While there is generally a positive outlook on the demand for goat meat translating into a positive outlook for the meat goat industry, little of the published literature has quantified this demand for goat meat for the whole U.S. This positive outlook is arising from dietary changes in America that seem to be in line with similar changes worldwide.

Shifts in global diets

The last two centuries have seen a fundamental dietary transformation in essentially all affluent countries. Globalization and increased per capita income are changing the eating habits

of individuals all around the world (Regmi, 2001). One of the main forces driving these changes in global food consumption is trade. Trade increases the array and the availability of food to consumers. Trade, in turn, is affected by supply factors, such as relative growth in factors of production, and demand-driven factors, such as growth in disposable income and changing consumer preferences (Regmi, 2001).

Changes in international trade patterns

International trade is usually defined as trade between two or more partners from different countries (an exporter and an importer). Early international trade consisted mostly of barter transactions. According to Wikipidea, the free encyclopedia, barter is a form of trade where goods or services are exchanged for a certain amount of other goods or services; i.e., there is no money involved in the transaction. It can be bilateral or multilateral trade. The disadvantage of using bilateral barter in the past was that it depended on the mutual coincidence of wants. Before any transaction could be undertaken, the needs of one person had to complement the needs of another person. When money evolved as a medium of exchange, this improved trade because then money could be used to obtain whatever good or service that was demanded.

Changes in food consumption in one region generally have implications for production and trade in other countries. In each country, trade acts to balance the difference between production and consumption, while at the same time trade links countries in a global economy. With growing interdependency, shifts in consumption can have major impacts on food markets throughout the world. In the last two decades, the composition of world agricultural trade has undergone a dramatic shift. Today, grain trade no longer serves as a proxy for agricultural trade as it once did. Bulk commodities (grains, oilseeds, cotton, and tobacco) have become less

important in world trade, representing less than 30 % of world agricultural trade. Now, countries exporting a higher content of non-bulk commodities have increased their share in the world market, as bulk commodities become less important in total trade value (Gehlhar and Coyle, 2001).

The major determinants of changes in the structure of global food trade, as addressed by Coyle et al. (1998), are income growth and food expenditures, factors of production, transport costs, and trade policy changes. Of these determinants, income growth and its impact on food consumption was most important in explaining changes in trade patterns over the period 1980 to 1995.

American diets

As global consumption patterns have changed, food consumption patterns in the United States have also been changing dramatically. These changes in the American diet have occurred gradually over time, resulting in part from increased ethnic diversity in the population, greater disposable household income, increased trade and improved transportation, greater numbers of women in the labor force, and increased awareness and consumer preference for improved quality and more healthful products (Regmi, 2001).

These changes in food consumption patterns have resulted in large changes in per capita food consumption in the United States over time (Regmi, 2001). Americans are changing the way they eat and the foods they buy. New lifestyles, shifting demographics, and growing concerns about nutrition and health contribute to these changes. In response to American consumers, the food system may be shifting from volume production for general consumer markets to marketing and production for specialized markets. The food industry has tried to adapt to these changing

demands by shortening the path from farm to consumer with a more tightly integrated market structure and industrialization. Firms in the food system have changed from a "here is what we produce" to "here is what consumers want" perspective (Schluter, 1999).

Americans at the beginning of the 21st century are consuming more food and several hundred more calories per person per day than did their counterparts in the late 1950s (when per capita calorie consumption was at the lowest level in the last century), or even in the 1970s (USDA, 2001-02). Considering the basic relationship of calories in versus calories out, people tend to gain more pounds if they consume more calories or expend fewer calories. Yet many are unwilling or unable to make the sacrifice of eating less and/or exercising more. As an alternative to more exercising and less eating, there are many special diets that emphasize changing dietary preferences rather than decreasing the amount of food consumed. Two of the most popular and competing diets during the last 15 years have been first the low-fat, low-cholesterol diet and later the low-carb diet. As a large number of Americans adopted these diets, the consumption of different foods changed (Miljkovic and Mostad, 2005). Miljkovic and Mostad (2005), showed that beef represents one of the foods whose demand fluctuated as the perception about its healthiness changed.

New products, particularly more convenient ones, also contribute to shifts in consumption, along with increasing imports, growth in the away-from-home food market, expanded advertising programs, and increases in nutrient-enrichment standards and food fortification. Socio-demographic trends that also drive changes in food choices include smaller households, more two-earner households, more single-parent households, an aging population, and increased ethnic diversity (Schluter and Lee, 1999).

Consumption patterns for meat and meat products in the United States have also changed considerably over the last few decades. Declining beef, fast growing poultry, and leveling-off pork consumption characterized the well-known shift from "Red" to "White" meat (Nelson and Liu, 2005. American meals have traditionally centered around the consumption of meat. Today it is common to observe meat and meat products being served at each daily meal: ham, bacon, and sausage at breakfast, a meat sandwich at lunch, and a cut of red meat or poultry at dinner. Fortuitously, American consumers' revealed tastes and preferences for meat are well accommodated by the ample resource base of the United States (Haley, 2001).

Now more than ever, America is a nation of meat eaters. In 2000, total meat consumption (red meat, poultry, and fish) reached 195 pounds (boneless, trimmed-weight equivalent) per person, 57 pounds above average annual consumption in the 1950s. Each American consumed an average of 7 pounds more red meat than in the 1950s, 46 pounds more poultry, and 4 pounds more fish and shellfish. Rising consumer incomes, especially with the increase in two-income households, and meat prices in the 1990s that were often at 50-year lows, when adjusted for inflation, explain much of the increase in meat consumption. In addition, the meat industry has provided scores of new brand-name, value-added products processed for consumers' convenience, as well as a host of products for food service operators (USDA, 2001-02).

Nutritional concern about fat and cholesterol has encouraged the production of leaner animals (beginning in the late 1950s), the closer trimming of outside fat on retail cuts of meat (beginning in 1986), the marketing of a host of lower fat ground and processed meat products, and consumer substitution of poultry for red meats since the late 1970s–significantly lowering the meat, poultry, and fish group's contribution to total fat and saturated fat in the food supply. Despite near record-high per capita consumption of total meat in 2000, the proportion of fat in

the U.S. food supply from meat, poultry, and fish declined from 33 percent in the 1950s to 24 percent in 2000. Similarly, the proportion of saturated fat contributed by meat, poultry, and fish fell from 33% in the 1950s to 26% in 2000 (USDA, 2001-02).

Recent Economic Research Service (ERS) research has identified three broad demographic trends that will shape future U.S. food markets: more mature consumers, more diversity, and more people to feed (Cromartie, 2002). The aging of the baby boom generation, born between 1946 and 1964, will accelerate growth in the number of Americans older than 65, who will number 54 million by 2020. Older Americans typically eat less food than younger ones, due to lower activity levels and energy needs, and they typically dine out less frequently. According to ERS projections, small declines in per capita consumption of fried potatoes, cheese, sugar, beef, and poultry are expected, while the increase in older consumers could signal an increase in per capita consumption of "other potatoes" (such as baked), eggs, fish, fruits, and vegetables (Blisard et al., 2002).

American consumers participate in a food system that is characterized by the fulfillment, if not satiation, of basic needs—what is termed as a mature market (Ballenger and Blaylock, 2003). Consumers of all ages and recent immigrants have higher standards of living now than in earlier times, and they benefit from a highly productive agricultural sector. Consequently, most people are generally very well-fed and not apt to need or want larger quantities of food. However, rising incomes allow Americans to continue to upgrade their food choices to include, for example, more expensive cuts of meats, exotic vegetables, luxury food items, ready-to-eat meals, and higher priced restaurants. According to Ballenger and Blaylock (2003), higher incomes drive up per capita food expenditures more rapidly than per capita quantities consumed for virtually all foods. Hence, more of the extra consumer dollar will go to "quality" than to

quantity. More prosperous consumers prefer select cuts of meat, value-added products like lamb chops trimmed and dressed and ready to pop in the oven, pre-marinated fish, single-serving lunchbox snacks, and pre-washed and bagged salad greens. Previous studies have found that, as U.S. incomes rise, consumers spend more on expensive fresh foods, prepared foods, and dining out. Higher consumer incomes are likely to engender small shifts in demand for particular foods and commodities due to different consumption patterns observed among those with different income levels.

Growing ethnic diversity has contributed to shifts in food preferences, as well as a notable expansion of the American food repertoire. ERS researchers reported that the expanding ethnic population base will increase per capita beef consumption very slightly and poultry and fish consumption somewhat more. The United States is indeed growing, as seen in the 2000 census count of 281 million people, 54 million more than in 1980. A large share of U.S. population growth results from a high tide of immigration initiated in the 1960s and continuing at least into the near future. By 2020, the U.S. population will likely grow another 18 to 28 percent, implying another 50-80 million people to feed (Ballenger and Blaylock, 2003).

Goat meat

Food preferences vary between different nationalities, cultures, religious and ethnic groups. Current demographic patterns in the United States favor increased consumption of goat meat (Thompson et al., 2004). Increased ethnic diversity is hypothesized to increase the demand for many ethnically identified foods, including goat meat, lamb and mutton, and other meats. Domestic consumption is centered in areas with significant Hispanic, Muslims, and various Caribbean and Asian markets where goat meat is a traditional staple (Hansen, 2004). Goat meat,

commonly referred to as 'chevon' or 'cabrito', is, however, the most popular meat product in the world and is often served in specialty dishes centered on festival or holiday events (Sande et al., 2005). There is a large goat population in the tropical regions of the world, and according to the FAO Production Yearbook (1984), 95 % (432.7 million) of the goats are found in developing countries, while only five percent (26.9 million) are located in developed nations (Gelaye and Amoah, 1991). Consumption in the United States, however, is not widespread, although 'chevon' offers consumers a tasty, low-fat meat compared to beef or pork (Getz, 1998). In addition, the meat goat business seems to hold new economic potential, particularly for small scale producers who find it easier to raise goats in comparison to the other larger livestock because goats require less land per animal.

In the United States, the goat industry is still in its infancy, but with a promising trend for growth (Gelaye and Amoah, 1991). Goat meat consumption in the United States has grown sharply over the past 20 years (Gipson, 1999). This increase in consumption is driven by the popularity of goat meat with the diverse ethnic groups that immigrate yearly to the United States from countries where goat meat is popular, and also the popularity of heart-friendly ethnic foods.

In the past, the perceived scarcity of goat meat in the United States discouraged the immigrants from holding onto their goat meat eating tradition (Stanton, 2004). In recent years, there has been a switch in philosophy to one that encourages people to celebrate their diverse cultural backgrounds. This has encouraged most immigrants to rediscover their goat meat eating habits, hence creating an increase in demand (Stanton, 2004). In addition, there has been an increase in the U.S. immigrant population in recent years. These two factors have greatly increased demand for goat meat within the United States. Since meat goats have been a minor enterprise in the past, their production was very low, leading to a low local supply of goat meat.

Ethnic communities also come from countries where sheep and lamb are consumed. For most of these communities, goat meat and sheep and lamb are considered substitutes.

Sheep and lamb

Lamb and sheep can typically be marketed within the same ethnic markets as goats. Sheep and lamb consumption is very low compared with other red meats, and its consumers are culturally and ethnically distinct. Consumption has remained constant within these groups who persist in maintaining their ethnic practices, whether related to habit, tradition or religious beliefs (Jones, 2004).

On the other hand, most Americans eat no lamb and mutton at all, while some consume more than a pound. On average, lamb is purchased by fewer than 5 % of households on a weekly basis. The lamb and sheep industry has been in a steady decline over the past decade. Due to this, demand surpassed supply and thus imports were used to meet this excess demand.

Problem statement and objectives

Demand potential for goat meat has drawn a lot of attention to the goat industry in recent years. Yet in contrast to other meat products, goat meat remains a largely neglected product on the meat market and an issue less discussed in academia. The main problem is that few official statistics are kept and much of the available information found on the number of animals, the demand potential, and the retail price of goat meat is contradictory in nature. While there is generally a positive outlook on the demand for goat meat translating into a positive outlook for the meat goat industry, little of the published literature has quantified the demand for goat meat in the United States.

Meat goats have been a minor enterprise in the U.S. in the past. Goats were initially kept for fiber and milk production, with chevon as a by-product. Also, the majority of the predominantly white American population has never consumed goat meat. Due to this, a relatively thin body of published literature regarding goat meat demand exists. In addition, most price and supply data are unreported, since the USDA stopped tallying nationwide goat numbers many years ago. Thus, estimates of price and supply are poorly documented.

According to the U.S. Census Bureau, ethnic population increased from 9.6 million in 1970, to 14.1 million in 1980, to 19.8 million in 1990 and to 28.4 million in 2000, with a 57.9% increase in the Hispanic population between 1990 and 2000. The United States is currently experiencing the largest sustained wave of immigration in its history, with 1.2 million legal and illegal aliens arriving each year (CIS, 2001). Most of these immigrants are goat meat, lamb and mutton, and other lesser meat consumers.

Goat meat is particularly popular with Hispanics, especially Mexicans. Muslims also consume greater quantities of goat meat, and their numbers have increased tremendously in the past decade as well. Not only did the ethnic population increase at an unanticipated rate, but the household income of ethnic groups in the United States has also increased in the past decade. According to the United States Census Bureau (www.census.gov), the average household income increased by 18.8% during the past decade, with Asian household income increasing at a rate of 51.3% after adjusting for inflation. In addition, there is the "Yuppie" community, which fancies gourmet fare, and a section of the American population who are becoming increasingly health conscious and are thus reverting to better health meat products.

Since a majority of this meat demand is ethnically based and the desire for immigrants to maintain their identity is so strong, some researchers have theorized that the demand for goat

meat is relatively price inelastic (less than one in absolute terms). While this hypothesis is yet to be tested (a search of the literature revealed no published empirical studies on the demand elasticity for goat meat), it appears to be in accordance with other empirically tested demand elasticities for red meat (Lillywhite, 1999).

There is a noticeable lack of research regarding goat meat demand. This is mainly due to limited supply and price data. The most recent estimate of goat meat demand was done by Gipson (1999). He concluded that about 800,000 goats were slaughtered for U.S. consumption in 1998. Almost seven years since, there is still no reliable supply and price data. This therefore opens a vast area for research opportunities. The only reliable source for supply is still import data, which can be used for estimating import demand elasticity for goat meat. Since it is believed that ethnic communities are also the main consumers of lamb and mutton, then it will be appropriate to estimate import demand for lamb and mutton as well. The objectives of this thesis are:

- 1. Use import data to estimate import demand elasticities for the minor meats group (goat meat, sheep and lamb and other meats), with particular emphasis to goat meat, by the US
- 2. Determine the impact of the Hispanic population on import demand for the minor meats

Organization of the thesis

This thesis is organized into six chapters. The introduction, problem statement and justification are presented in the first chapter of this thesis. This first chapter discusses the changes in world consumption patterns and how they have led to the change in the structure of international trade. The chapter also discusses changes in meat consumption patterns and in population structure in the United States, and how these changes are continually creating a

market for ethnically identified foods. Chapter two covers the literature review on the factors that have led to changes in consumption patterns and international trade. Chapter three presents the theoretical background on consumer demand theory, utility maximization and separability of preferences. Chapter three also presents the regression model specification and functional form. Chapter four presents descriptive sample results, empirical findings and a discussion of these findings and their implications. The last chapter presents the summary and conclusions derived from the study.

CHAPTER 2

LITERATURE REVIEW

The purpose of this chapter is to present the essential theory underlying the current state of international trade and of consumption diets worldwide. The chapter begins with a discussion of the change in the level of exports and imports as well as agricultural trade commodity composition between developing and developed countries. Next is a discussion of the various factors that have led to these changes and their impact on trade and consumption patterns. This discussion also covers the impact of these factors on international meat trade and the shift in meat consumption patterns in the U.S. and the link to minor meat consumption.

The final section discusses the emergence of the goat meat industry. This gives details of the characteristics of goat meat compared to other meats and its emerging increased demand in the United States. A discussion of domestic production and the level of supply of goat meat is also covered. Next is a discussion of the sheep and lamb industry trend over the past decade and the current situation in light of the shifts in meat consumption patterns in the U.S.

Changes in the structure of international trade

Over the course of the past 40 years, the net flow of agricultural commodities between developed and developing countries has reversed direction. In the early 1960s, developing countries had an overall agricultural trade surplus of almost US\$7 billion per year. By the end of the 1980s, however, this surplus had disappeared. During most of the 1990s and early 2000s, developing countries were net importers of agricultural products. FAO has projected that this agricultural trade deficit is likely to widen markedly. The change has been even more

pronounced for the less developed countries (LDC), which over the same period have changed from being net exporters to significant net importers of agricultural commodities. By the end of the 1990s, imports by the LDCs were more than double their exports.

Global trade in foodstuffs has grown rapidly and changed radically over recent decades. Between 1970 and 2001, gross world food imports, measured in terms of calorie equivalents, rose by almost 60%. But this growth differed markedly among both country and commodity groups. Gross imports of food by developing countries grew by 115 % over this period. Imports by developed countries, which already import a higher proportion of their food, grew by 45 %. A closer look at the data reveals that food imports by developing countries increased rapidly during the 1970s, grew more slowly during the 1980s and accelerated again over the 1990s. This pattern holds true both for the volume of food imports and for the ratio of food imports to availability for consumption per capita. The expansion of food imports meant that the food trade surplus of US\$1 billion of developing countries was transformed into a deficit of more than US\$11 billion during this period. Moreover, this trend is expected to continue: according to FAO projections, by the year 2030, the net food trade deficit of developing countries is expected to swell to more than US\$50 billion in constant 1997–99 US\$. Despite substantial differences in the trade and dietary profiles of developed and developing countries, imports of particular commodities appear to be evolving in a similar manner (FAO, 2004).

Agricultural trade consists of food and non- food commodities in both raw and processed forms. A useful classification of agricultural trade is a breakdown of agricultural trade into four components; bulk commodities, processed intermediate products, fresh horticultural products, and processed consumer goods. From 1980 to 1997, the share of bulk commodities steadily dropped (Fig. 2-1) while the shares of non-bulk categories remained steady or increased. Over

the past 15 years, many of the faster growing categories in trade are non-bulk packaged products, where consumers differentiate products carrying unique brands and labels (Gehlhar and Coyle, 2001). Among the five broad food commodity groups – cereals, edible oils, animal products, sugar, and fruit and vegetables – cereal foodstuffs once dominated international trade¹. Now, however, the share of cereals in total agricultural imports has fallen below 50% in developing countries and below one-third in developed countries. While the share of cereal imports has declined, both developed and developing countries are importing greater quantities of higher-value and processed foods, particularly edible oils, livestock products and fruits and vegetables (FAO, 2004).



Figure 2-1: Composition of world agricultural trade (Source: U.N. COMTRADE, ERS)

¹Bulk commodities consist of raw grains, oilseeds, tobacco, and cotton. Intermediate processed commodities consist of semiprocessed goods such as flours, meals, and oils. Fresh horticultural products consist of unprocessed fruits and vegetables such as bananas and tomatoes, and nursery products including cut flowers. Consumer-processed products include processed products at or near where a substantial degree of processing has taken place. Items in this category include beverages, bakery products, ready to eat cereals and snack food, fresh and frozen meat, and preserved fruit and vegetables

Shifts in global diets due to economic development

One of the primary factors affecting food consumption patterns is the ability to purchase food. The last two decades have witnessed major increases in per capita income levels of households all over the world. Consumers in high-income countries, such as the United States, spend a large share of their food budget on meat, while cereal is the predominant component of the food budget for consumers in poorer countries (Regmi, 2001). Generally, as the population grows wealthier, the consumption of meat and fresh produce increases.

At very high-income levels, such as in the United States, changes in income and food prices may not translate to perceptible changes in food expenditure patterns at a national level. However, changes may occur within the composition of sub-categories of food, such as substituting grocery store brands with 'quality-assured' organic brands, or replacing store brand meat and cheese with imported products perceived to be of better quality. Similarly, at very lowincome levels, changes in income and food price may not result in changes in consumption of certain food groups. This is due to consumption shifts within a food sub-category. As income levels increase beyond a certain threshold and consumers migrate to the 'middle-income' category, they appear most likely to change their food basket by consuming a more diverse and higher valued diet (Regmi, 2001).

Income growth, relative price changes, urbanization and shifts in consumer preferences have altered dietary patterns in both the developed and developing countries. When people have more money to spend, they add more variety and more expensive and high-value foods to their diets. These changes are reflected in both the volume and the composition of world trade in agricultural commodities. Expenditures on foodstuffs and responses to income changes differ between developing and developed countries. In the latter, most consumers can already afford

the foods they prefer. When their incomes rise, changes in their diets and food purchases are, therefore, relatively small. In developing countries, on the other hand, rising incomes have an immediate and pronounced impact on diets and consequently on trade in both commodities and processed foods, as people adjust their budgets to include higher-value food items. Similarly, declining real food prices have allowed poor consumers access to improved diets at existing income levels (FAO, 2004).

When the basic demand for a well-balanced meal is met, further increases in income result in demand for other 'quality attributes' in the food consumed. The demand for 'quality attributes' in developed countries has escalated in recent years, due to increased media attention and public awareness resulting from various incidences of large-scale food contamination. Consumers in developed countries are increasingly demanding food products perceived to be safer, specifically products that are free from disease-causing organisms, chemical residues, and that are not produced using any chemical inputs or genetic modifications (Regmi, 2001).

International meat trade

International trade has been increasing faster than global GDP (GDP is itself the internal trade among the people of a country) over the past 25 years (Clarke, 2000). International trade in meat is also increasing rapidly, in both absolute terms and relative to total global meat production (Fig. 2-2). Increasing meat trade is not an isolated trend, but rather a part of an overall world economy that is becoming ever more dependent on trade in goods and services. From 1961 to 2003, total global meat production increased from 71 million tons to 271 million, and trade increased from only 3.5 million tons to 26 million. As a percentage of meat production, global trade increased from about 5% in 1961 to about 10.5% in 2002. Furthermore, there is a high

correlation between the increase in meat trade and per person global GDP.

This results because as the world gets richer, the need to trade meat increases (Elam, 2005)



Figure 2-2: Global meat production and trade (Source: FAO STAT)

Dietary changes usually come about due to increased household income which results from economic development. With increased income, households can purchase more food and higher valued foods, such as meat (Regmi, 2001). Economic development also brings urbanization. Urbanization (which can also occur in the absence of economic growth) increases household access to meat sold in shops and brings changes in occupational and household structure that favor consumption of food away from home, including meat. The importance of dietary changes to meat imports is shown by the case of Japan, the world's largest importer of beef and pork, both in value and volume (Dyck and Nelson, 2003). Japan's national diet changed during the period, 1960 to 1995, due to growing affluence, urbanization, and exposure to global trends. This changed consumption per person six-fold.

As income grows, meat typically becomes a more important source of calories in the human diet (Fig 2-3). While the relationship between income and livestock product consumption is well known, the link between economic growth and meat trade is less clear. Regions with faster growth in meat consumption do not necessarily become larger importers of meat. Expansion of domestic meat production plays an important role in determining import growth. Imports will depend on how competitive domestic producers are in producing for the home market (Gehlhar and Coyle, 2001).

To meet changes in meat demand, countries can either increase domestic production or tap into world markets through trade. For example, countries which want to rapidly increase meat consumption but have limited resources, can import poultry meat, which is relatively less expensive in relation to other meats and also import the technology needed to produce chicken.





However, in some cases, increasing domestic output is impossible. For example, land constraints and pollution are forcing the governments of Hong Kong and Singapore to implement policies aimed at halting domestic pork production. Singapore now imports live hogs for slaughter from the Philippines and Hong Kong imports hogs from China (Shagam, 1989).

As incomes go up, there is a strong tendency for values of different meat cuts to diverge (Elam, 2005). It is, after all, value (not cost) differences that are the major driving force for trade, whether domestic or international. A tendency for diverging parts prices can be seen clearly if the extremes of the world's income range are compared. In relatively poor countries, most meat is sold in live-animal (wet) markets, and there is little or no difference in value attached to different parts. The most extreme example is the live broiler market where the entire bird is sold for one price.

On the other end of the spectrum, there are places, such as the U.S., Japan and Europe, where different broiler parts have very different prices. This difference in pricing is due to more income, which causes people to be more selective about what they buy at the grocery store. The preferences are probably there all along, but people with limited income cannot be as picky about what they eat. As pricing of the preferred parts increases, producers have an incentive to increase production, but this creates a new problem. As the production of the preferred parts increases, so does the production of the parts people don't like as well. Those less favored parts prices fall as their supply increases. In total, producers continue to cover total costs, but cost recovery becomes more and more dependent on the willingness of consumers to pay premium prices for the parts they want most incomes go up, there is a strong tendency for values of different meat cuts to diverge.

International meat trade has a long history, but recent decades have seen fast growth of trade volume and value (Fig. 2-4). Reduction in protectionism is one reason. Associated with the reduced protectionism, either as causal factors or as consequences of liberalized trade, are important changes in diets, distribution technology, and multinational business structures (Dyck and Nelson, 2003).



Figure 2-4: World meat exports, 1970-2001 (Source: FAO STAT, 2003).

Effects of distribution technology

Trade opportunities have increased with technological advances in transportation of highly perishable products like meat. Technology has also increased shelf life, improved product packaging and presentation, and affected preparation; microwave cooking is an example. All these developments in turn influence consumption and trade patterns (USDA, 1992). In the past, fresh meat could not be transported over long distances because of its perishability. Frozen meat could not be shipped to destinations lacking refrigeration and an adequate distribution system. New technologies now allow for chilled meat, which can stay fresh for long periods of time, to be shipped to many locations. In parts of the world where it is customary to pick out the live animal immediately before slaughter, advertising and other promotional activities encourage consumers to try fresh, chilled, or frozen cuts. Such marketing efforts are improving acceptance of frozen and packaged meat (Shagam, 1989).

Households in developed countries prefer fresh meat, although chilled meat is usually a close substitute for fresh meat and has a longer shelf-life than frozen meat (Dyck and Nelson, 2003). Current technology advances have made it possible to ship beef and pork for long distances in chilled rather than frozen form. New technology (especially controlled-atmosphere refrigerated containers, vacuum packing, and improved microbial control) has lengthened the time in which meat can be kept marketable and has encouraged transoceanic trade in chilled meat by ship.

Multinational business structures and international trade

Hundreds of firms of all sizes engage in world meat trade, but a few very large firms are clear market leaders. These firms tend to be important meat firms in their home countries, and they are able to sell and/or produce meat in more than one foreign country. A larger, international market may enable increases in plant and firm size that lead to economies of size. As a firm sells to a larger market, its costs per unit of meat fall, because it can expand its size of operation. Seen from another perspective, large firms can deliver larger orders of meat of consistent quality, more often, and at lower cost than smaller firms, and thus are successful in

competing for export markets. Firms may also realize economies of scope (for example, realizing cost savings by providing centralized management, sales force, or research to several operations). In general, large firms dominate first the meat markets of countries with large populations, then reach out to foreign markets to attain better prices for cuts and byproducts than can be realized in their home markets.

Firms can also take advantage of differences in meat cut preferences. Shipping a cut to a foreign market where it commands a higher price can increase a firm's net returns. Transportation and distribution costs may be lower for larger quantities and more frequent shipments. Thus, large firms which can reliably and consistently produce large quantities of cuts (or byproducts) may have a competitive edge over smaller firms in supplying such cuts. The decision to invest in production in another country or to simply export to that country is influenced by the possibilities for increasing returns to plant size. Another reason for multinational operation may be the opportunity to extend technologies or management practices to a country where they are not yet in use, and to capture profits as an early adopter of these methods (Dyck and Nelson, 2003).

Changes in world meat consumption patterns

Changing lifestyles also affect consumption and trade patterns. As consumers demand more food away from home, this usually results in an increase in the demand for foods which are quickly and easily prepared or are pre-made. For example, the market for fast foods, such as fried chicken and hamburgers, increases. In many higher income countries, consumer preferences have shifted from large cuts of meat like roasts, toward foods that are simple to prepare, like steaks, chops, and de-boned chicken breasts.

Consumers will also change their food choices in response to concerns over the quality and quantity of foods available. In many countries, this led to a move away from meat products containing high levels of fat and cholesterol. For example, some people may switch from pork and beef to chicken and turkey, products perceived as lower in fat and cholesterol. Even within the same meat class, health consciousness about the fat content of foods has increased demand for leaner cuts of meat (Shagam and Bailey, 1992).

In addition to changes in incomes, lifestyles, and technology, cultural factors can affect consumption patterns (Gehlhar and Coyle, 2001). Nations where the population is predominately Moslem or Jewish will not use pork products. Therefore, increases in meat demand in these countries will be for beef, lamb, and chicken. India, which is predominately Hindu and therefore vegetarian, has a very low demand for meat. Other cultural practices, such as cooking style or service, can influence demand for specific cuts of meat. For example, a society which is used to stir-frying foods, such as the Japanese, will be less likely to purchase roasts or lean cuts of beef.

Finally, governments can indirectly influence consumption patterns through trade or production policies. Many barriers beyond those related to transportation and perishability exist to the international meat trade. To protect domestic producers from competition, many governments impose import quotas, high tariffs, and other trade barriers that make trade difficult or impossible. The concept of self-sufficient food production keeps some nations producing certain commodities which could be imported more cheaply. Stringent veterinary regulations aimed at protecting the wholesomeness of a country's meat supply also hinder trade. Legitimate concerns about preventing disease do exist. For example, the occurrence of hoof and mouth disease in some countries precludes shipping fresh meat from these countries to those where the disease is not evident. In the Soviet Union and Eastern Europe, governments are caught between

a desire to upgrade national diets and an inability to purchase imported feed components. Since poultry species are more efficient than cattle or hogs at converting feed to meat, Soviet Bloc governments are redirecting resources into poultry production. In the European Community, agricultural policies have led to considerable overproduction in the dairy sector, and a policy decision to cut the dairy herd resulted in more beef (Shagam, 1989).

American meat consumption patterns

Substantial changes in meat demand and consumer preferences have been experienced in the past decades (Nelson and Liu, 2005). At the beginning of the 21st century, Americans are consuming greater quantities of meat products than in the past. United States Department of Agriculture (U.S.D.A.) statistics indicate that U.S. per capita meat consumption increased more than 11% from 1970-2000 (Fig. 2-5). However, data also show that significant within-category changes have occurred since the mid- 1970s. U.S. per capita consumption of poultry products has increased dramatically, while per capita beef and veal consumption have declined (Haley, 2001).

Over the three decades prior to 1989, there was an evident trend away from the consumption of "red meats" and toward "white meats" in the United States (Chavas, 1989). At least four forces may explain this trend. First, consumers could be substituting out of beef and into poultry and pork in response to changing relative prices (Moschini and Meilke, 1989; Menkhaus et al., 1985). Second, incomes (and associated expenditures on meat) have increased, and the income elasticity of demand may be less for beef than for either poultry or pork. Third, changes in the value of the time of family members (such as might result from increased labormarket participation by women) may lead to changes in eating and cooking habits (Chalfant and

Alston, 1988). Fourth, tastes may have shifted in response to increased information about the healthiness of saturated fat and cholesterol (Choi and Sosin, 1990; Chavas, 1983).



Figure 2-5: Total U.S. per capita consumption of red meat and poultry (Source: ERS, USDA).

Increased ethnic diversity and health consciousness, together with increased incomes of the American population, have brought about an increased demand for other meats like goat meat, lamb and mutton. While it is true that many immigrants come to the United States to begin new lives as American citizens, there is increasing evidence that many of these same immigrants wish to maintain their ethnic identity. It has been argued that for many ethnic and religious groups within the United States, this desire to maintain identity plays a significant role in consumption and consumer demand. That is, members of either of these two groups may make increased efforts within their consumption patterns to maintain an identity with their homeland. This effort is readily evidenced in food preference and selection (Lillywhite, 1999). The majority of these ethnic groups have a preference for goat meat, lamb and mutton, and other exotic meats, all linked to their cultural or religious beliefs.

Goat meat versus other meats

The US goat industry is predominantly an infant industry with considerable demand potential. The fastest growing animal industry in the United States is the goat meat industry. The main consumers of goat meat emanate from various ethnic groups, and the health and gourmet food sectors (Singh-Knights and Knights, 2005). The substantial changes in meat markets and the evolution of consumer preferences slowly created a market environment favorable for meat goat consumption (Nelson and Liu, 2005). Goat has won favorable recognition for its quality (Babiker et al., 1990), which match some consumer preferences for low-fat and consumer concerns on health. When compared to other meats, goat meat is low in calories and fat. In addition, it is high in protein and other important nutrients (Table 2.1).

Meat Type	Energy	Total Fat	Saturated	Protein	Iron (g)	Cholesterol
	calories		Fat (g)	(g)		
Goat	122	2.58	0.79	23	3.2	76
Beef	245	16.00	6.80	23	2.9	70
Pork	310	24.00	8.70	21	2.7	60
Lamb	235	16.00	7.30	22	1.4	70
Chicken	120	3.50	1.10	21	1.5	60

 Table 2.1. Comparison of Goat Meat to Other Meats

Source: Current Trends in Goat Production in the United States, David M. Sherman
Some evidence (Nelson et al., 2004) suggests that goat meat fares favorably in palatability when compared with lamb and beef. In one study (Degner, 1991), 600 consumers (25% of whom had eaten goat before) were asked to evaluate unidentified samples of barbecued goat and beef. Although the results were not significantly different (P > 0.05), overall appeal ratings indicated that 42% of the respondents preferred goat, 38% preferred beef, and 20% did not distinguish between the two. In another study (Griffin et al., 1992), two groups (ten members each-one group made up of members native to the U.S., and one made up of members from different ethnic groups, all of which had eaten goat before) compared goat and lamb meat. The participants found sheep meat to be more palatable, but flavor scores were similar between the two (Miller, 1999).

Statistics show that the United States does not have enough meat goats to keep up with the demand and hence depends on imports to meet most of the excess demand (Pinkerton, 1995). The Foreign Agriculture Service (FAS) of the USDA demonstrates that the U.S. shifted from a net exporter to a net importer in 1991 (Pinkerton, 1995). Since 1991, net imports of goat meat have experienced substantial growth (Gipson, 1999). These increases in imports are a clear indication of unmet demand. Currently, a major part of this existing demand is met by imports, mainly from Australia and New Zealand. As shown in figure 2.6 below, the United States imports more goat meat than any other country (Mauldin and Mauldin, 2003). Between 1989 and 1998, importation of chilled/frozen goat meat continued to increase linearly, while exportation decreased quadratically (Gipson, 1999).

Domestic production

The total goat market in the U.S. is thought to be growing at a rate of more than ten to fifteen percent annually. Still, there are not enough goats produced in the U.S. to meet domestic needs (Johnson, 2002). Goats were initially produced for fiber and milk with goat meat as a co-



Figure 2-6: Goat meat importers (Source: Meat goat monthly magazine, 2003)

product of these two enterprises. With the decline in the importance of fiber, most farmers diverted their attention to raising meat goats. The number of farms producing meat goats has also increased. This increase in number of farms and goat production has been encouraged mainly by increases in niche market populations with historic preferences for goat meat. Nye and Moore (2002) reported that meat goat production is also growing because of goat's economic value as efficient converters of low quality forages into quality meat, milk and hides products for many specialty type markets.

The meat goat is also popular for situations where resources are limited, and a small herd of goats may be the only livestock enterprise that a small, part-time farmer can raise efficiently and profitably and become self-sufficient. Therefore, goats are particularly attractive to smallscale farmers because the small animals don't require much land to graze and are easier to handle than larger livestock (Tadesse, 2004).

Sheep and lamb

Lamb is generally a higher priced product than beef, pork and poultry, since lamb consumers prefer the high-value cuts as legs and loins. Thus, consumers will unlikely substitute these products for lamb unless they have other strong preferences or when economic conditions dictate (Menkhaus and Whipple, 1998).Lamb and mutton production has traditionally been closely linked to wool production, almost produced in fixed proportions. However, demand for wool greatly declined after World War II, due to reduction in use by military service personnel, and also due to substitution by the less expensive synthetic fibers, which when blended with natural fibers were more attractive to consumers than wool. This decline in wool production brought about a shift in emphasis to meat production (Jones, 2004). However, lamb prices have been unable to support industry recovery.

Domestically, lamb continues to compete with other protein sources, such as beef, pork, veal and poultry, for retail space and sales. Lamb tends to be substituted for other protein sources, since it is generally highly priced (Miller, 2003). Per capita U.S. lamb and mutton consumption dropped from 4.5 pounds (retail weight) in the early 1960's to around 1.1 pounds over the past two decades (Fig. 2-7).

Consumption of lamb and mutton is mostly confined to ethnic niches and small segments of the population who eat mainly high-value cuts. These groups persist in maintaining their ethnic practices either related to habit, tradition or religious beliefs. Ethnic persons may expend great effort to keep their identity from being merged into the dominant society. The markets for both lamb and mutton have weakened as stock sheep inventories have declined. Lamb consumers prefer the high-value cuts, such as legs and loins, while producers, processors and retailers struggle to sell the remaining cuts. U.S. sheep farmers are less inclined to produce when the returns from the whole carcass are based on a few desirable cuts, causing domestic demand to exceed domestic supply. This excess demand has then to be met by imports (Jones, 2004).



Figure 2-7: Per capita consumption of lamb, 1975-2002 (Source: US Department of Agriculture, National Agricultural Statistics Service (NASS).

Sheep numbers generally have been declining since 1942, when numbers peaked at 56.2 million head. The decline of the last several years was caused largely by drought conditions in many Western sheep producing states. Declining U.S. sheep numbers and lamb meat production

has led to increased imports of lamb for U.S. consumption. Imports amounted to less than 20 percent of consumption in 1995, but increased to more than 45% in 2004. Due to strong U.S. lamb prices in 2004, lamb meat imports increased 7.7% over 2003. Imports likely will increase again in 2005, but the rate of increase should moderate because of the declining value of the dollar relative to currencies in lamb exporting countries. Australia accounts for about 67% of U.S. lamb and mutton imports, with New Zealand providing 32% and Canada and several other countries sending the remaining 1% (Petry, 2005). There is no work which has been done on the other meat category and thus no literature exists about its supply or demand.

The next chapter provides details on the theory and specification of the linear approximate AIDS (LA-AIDS) model used in this study to estimate import demand for minor meats by the U.S.

CHAPTER 3

THEORY AND METHODOLOGY

The purpose of this chapter is to describe the theory underlying the concept of consumer utility and demand estimation with the objective of deriving estimates for import demand of the minor meats. First is a general description of the link between consumer utility maximization and demand. This is followed by a discussion of the concept of aggregation and separability and how this can enable estimation of a subgroup of commodities. Next is discussion of the importance of the LA/AIDS model in demand estimation and then, the specification and parameters included in the model. The last section of this chapter provides the source of data for our study and the type of regression that was employed for estimating the LA/AIDS model. This includes a description of the method of estimation and a mention of the expected results.

Neoclassical consumer theory

The analysis in this study is based on consumer utility theory. Consumers normally purchase commodities and services to increase their utility/satisfaction from the consumption of these products or goods and services. The basic tenet of the theory is that any rational consumer will always choose the most preferred option, or bundle of goods, from a set of feasible alternatives; that is they will maximize their utility subject to a constraint on the amount of income they have to spend. This utility-maximizing, or most preferred bundle of goods, can be expressed as the quantity of each commodity the consumer desires at a given level of prices and income. The correspondence that relates the vector of prices (**p**) and income (y) to the demanded

bundle is called the consumer's *demand correspondence*. When this correspondence is singlevalued for all (\mathbf{p} , \mathbf{y}), it can be referred to as a demand function. This demand function is observable and is known as the Marshallian demand function (Varian, 1992; Silberberg, 1990), or, more generally as, the Walrasian demand function. For the *i*th good, the Marshallian demand function can be written as

$$q_i = g_i(\mathbf{y}, \mathbf{p}) \tag{3.1}$$

The utility function that measures the level of satisfaction a consumer experiences from consuming a particular bundle of goods and services is represented as

$$\mathbf{u} = \mathbf{u}(\mathbf{q}) \tag{3.2}$$

where $\mathbf{q} = (q_i)$ is taken to be an n-element vector whose elements are levels of the goods or services consumed per unit of time. The amount of each good that the individual wishes to purchase is referred to as the consumer's preference. Preferences indicate which consumption bundle a consumer will choose relative to other consumption bundles. In the neoclassical model of consumer demand, individuals are hypothesized to maximize utility by choosing from a finite set of consumption bundles subject to exogenously determined prices and a fixed level of expenditure. The economic problem of allocating scarce resources to achieve the highest possible utility is an application of the mathematical optimization problem, which is defined as the choice of certain variables to maximize a function subject to constraints (Intriligator, 1971); thus,

$$maximize u(\mathbf{q}) \tag{3.3}$$

subject to
$$p_1q_1 + p_2q_2 + ... + p_nq_n \le y$$
 (3.4)

where **q** is an n-vector of commodities, p_i is the commodity price for q_i and y is income. This maximization results into the Marshallian demands specified in (3.1) above. For our case, the

consumer is the importing country (United States) who is faced with the choice of what level of each good to import. The initial problem facing the importer is the choice between all other goods and minor meats, and at the second stage, the choice is the level of each minor meat to import.

Aggregation and separability

Since consumers generally buy a vast number of different commodities, empirical analysis is usually carried out at some level of aggregation across commodities (Lewbel, 1996). The idea of aggregation arose from the Composite Commodity Theorem of Hicks (1936) and Leontief (1936), where the constancy of relative prices was used to define commodity groups (aggregates). This theorem has, however, been questioned, since prices of commodities do not vary uniformly all the time. As an alternative, the idea of whether or not preferences themselves could provide a natural structuring of commodities was adopted. This is based on separability of preferences and two-stage budgeting. A group of goods is said to be weakly separable if the goods can be partitioned into subsets in such a way that every marginal rate of substitution involving two goods from the same subset depends only on the goods in that subset and are independent of the goods outside that group (Pollak and Wales 1992). This can be represented formally as;

$$\partial (U_i / U_j) / \partial q_k = 0, \quad \text{for all } i, j \in N_{r_i} \text{ and } k \notin N_{r_i}$$

$$(3.5)$$

where
$$U_i = \partial U / \partial q_i$$
, and $U_j = \partial U / \partial q_j$ (3.6)

Under the assumption of weak separability, the utility function assumes a non-additive form (Goldman and Uzawa, 1964).

$$U = u(\mathbf{q}) = F[u^{1}(q^{1}), u^{2}(q^{2}), ..., u^{s}(q^{s})],$$
(3.7)

where F[.] is some increasing scalar function of s variables and each u^i (i=1,...,s) is a scalar subutility function of the quantities contained in the *i*th commodity group only. Weak separability is a necessary and sufficient condition for the second stage of the two-stage budgeting procedure (Deaton and Muellbauer, 1980b).

The concept of weak separability allows for a convenient disaggregation in empirical demand analysis. Hence, weak separability of the consumer's preferences is assumed here between minor meats and all other goods. Separability means commodities can be partitioned into groups so that preferences within a certain group can be described independently of the quantities in other groups. This implies that we can have subutility functions for each group and that the values of each of these subutilities combine to give total utility. Each of the subutilities could have one or more deeper subgroupings. Everything combined would yield a utility tree, where the individual commodities are the outermost twigs which join to form branches that in turn join to form the tree (Deaton and Muellbauer, 1980).

At the top level, commodities are partitioned into broad groups, such as shelter, clothing, food, and medical expenses. These broad groups can then be partitioned into various sub-groups. For instance, the food group can be partitioned into cereals, dairy, meats, and produce. Commodities in the meat group can be more narrowly divided into main meats and minor meats. The minor meats can in turn be partitioned into goat meat, sheep and lamb, and other lesser meats. The major meats can be partitioned into beef, pork, poultry and fish. This process continues until the lowest level is reached, where by the groups are defined as individual commodities.

The demand equations for the individual commodities comprising the lowest level of the utility tree can be derived using relatively few and reasonable assumptions. However, the

demand equations for the aggregated commodities located at higher levels of the utility tree can only be estimated when much stricter restrictions are placed either on relative prices or the structure of the consumer's utility function and the nature of consumer preferences (Enoo, 1998). Figure 3.1 below illustrates various levels of commodity aggregation.



Fig. 3-1. Various levels of commodity aggregation in demand estimation

The implication of weak separability on observed consumer behavior results in conditional demand functions. These are obtained by assuming that the goods in one branch, r, are available on the market, while all other goods are pre-allocated. The conditional demand functions are determined by

maximize
$$U = F[u^{1}(\mathbf{q}^{1}), u^{2}(\mathbf{q}^{2}), ..., u^{s}(\mathbf{q}^{s})],$$

subject to $\sum p_{i}^{r} q_{i}^{r} = y^{r}$, and $q_{k}^{s} = q_{k}^{s^{*}}$ i=1, ..., N_{r} , and $k \in N_{s}$ (3.8)

where y^r is the budget allotment to branch r, and $q_k^{s^*}$ is the pre-allocated amount of goods in group s. Absorbing the last constraint into the utility function results in

$$\mathbf{U} = \mathbf{F}[\mathbf{u}^{1}(\mathbf{q}^{1^{*}}), \mathbf{u}^{r}(\mathbf{q}^{r}), ..., \mathbf{u}^{s}(\mathbf{q}^{s^{*}})],$$
(3.9)

This reduces utility maximization to the constrained maximization of the branch utility function, $u^r(q^r)$, so that utility maximizing values of branch commodities, $(q_1^r, ..., q_n^r)$, are independent of the levels of the pre-allocated goods. The conditional demand functions for the goods in branch *r* are of the form

$$g_{i}^{r}(\mathbf{p}^{r}, y^{r}, \mathbf{q}^{*}) = g_{i}^{r}(\mathbf{p}^{r}, y^{r}),$$
 (3.10)

while the ordinary demand functions for those commodities belonging to branch r are expressed as:

$$g_i^r = g_i(\mathbf{p}, y) = g_i^r(\mathbf{p}^r, y^r),$$
 (3.11)

where **p** is the vector of all prices ($p_1^1, ..., p_{n_1}^1, ..., p_1^r, ..., p_{n_r}^r, ..., p_1^s, ..., p_{n_s}^s$). This means that total expenditure and the prices of goods outside the branch enter the demand functions for goods in the branch only through their effects on y^r, the budget allotment on the branch.

A two-stage budgeting procedure assumes that consumers allocate their total expenditures in two stages (Deaton and Muellbauer, 1980b). In the first stage, total expenditure is allocated over broad groups of goods, while in the second stage group expenditures are allocated over individual commodities. It is well known that weak separability of the direct utility function over broad groups of goods is a necessary and sufficient condition for the second stage of a two-stage budgeting procedure. However, weak separability imposes restrictions on consumer behavior (Alston, 1990). For our case, we assume total expenditure was first allocated to total imports for the minor meat group (i.e., goat meat, sheep and lamb, other meats), and then to each individual commodity within this minor meat group. This is consistent with the assumption of weak separability.

When investigating import demand for minor meats, one needs to justify whether minor and major meats (beef, pork and chicken) are separable i.e., justify under what conditions meaningful economic aggregates exist. There are two fundamentally different approaches to validate aggregation; - different forms of separability and relationships between prices (Deaton and Muellbauer, 1980a). Creating groups of goods that are investigated in isolation from the rest of the consumer's bundle is normally justified with a weak separability assumption. Weak separability gives conditions for the structure of consumers' preferences so that it is valid to investigate the demand for a limited number of goods. However, whether a weak separability assumption is valid depends on the relationship between the goods in question and all other goods in the consumer's bundle. To test for weak separability, one needs data on all goods, and the test involves estimation of a much larger demand system. These tests are in general difficult to conduct and have low power (Lewbel, 1996). This leads most researchers to assume weak separability without any testing. However, this also makes the results they obtain questionable, since one can raise doubts with respect to the validity of the separability assumption (Asche et al., 2005).

Aggregation based on relationships between prices is formulated in the Composite Commodity Theorem, CCT (Hicks, 1936 and Leontief, 1936). The CCT basically states that if a group of prices move in parallel, then the corresponding group of commodities can be treated as a single commodity with a single price (Deaton and Muellbauer, 1980). However, the CCT requires that the prices move absolutely synchronously and so have a correlation of one, something that does not hold empirically (Lewbel, 1996). The GCCT of Lewbel is hence a

generalization that gives an empirically operational version of the CCT; it relaxes the Hicks-Leontief theorem by allowing the price ratio to vary across observations. Lewbel (1996) also shows that an AIDS model aggregates consistently within each group. A further advantage of the GCCT is that we only need the import data to test whether the theorem holds or not. The GCCT can be represented as described below. Define ρ_i as the relative price which is obtained as the difference between the log of the individual price of good i, r_i and the log of the group price index, R_i ;

$$\rho_i = r_i - R_I \tag{3.5}$$

where $r_i = \ln p_i$ and $R_I = \ln P_I$, p_i is the individual price of good *i* and R_I is the group price index for all the goods in group I. If the distribution of the relative price ρ_i is independent of R_I , the GCCT will hold. Lewbel shows that for nonstationarity of prices, this is equivalent to finding that μ_i in the relationship

$$\rho_i - R_I = \mu_t \tag{3.6}$$

is nonstationary, or that the relative price ρ_i is not cointegrated with R_I . ρ_i and R_I are independent random variables if,

correlation (
$$\rho_{i\in I}, R_I$$
) = 0.

The converse of this statement is however, not generally true. This means

correlation ($\rho_{i \in I}, R_I$) = 0 does not imply that ρ_i and R_I are independent random variables.

Model specification

This section provides a detailed description of the functional form of the model and some examples where the model has been used for demand estimation. The import demand for minor meats, here in defined as goat meat, sheep and lamb, and other meats will be estimated within a system of demand equations. The demand for each good in the system is specified as a function of its own price, the prices of the other goods in the system, and total expenditures on the group of goods. The model assumes that meat products are weakly separable from other food and nonfood consumption items. The functional form used to estimate this system of demand equations is the Almost Ideal Demand System (AIDS) of Deaton and Muellbauer (1980a, b). Deaton and Muellbauer (1980a, b) have shown that the Almost Ideal Demand System (AIDS) generates a system of demand equations that is consistent with neoclassical consumer theory of a cost minimizing consumer. This is because the model is derived from the consumer's expenditure function defined as the minimum cost necessary to attain a specific utility level at a given set of prices. Demand functions are then obtained in budget share form by a natural logarithmic differentiation of the expenditure function with respect to prices. The resulting AIDS demand function is however nonlinear in its parameters. The AIDS specification is also famous in demand estimations because it is a flexible functional form, which provides an approximation to the true (and unknown) underlying indirect utility function (Deaton and Muellbauer, 1980a). This model is also versatile, in that it can be estimated in a linear form and allows incorporation of demographic factors.

The AIDS model has its roots in duality theory and multistage budgeting, and it is most useful for providing insight into the process consumers use to allocate expenditures first among food groups and then among products within food groups. This model has been used extensively (Anderson and Blundell, 1982; Blanciforti and Green, 1983a, b; Blanciforti et al., 1986; Chalfant, 1987; Eales and Unnevehr, 1993; Fujii et al., 1985; Moschini and Meilke, 1989; Seale et al., 1992), which makes it very popular in demand system estimation.

In the context of a trade allocation model, the two-stage budgeting procedure can be explained as follows. In the first stage an importer's total imports of all goods and services can be expressed as

$$M = M(X, P, P_0, Z_1), (4.1)$$

where *M* is total imports of all goods and services, *X* is the importer's national income; *P* is an index of the import price of all goods, P_o is a vector of the prices of all other goods, and Z_1 is a vector of other explanatory variables. In the second stage, total imports of all goods and services are divided up into distinct commodity groups

$$M_i = M_i (M, P_1, ..., P_n, Z_2), \quad i = 1, ..., n,$$
 (4.2)

where M_i represents the imports of good *i* (*i* = 1, ..., n), P_j represents the import price of good j, and Z_2 is a vector of other exogenous variables.

The AIDS model expresses the dependent variable as a budget share, and this has several advantages. First, budget shares are dimensionless, so they are useful for comparison across import goods and time. As the sum of the budget shares is one, consumer budget allocations among goods are easily compared, and shares for different types of imported goods can also be compared in the same time period (Kim, 2003). In an AIDS specification of import demand, the budget share of imports for commodity *i* is given by

$$w_i = \alpha_i + \sum_{j=1}^n \gamma_{ij} \operatorname{Inp}_j + \beta_i \operatorname{In}(x/P) + \varepsilon_i, \qquad i = 1, \dots, n,$$
(4.3)

where w_i is average expenditure share, and the j^{th} commodity share is $w_j = (p_j q_j)/x$; q_j is the quantity demanded of the j^{th} commodity, and $\alpha_i, \beta_i, \gamma_{ij}$ are parameters of the system;

$$x = \sum_{i=1}^{n} p_i q_i$$

is total expenditure on all imports included in the system; p_i denotes prices of the jth good within the group; p_i and q_i represent the price and quantity, respectively, of the *i*th good; and *P* is a translog price index defined as

$$InP = \alpha_0 + \sum_k \alpha_k Inp_k + \frac{1}{2} \sum_j \sum_k \gamma_{ij} Inp_k Inp_j$$
(4.4)

The AIDS is linear except for the translog price index InP, which is nonlinear in its parameters, and this creates difficulties for empirical estimation. If *P* is known, then equation (4.3) is linear in parameters and can be estimated by ordinary least squares (OLS). Following Deaton and Muellbauer (1980), a linear approximation of the AIDS model is often used, which substitutes the Stone index for log *P* in equation (4.4) above. Stones's index is

$$Inp^* = \sum w_k Inp_k \tag{4.5}$$

where $P \approx \phi p^*$, as an approximation for P, so that OLS estimation can be applied; w_k is the expenditure share of source k in total imports. The resultant model, referred to as the linear approximate AIDS (LA/AIDS), becomes

$$w_i = \alpha_i^* + \sum \gamma_{ij} Inp_j + \beta_i In(x/p^*), \qquad (4.6)$$

where $\alpha_i^* = \alpha_i - \beta_i \ln \phi$. Deaton and Muellbauer (1980) argue that if prices are highly collinear, Stone's index should be a good approximation of the translog index. In the extreme case, when *P* is exactly (linearly) proportional to *p**, the LA/AIDS model can be used to estimate the parameters of the AIDS model because, then, the LA/AIDS can be written in terms of the AIDS model parameters as

$$w_i = (\alpha_i - \beta_i In\phi) + \sum_j \gamma_{ij} Inp_j + \beta_i In(x/p^*)$$
(4.7)

More generally, however, the relationship between the parameters of the AIDS and the corresponding parameters of the LA/AIDS is not known (Green and Alston, 1990). The use of Stone's price index however, has been questioned by several authors (Chalfant, 1987; Green and Alston, 1990; Pashardes et al., 1995). There are several explanations for this, including simultaneity bias (measurement errors), omitted variables, and that Stone's index is not invariant to the arbitrary choice of units of measurement for prices and quantities. Such changes may result in different values of the parameter estimates. To avoid these problems, Moschini (1995), suggested three alternative Stone indices that correspond to loglinear versions of the classical Laspeyres, Paasche and Tornquist indices. In our model, the Laspeyres index, which, unlike the Stone index, is invariant with the units of measurement will be used. This index is defined as

$$InP_{t}^{L} = \sum_{i=1}^{n} w_{i}^{0} In(p_{it}), \qquad (4.8)$$

where w_i^0 is the expenditure share of good *i* in the base period, t-1, and p_{it} is the price of good *i* in the period t. According to Buse and Chan (2000), all other indices substituted for the true index in the AIDS model produce biased and inconsistent estimators. They found the Laspeyres index to outperform other indices in bias alone, and the best performing index in Monte Carlo experiments. This index has the additional advantage that it cannot be endogenous, due to variation in the expenditure shares within the index (Chern, 1999).

Demographic and non-economic factors have been known to influence consumer behavior; hence, it is natural to extend the AIDS model to incorporate these factors (Jones et al., 2003). To include the effects of demographic and non-economic variables, price coefficients of the expenditure function are assumed to depend on demographic variables. The intercept term, α_i , in equation (4.3) is assumed to be a linear function of the demographic attributes. We will use the US monthly disposable personal income (DPI) and the US Hispanic population. Hispanic population was chosen because they are the fastest growing among the three largest goat meat consuming populations in the U.S., and they are the only group that offers true year-round market for goat meat. These variables are hypothesized to be relevant for meat import data, and they can be incorporated into the LA/AIDS model by specifying:

$$\alpha_i = \alpha_i^* + \sum_{j=1}^n \delta_{ij} D_j, \qquad (4.9)$$

where D_j are demographic attributes, α_i^* is the intercept net of demographic effects, and δ_{ij} are the parameters associated with D_j . Incorporating all the factors related to our data, equation (4.9) can be written as

$$\alpha_i = \alpha_i^* + \delta_{i1} DPI + \delta_{i2} Hisp \tag{4.10}$$

where *DPI* is income (measured by the importing country's disposable personal income), *Hisp* is the importing country's ethnic population (we have chosen to use ethnic population instead of total U.S. population because ethnic communities are thought to be the main consumers of goat meat and lamb and mutton).

Incorporating equation (4.10) into the original AIDS will result in an estimation problem due to a large number of demographic factors. This problem can be avoided by using the LA/AIDS model. Incorporating equation (4.10) into the LA/AIDS model, equation (4.6) becomes

$$w_{it} = \alpha_i^* + \delta_{i1} DPI + \delta_{i2} Hisp + \sum_{j=1}^n \gamma_{ij} Inp_{jt} + \beta_i In(x/P^*) + e_{it}$$
(4.11)

where P^* is the Laspeyres price index; x is total expenditure; α_i^* represents the budget share when all logarithmic prices, expenditure, and non-economic factors are zero; γ_i , δ_i , and β_i are model parameters to be estimated, and e_{ii} is an error term.

The resulting model is estimated using Zellner's Iterative Seemingly Unrelated Regression (ITSUR) procedure (Zellner, 1962). The linear approximation of the AIDS model was selected to estimate price and expenditure elasticities since budget (expenditure) data are available. Due to the linear approximation of the original AIDS model, empirical applications are not really difficult to carry out and results obtained are comprehensible enough to be interpreted with ease. Since budget shares sum to one in the AIDS model, the contemporaneous covariance matrix of disturbance terms is singular. Hence, to prevent the variance-covariance matrix of the residual terms from being singular, one share equation must be omitted during estimation of the LA/AIDS model. To be consistent with consumer theory, the model is estimated with homogeneity and symmetry imposed. Homogeneity implies that consumers react to real, not nominal, prices. Symmetry implies that the effect of a change in the price of good *j* on the demand for good *i*. In order to ensure that the AIDS model is compatible with demand theory, the parameters of the demand equations must satisfy the following set of restrictions;

$$\sum \alpha_i = 1, \quad \sum_i \gamma_{ij} = 0, \quad \sum \beta_i = 0,$$
 (4.12)

$$\sum_{i} \gamma_{ij} = 0, \forall i \tag{4.13}$$

$$\gamma_{ij} = \gamma_{ji}, \forall i, j \tag{4.14}$$

These restrictions are known as the adding-up, homogeneity, and Slutsky symmetry conditions, respectively. These theoretical restrictions are derived from utility theory and directly imposed

on the equation in (4.3). The adding-up condition is met by the construction of the data, while the homogeneity and symmetry restriction must be imposed on the estimated parameters (Asche, 1996). Given the above specifications, Marshallian (uncompensated) and Hicksian (compensated) demand elasticities were computed from the estimated parameters of the LA/AIDS model, according to Asche and Wessels (1997), as specified below

$$\varepsilon_{ii} = \delta_{ii} / w_i - (1 + \beta_{ij})$$
 Marshallian own-price elasticity (4.15)

$$\varepsilon_{ij} = \delta_{ij} / w_i - \beta_i w_j / w_j$$
 Cross-price elasticity (4.16)

$$\varepsilon_{ij}^{*} = \varepsilon_{ij} + w_j \eta_i$$
 compensated (Hicksian) elasticities (4.17)

$$\varepsilon_i = \delta_{i2} / w_i$$
 demographic elasticity (4.18)

$$\eta_i = \beta_i / w_i + 1$$
 expenditure elasticities (4.19)

As a general rule, own-price elasticities are expected to be negative and expenditure elasticity to be positive. No *a priori* assumptions are made for the cross-price elasticities. Hispanics are the majority and fastest growing group of the ethnic populations. The increase in their numbers in the US in recent years is thought to be influencing the consumption of these minor meats, mostly used in specialty dishes. The demographic elasticity is therefore expected to be positive.

Before estimating import demand using the LA/AIDS model, separability between imports and local production for minor meats was first investigated. The competition between imports and local production has been known to be a frequently encountered problem in past demand studies, and in all these cases, the Armington model was used to handle the problem. The Armington model, however, relies on a set of weak separability assumptions which several authors, including Winters (1984) and Alston et al. (1990) have shown to be questionable (Asche et al., 2005. In this study, we used the Generalized Composite Commodity Theorem (GCCT) to test for separability. Weak separability of preferences and two-stage budgeting were assumed for the group of minor meat imports. According to Winters (1984) and Alston et al. (1990), the separability assumptions, that all goods from all sources are separable from each other as well as all other goods, are not in general necessary between imports from different countries. This is because flexible functional forms like that of Deaton and Muellbauer (1980), allow import demand equations where the imported goods are not separable.

The generalized composite commodity theorem proposed by Lewbel (1996), relaxes the Hicks-Leontief theorem (which requires that prices of all items in the group move absolutely synchronously, conditions which are never satisfied in real world data) by allowing ρ to vary over time, and instead assumes only that the distribution of ρ is independent of **R** and of income (Lewbel, 1996). Following Lewbel (1996), define ρ as a vector of ρ_i **r** as a vector of r_i , and **R** as a vector of R_i and

 p_i = price for commodity i i = 1,...,3

 P_I = price index of group I

 $z = \log$ of total import expenditures

$$r_i = In(p_i), \ R_I = In(P_I), \ \rho_i = In(p_i/P_I) = r_i - R_I,$$
 (4.20)

Weak separability can be tested by first testing the time series properties of each ρ_i and R_i to determine whether they are stationary or not. This is done using the augmented Dickey-Fuller test. If both are stationary, then, Spearman's rank correlation test is used to determine whether the relative price and group index are independent or not. If both are nonstationary, then the test for independence is done using Johansen's cointegration test. If one is stationary and the other nonstationary, then they can not be integrated and the GCCT holds. The outcome of

independence in either of the above tests will mean the GCCT holds and thus that imports are separable from local production.

Data and estimation procedure

Data on goat meat, sheep and lamb, and "other meat" monthly imports to the United States were obtained from the USDA Foreign Agricultural Service, Foreign Trade Statistics (<u>www.fas.usda.gov/ustrdscripts/USReport.exe</u>). The FAS reported both the monthly imported value in US \$ and the total imported volume in metric tons for the period 1989:1 through 2004:12. Real values in 1982-84 dollars were obtained using the monthly consumer price index from the Bureau of Labor Statistics (<u>www.bls.gov/cpi/home.htm</u>). The seasonally unadjusted U.S. average consumer price indexes for all urban consumers with 1982-84 base were utilized. Thus, the import prices were calculated by dividing the value of imports by the imported quantities. Data on monthly Hispanic population were obtained from the U.S. Census Bureau (<u>www.census.gov</u>).

There are some specification problems that need to be mentioned. First, the fact that we are using import data has implications for the interpretation of the results. The LA/AIDS model is a consumer demand model; hence, using import data implies that we are actually estimating a derived demand system. A major problem with using import data is that consumers preferences are not necessarily reflected by the importers' preferences. However, since the AIDS model is also used in estimating international trade models, then it is possible to interpret the results in our case as import demand, according to Asche et al. (2005).

To test for the GCCT, the time series properties of the individual prices p_i , relative price ρ_i , group price index R_i , shares w_i and the real expenditure variable x, were investigated

using the Augmented Dickey-Fuller test (Dickey and Fuller, 1979). Based on the outcome of these tests, choose an appropriate test for independence between the relative prices ρ_i and the group price index R_I (Davis, et al., 2000).

The above literature is an overview of the LA/AIDS model, its functional form and how estimation is to be done. It also provides a mention of the type and source of data that will be used in this estimation. The next section embarks on a discussion of the results obtained from estimation of the LA/AIDS import demand model.

CHAPTER 4

RESULTS AND DISCUSSION

This chapter begins by presenting descriptive statistics of dependent and explanatory variables that are included in the LA/AIDS imported meats demand model. This is followed by a presentation of the time series results for stationarity of the individual import prices, relative prices, budget shares and real import expenditures. Next, the results for cointegration (independence) between the relative prices and the group price index are presented and discussed.

Parameter estimates of the LA/AIDS model of import demand for the three minor meat groups (goat meat, sheep and lamb, and other meat) are next presented and a commentary on expected signs and interpretation of the model coefficients is provided. Price and income elasticities of import demand are also calculated to assist in the understanding of how sensitive demand for imports is with respect to changes in import price and income. An interpretation of these elasticities is also given.

Sample descriptive statistics

Import demand for goat meat, sheep and lamb, and other lesser meats was estimated using monthly data from 1989:1 to 2004:12. Figures A.1-A.3 show plots of import values, prices and import shares for goat meat, sheep and lamb and other meats. From these plots, the import value for all the three minor meats show a general increase over the period 1989 to 2004. Import prices plots show that other lesser meat group has the highest price, although this has been

declining since 1996. Import prices for goat meat and sheep and lamb show a slight increase over the study period.

Descriptive statistics (means, standard deviations, minimum and maximum values) of the import budget shares and unit prices for the minor meats (goat meat, sheep and lamb, and other meat) are presented in Table 4.1. These show that other meat constitutes almost 50% of minor meat imports, while sheep and lamb have almost the same import share (27 %) as goat meat (26%). Unit prices show that the U.S. pays more per pound for other meat than for goat meat, and sheep and lamb, but it pays more for goat meat than sheep and lamb. The latter outcome is not at all surprising, since the sheep industry has been struggling because prices in this industry have been unable to support its recovery from the ongoing decline since the end of World War II (Jones, 2004). This finding also seems to be in agreement with other literature (Solaiman, 2005; Glimp, 1995), that goat meat is on average more expensive than lamb and mutton. Glimp (1995) indicated that goat meat prices are generally higher on a per unit of weight basis compared to other red meat. The unit prices shown in Table 4.1 are in dollars per metric ton, and these translate to 0.64, 0.49 and 2.61 dollars per pound for imported goat meat, sheep and lamb, and other meat, respectively.

Table 4.2 presents results of the Augmented Dickey-Fuller test (Dickey and Fuller, 1979), used to test for stationarity of the import time series. The null hypothesis of nonstationarity (unit root) was not rejected for all the 6 variables at a 5 % level of significance (p-value). After differencing each of the variables, the null hypothesis was rejected at the 5 % level of significance. This indicates that these series are AR (1). That is, they are autoregressive series of order one, where nonstationarity of the series is removed by differencing to make them stationary. The group price index for imported minor meat group was created using the

Tornquist-index, and this was found to be stationary. The relative import prices for each of the three commodities were also found to be stationary. To test for cointegration (independence) between each of the relative prices and the group index, Spearman's rank correlation test according to Davis et al. (2000), was used. The results presented in Table 4.3 indicate that each of the import relative prices is independent of the import group price index; thus, the generalized composite commodity theorem (GCCT) proposed by Lewbel (1996), holds in this case. The implication from this finding is that imports are separable from local production, and thus it is valid to estimate import demand without considering local production.

Import demand estimation

Tables 4.4, 4.5 and 4.6 present the estimated parameters for the LA/AIDS specification of the imported meat demand using Zellner's iterative seemingly unrelated regression (ITSUR) for goat meat, sheep and lamb, and other lesser meats, respectively. In this estimation, one equation was dropped from the system to avoid the singularity condition in the variance-covariance matrix (Barten, 1969). The parameter estimates of the dropped equation were recaptured from the estimated models using the homogeneity and symmetry conditions.

The parameter estimate for the Hispanic population in the U.S. is significant in the sheep and lamb and the goat meat share equations at a 10% level. The Hispanic population parameter estimate has a negative sign in the goat meat and other lesser meat share equations but it has a positive sign in the sheep and lamb equation, although the magnitude is close to zero. This means that Hispanic population has a small positive influence on the sheep and lamb import share. Since a greater portion of imports come in the frozen form, the negative coefficient could mean that Hispanics are not major consumers of goat meat and other lesser frozen meats. This might

also be due to the fact that official Hispanic population statistics are well below the true figures, because of unreported illegal immigrants. In addition, Asians, other peoples of African descent and African Americans are also major consumers of exotic meats such as goat meat and lamb and mutton. This means that the demographic effect on these meats was likely underestimated by including only Hispanic population shift effect. However, it is important to note that, the dependent variable is budget share, thus the negative population effect might not necessarily mean that Hispanic population has a negative effect on import quantity demanded for the minor meat groups.

The coefficient pertaining to the minor meat import expenditures is highly significant in the sheep and lamb equation, but it is not significant in the goat meat equation. Although this coefficient is negative in the other meat equation, it does not necessarily mean that the other meat group is an inferior import product because the dependent variable is the budget share rather than quantity. As reported shortly, the import expenditure elasticity for the other meat group is indeed positive, suggesting that other meat is a normal import good.

Disposable personal income is highly significant in the goat meat and the sheep and lamb equations. The parameter estimate for disposable personal income has a negative sign in the sheep and lamb demand, although elasticity is positive (Table 4.7). The negative sign could be because a majority of the American population does not consume sheep and lamb, although the dependent variable is budget share and not quantity, so the negative sign might not be of any significance. In addition, there is the likelihood that the Hispanic and other ethnic populations do not report their correct incomes, thus underestimating the effect of DPI on import demand.

Price effects

Tables 4.7 and 4.8 present the uncompensated own-price, cross-price and income elasticity estimates for the three minor meat groups. All the own-price elasticities of import demand for the three minor meat categories were negative. The negative signs are consistent with economic theory for demand; that is, when the prices of commodities increase, the quantities demanded generally decrease. Own price is expected to yield a negative effect on import demand.

The analysis suggests compensated own-price elasticities of -0.14 for goat meat, -0.21 for sheep and lamb, and -0.63 for other meat. The magnitudes of these estimates suggest all the three minor meat types to be import price inelastic, with goat meat as the most inelastic, followed by sheep and lamb and then other meat. This means quantities imported will not vary much with changes in import prices, when compared to a more price elastic demand. This indicates that recent increases in goat meat imports can not be due to a decrease in import prices, but it could be due to an increase in per capita income or substitution by other meat products. This seems to be in agreement with the observation about local demand. Lillywhite (1999) observed that demand for goat meat and sheep and lamb is relatively inelastic. This inelastic local demand may be attributed to the desire of ethnic populations to maintain their ethnic identity and thus may not easily substitute goat meat with other red meat sources. Sheep and lamb have been known to be easily substituted with other protein meat sources i.e., beef, pork, fish and chicken in the past (Steller, 2003). The inelastic import demand in this study may be due to the ethnic populations' effect since imports are generally for meeting the excess demand. In addition the majority of these ethnic populations are known to be willing to pay almost any price to obtain these specialty meats, which can result in an inelastic demand (Lillywhite, 1999). The magnitudes of the own-

price elasticities indicate that a one percent increase in import own-price of goat meat, sheep and lamb, and other meat decreases the import demand for goat meat, sheep and lamb, and other lesser meats by 0.14 %, 0.21 % and 0.63 %, respectively.

Estimated cross-price elasticities indicate that imported goat meat and sheep and lamb are net complements, which is consistent with the suggestion by Nelson and Liu (2005) but contrary to the earlier held belief that they are substitutes among the ethnic communities (Lillywhite, 1999). Other meat is, however, shown as a net substitute to both goat meat and sheep and lamb. The substitution effect is slightly larger for sheep and lamb than for goat meat. This is a further indication of the inelasticity of goat meat import demand compared to lamb and mutton. Note however that uncompensated price elasticities indicate both goat meat and sheep and lamb are complements to other meats.

Expenditure elasticities

The minor meat total import expenditure estimate (lxp) is significantly related to sheep and lamb, and other meat demand expenditure, but not significant to goat meat expenditure. This means that import demand for goat meat does not vary significantly with total expenditures on the minor meats group, a further indication that import demand for goat meat is inelastic. Total minor meats import expenditure has a positive effect on goat meat and sheep and lamb import demand and a negative effect on other meat import demand.

All the import expenditure elasticities have positive signs as expected (Table 4.5), with goat meat and sheep and lamb having expenditure elasticities greater than one. Estimated import expenditure elasticities are 1.12 for goat meat, 1.81 for sheep and lamb, and 0.47 for other lesser meats. The results suggest that goat meat and sheep and lamb are luxury imports, since their

import expenditure elasticity is greater than one and that other lesser meat is a normal import product. This outcome seems to be consistent with the price effect finding of substitutability between other meat and goat meat and also with sheep and lamb. Given a fixed level of expenditure for the minor meat groups, if import prices increase, importers will be expected to substitute a normal good for a luxury one. Sheep and lamb import demand is more expenditure elastic than goat meat demand. This is an indication that minor meat importers will adjust imports of lamb and mutton more easily as expenditures on minor meats imports change than their imports of goat meat.

Sheep and lamb import expenditure elasticity appears to be consistent with the finding that its consumers prefer high value cuts (Menkhaus and Whipple, 1998), and that it is mostly purchased by consumers with high incomes (Jones, 2004). At the same time, it is also consistent with the held belief that its consumers readily substitute lamb and mutton with other protein sources e.g., beef, pork and chicken when expenditure declines (Steller, 2003). A one percent increase in disposable personal income will increase goat meat, sheep and lamb, and other meat import demand by 1.12%, 1.81% and 0.47 %, respectively.

The above section has given a detailed discussion of the results obtained from this study. This leads to the next chapter which gives a summary and conclusion of the whole study.

CHAPTER 5

SUMMARY AND CONCLUSIONS

This chapter presents a concise summary and description of the research conducted in this thesis. Conclusions are drawn based on the results obtained from estimating an LA/AIDS model using import data for three minor meat categories, and implications for the goat industry and prospective producers are discussed. Limitations of the study are also addressed, and, recommendations for further research are given.

Summary

Over the course of the last decade, meat consumption patterns in the U.S. have been observed to have changed, and these seem to be in line with consumption patterns worldwide. These changes in the U.S. have been away from red meat and towards white meat. These meat consumption changes have been attributed to changes in diversity of the American population, as well as to health and nutritional concerns, which have created a favorable market for goat meat, lamb and mutton and other lesser minor meats. It is important to note that even though there is a shift away from red meats towards white meats in the U.S., goat meat and sheep and lamb are low in fat and cholesterol. The U.S. does not presently produce sufficient goats and sheep to supply its needs, and this has resulted in sharp increases in the amount of imports, especially of goat meat, to meet the excess demand.

The meat goat industry in the U.S. is apparently still in its infancy stage and thus appears unorganized for the most part. Due to limited official local goat data, most of the information in this industry is based on estimation and is largely contradictory in nature. Local meat goat

production, slaughter and meat sales have not received much attention in the U. S., because this has traditionally been a very small industry and market. The major demand for goat meat is limited to the various ethnic groups who eat goat meat, lamb and sheep, and other exotic meat on a regular basis. Ethnic populations that require goat meat for religious and cultural reasons are increasing due to increasing immigration. The U.S. is currently experiencing the largest sustained wave of immigration in its history. With more immigrants coming to the U.S., ethnic populations, and hence the demand for minor meats is increasing.

The U.S. is currently the largest goat meat import market in the world. These imports are projected to continue unless there is an increase in local production. Although goat meat imports by the U.S. are expected to continue to grow in the future, its growth may be constrained both by increased interest in goat meat production by local producers and by the preference of ethnic consumers for fresh goat meat. Our results indicate goat meat import demand to be highly inelastic, and yet import prices have been noted to have risen. The implication from this to producers is that there is excess demand.

Goat meat is one of the most widely consumed meat proteins in the world, but not in the United States. Recent initiatives, such as the Tobacco Buy-Out Program, have caused a shift in agricultural production. Recent influxes of vast numbers of ethnic populations have created demand for ethnic food products, goat meat being among them. Production costs in the U. S. often result in goat meat that is substantially higher in price than imports and this might cause consumers to substitute imports for locally produced meat.

The decline in the U.S. sheep industry is well-documented. Sheep numbers fell from 56 million in 1942 to less than 8 million in 1998. Predator problems, falling consumer demand for mutton and lamb, labor shortages, the elimination of wool incentive payments, along with the

expansion of synthetic fiber use, are some of the suggested reasons for this decline. However, strong domestic demand, arising from increasing ethnic populations, has surpassed the low supplies and thus led to increased imports. Imports amounted to less than 20 % of consumption in 1995, but increased to more than 45 % in 2004, and they are likely to continue increasing. The situation in the demand for sheep and lamb is similar to goat meat demand, and thus the factors mentioned above apply to sheep and lamb as well.

Conclusions and implications

The main purpose of this study was to determine the import demand elasticity for goat meat, sheep and lamb, and other lesser meats imports by the U.S. It is important to note that the ethnic consumers' preference for freshness and the way of slaughter could lead to underestimating local demand when using import demand. First, the results of this research indicate that import demand for the three minor meats is price inelastic. The implication of inelastic import demand in the face of increasing ethnic population is increasing excess demand for these minor meats. While import demand might not fully represent local demand, based on the various reasons explained above, they can be considered a better estimate for local demand than using the few available local statistics, since the literature has indicated that imports make up a greater part of goat meat consumed in the U.S.

The situation in the sheep and lamb industry has been quite unstable due to various reasons outlined within the text. The decline in the industry has led to an increase in imports. Given that import demand for sheep and lamb is inelastic, then it means that the new consumer base, notably due to the increase in ethnic populations, is a good sign as to the potential for revitalization of this industry. Producers within this industry should be able to produce more and

target this increased consumer base who seem to have the same preferences for sheep and lamb as for goat meat. While the results of this research are not wholly conclusive, they showed that the minor meat market in America exists.

Limitations and further research

There are some limitations in this study which are worth noting. First, ethnic populations are known to be the main consumers of goat meat, lamb and mutton and other exotic meats in the U.S. (Jones, 2004). Of these ethnic populations, Hispanics are the majority and their numbers have been increasing rapidly over the last decade. A major limitation, however, is that the official census statistics do not reflect the actual number of these ethnic populations. This is thought to be due to the fact that a large number or proportion enters the U.S. illegally, and thus their numbers are not recorded. In our study, Hispanic population was only significant in explaining import demand for goat meat at the 10% level of significance and not significant to other exotic meat demand. It was significant in the lamb and mutton demand at the 5 % level of significance. This could be due to this disparity between official and actual numbers. In addition, it could be due to the fact that we only used Hispanic population instead of using all ethnic populations that are known to be consumers of these minor meats.

The majority of the ethnic consumers prefer fresh to frozen meat (SSCF, 2003)¹, yet most imports come in the frozen form. This in itself could limit demand for these imports. In addition, some of these ethnic populations, particularly those who are Muslims and those who are Jewish, are very strict on the way of slaughter; they only eat Halal meat. This will mean that this section of the ethnic population will be reluctant to purchase imported meat, which they are not sure on the method of slaughter. Most mainstream stores are reluctant to carry goat meat and other minor

¹ SSCF is The Southern States Cooperative Foundation.

meats due to unsteady supply. This therefore limits availability of goat meat and other minor meats to oriental stores. These oriental stores take advantage of this situation and set very high prices for these products, which might further limit the demand.

While demand for these meats has mostly an ethnic consumer base, there is also the health conscious sector, and the Yuppie community, which have been noted to be increasing. These were not represented in our study but they could add to the demographic effect on the demand for these minor meats.

Irrespective of all the limitations mentioned above, this study has been one of the first to give a detailed quantitative analysis of goat meat import demand. While the study may not be conclusive due to the many limitations, it has given a more up-to-date quantitative estimation of import demand, especially for goat meat. This may provide a whole new look at the minor meat industry in the U.S. This industry is still largely viewed as an ethnic-oriented industry. This means it is an industry for products with a limited distribution network and associated with a particular group of persons or ethnic community, whose members are its main consumers. It is important to note that ethnic food is a dynamic term, changing over time and going through various stages. Thus, a product viewed as ethnic today may after a period of time be looked upon as common by the entire population and consumed by all. This is already evident in the U.S., because there is the health conscious section of the population and the Yuppie community who are consuming goat meat. This study, therefore, gives a more recent classification of an industry that should not be dismissed due to its ethnic affiliation, but rather, the findings should give both producers and policy makers a reason to invest into the development of the industry.

TABLES

Table 4.1. Descriptive Statistics for the Variables Used in the Goat, Sheep and Lamb and Other

Variable name	Variable description	Units	Mean	Standard deviation	Minimum value	Maximu m value
wg	Goat meat budget share		0.26	0.12	0.03	0.66
WS	Sheep & lamb share		0.20	0.13	0.05	0.64
WO	Other meat share		0.27	0.14	0.19	0.82
pg	Goat meat price	dollars/ MT	1429 47	237.97	868.41	2055.31
ps	Sheep & lamb price	dollars/ MT	1074.75	257.56	528.27	1821.55
ро	Other meat price	dollars/ MT	5771.21	1376.72	1005.34	8619.61
hispop	US Hispanic	numbers	30.42	7.02	21.2	44.20
	Population (millions)					
DPI	Disposable Personal	dollars	6.07	1.43	3.93	9.20
	Income (trillions)					

Meat Import Demand Model
Variable	Test statistic	<i>P</i> -value
name		
pg	-9.00(2)	<.0001
ps	-6.99(6)	<.0001
ро	-8.83(2)	<.0001
wg	-9.86	<.0001
WS	-10.37	<.0001
WO	-10.60	<.0001
Х	-13.40	<.0001

Table 4.2. Dickey Fuller Tests (differenced series)

Table 4.3. Spearman's correlation coefficients for the minor meat group

Relative price	R_{MN} (Group Index)
ρ_{pg} (goat meat)	-0.1745 (0.0157)
ρ_{ps} (sheep & lamb)	-0.0927 (0.2021)
ρ_{po} (other meats)	0.0778 (0.2849)

Independent	Parameter	Standard error	<i>t</i> -value	Pr > t
variable	estimate			
lpg	0.156	0.042	3.70	0.0002
lps	-0.171	0.033	-5.17	< 0.0001
lpo	0.015	0.026	0.57	0.5678
lxp	0.031	0.021	1.50	0.1358
hispop	-0.008	0.005	-1.68	0.0950
DPI	0.095	0.023	4.09	< 0.0001
Intercept	-0.328	0.126	-2.59	0.0105
R^2	0.453			

Table 4.4. ITSUR Parameter Estimates of the LA/AIDS Model for Goat Meat Import Demand,
Homogeneity and Symmetry Restrictions Imposed, 1989-2004.

Independent	Parameter	Standard error	<i>t</i> -value	Pr > t
variable	estimate			
lpg	-0.171	0.033	-5.17	< 0.0001
lps	0.140	0.035	3.98	< 0.0001
lpo	0.031	0.023	1.37	0.1732
lxp	0.217	0.019	11.24	< 0.0001
hispop	0.009	0.005	1.86	0.0651
DPI	-0.124	0.022	-5.65	< 0.0001
Intercept	-0.636	0.121	-5.27	< 0.0001
R^2	0.570			

Table 4.5. ITSUR Parameter Estimates of the LA/AIDS Model for Sheep and Lamb ImportDemand, Homogeneity and Symmetry Restrictions Imposed, 1989-2004.

Table 4.6. ITSUR Parameter Estimates of the LA/AIDS Model for Other Meat Import Demand, Homogeneity and Symmetry Restrictions imposed, 1989-2004.

Independent	Parameter
variable	estimate
lpg	0.015
lps	0.031
lpo	-0.046
lxp	-0.249
hispop	-0.0004
DPI	0.029
Intercept	1.960

	Expenditure	Uncompensated price elasticity		
	elasticity	Goat Meat	Sheep & Lamb	Other Meat
Goat Meat	1.12	-0.44	-0.68	-0.001
Sheep & Lamb	1.81	-0.85	-0.70	-0.26
Other Meat	0.47	0.17	0.21	-0.85

Table 4.7. Estimated Import Demand Expenditure and Uncompensated Price Elasticities, 1989-

2004

Table 4.8. Compensated Import Demand Price Elasticities, 1989-2004

	Compensated elasticity		
-	Goat meat	Sheep and Lamb	Other Meat
Goat Meat	-0.14	-0.38	0.52
Sheep and Lamb	-0.37	-0.21	0.58
Other Meat	0.29	0.34	-0.63

Table 4.9. Test Results for Homogeneity and Symmetry Restrictions

Restriction	Parameter estimate	Standard error	<i>t</i> -value	Pr > t
Symmetry	111.8	21.64	5.17	<0.0001
Homogeneity (goat meat)	-6.6	19.46	-0.34	0.7360
Homogeneity (sheep & lamb)	113.4	24.99	4.54	<0.0001

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APPENDIX



Figure A.1 Values of minor meat imports by the U.S., 1989-2004

Figure A.2 Import price for minor meats to the U.S.



Year



Figure A.3 Import shares for minor meats to the U.S.

Year