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DEMAND ESTIMATION FOR MEAT IN THE PHILIPPINES USING SOURCE-DIFFERENTIATED ALMOST IDEAL DEMAND SYSTEM *

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Abstract

The main objective of this study is to estimate the demand and income elasticities for meat (beef, broiler chicken, and pork) of the Philippines from 1994 to 2009, using the Source-Differentiated Almost Ideal Demand System (SDAIDS). The model is capable of estimating simultaneously demand equations of domestic and of different meat exporting countries. Included in the estimation are price- and income-elasticities. Data were taken from the United Nations Comtrade Trade Statistics website.

Results indicate that domestic production accounted for 94% of the total supply in the country for beef, broiler chicken, and pork, while imported meat accounted for only 6%. The top exporting countries of beef to the Philippines are India, Australia, New Zealand, USA and Brazil. For broiler chicken, they are USA and Australia; and for pork, the countries are China and Brazil. Income elasticities noted that broiler chicken is the most responsive to an increase in consumer's income. The Philippines' broiler chicken has the highest position in the Philippine market relative to the other sources namely USA, Australia, and China. Cross-price elasticities indicate weak substitutability and weak complementary.

Forecasting the possible volume of meat (beef, broiler chicken, and pork) demand in the country could be facilitated by precise estimates of price and income elasticities of demand. Hence, policy makers and development planners can make an assessment on the efficiency of the livestock industries in the Philippines given said estimates. It is recommended that meat consumption per region should be analyzed to have a clearer picture of the national demand for beef, chicken, and pork. In this way, surpluses or shortages could be avoided.

Keywords: *demand elasticity, domestic and import meat demand, income elasticity, SDAIDS model*

Introduction

Meat, from which the majority of animal proteins are drawn, is an integral part of many peoples' diet (Piggon and Marsh, 2004). Livestock and poultry meat products constitute one of the most important agricultural outputs in the world. In 1983, developing countries consumed 36% of all meat consumed worldwide and by 1993 the percentage had risen to 48%. Increases in meat demand have been met largely by substantial growth in livestock production in developing countries. Although per capita meat production in developing countries is still only a little more than one fourth of the developed-countries the developing world supplies almost half the worlds meat on the average. Asia is the fastest growing supplier, accounting for more than 80% of the net increase in meat output of developing countries (News and Views, 1999). The strong growth of demand for meat in Asia as well as in Central America is projected to push meat imports of developing countries to 10 million tones in 2010 (FAO, 2002).

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Data from the Food and Agriculture Organization (FAO) of the United Nations (Table 1) show that China consumes over 20 times its 1961 tonnage compared with 68 million mt in 2002. Next to China, the United States and Brazil registered an annual meat consumption of 36 million mt and 15 million mt respectively. The overall trend is higher consumption of meat and meat products over time.

Table 1. Meat consumption per country (in million metric tons): 1998-2002.

Country \ Year	1988	1999	2000	2001	2002
China	59	60	64	65	68
United States	33	35	35	35	36
Brazil	12	13	14	14	15
Germany	7	7	7	7	7
Russian Federation	7	6	6	7	7
France	6	6	6	6	6
Japan	5	6	6	6	6
Mexico	5	5	6	6	6
India	5	5	5	5	6
Italy	5	5	5	5	5
World	224	228	234	238	247

Source: FAO, 2005

Table 2 shows that Denmark has the highest meat consumption per capita in 2002. The per capita meat consumption of Filipinos in 2002 is only 31 kg. Most of this growth is in developing countries as their populations and incomes increase (FAO, Rome, 2005). The world's per capita meat consumption during the period 1998 to 2002 has increased only by 2 kg. or by 5.26%, while total world meat consumption over the same period increased from 224 million metric tons in 1998 to 247 million metric tons in 2002. Thus, most of the increase in total meat consumption in the world may be traced to increase in population.

FAO defines meat consumption as "the total meat retained for use in country for each country per year". Total meat includes meat from animals slaughtered in countries, irrespective of their origin, and comprises horsemeat, poultry, and meat from all other domestic or wild animals such as camels, rabbits, reindeer, and game animals.

Table 2. Meat consumption per capita (in kg): 1998- 2002.

Country \ Year	1998	1999	2000	2001	2002

New Zealand	140	138	122	147	142
Luxembourg	NA	NA	147	134	142
Bahamas	123	141	152	135	124
Denmark	126	130	130	139	146
Cyprus	126	132	134	132	131
United States	120	124	122	120	125
Spain	115	114	112	115	119
French Polynesia	105	103	107	109	112
Canada	103	107	107	108	108
France	102	100	100	103	101
China	NA	NA	49.9	NA	52.4
Philippines	NA	NA	27	NA	31
World	38	38	39	39	40

Source: FAO, 2005
NA – no data available

In Southeast Asia, the Philippines leads in per capita consumption of pork while Malaysia leads in per capita consumption of chicken (Rosegrant et al., 1999). As a whole, meat consumption in Southeast Asia is projected to more than double from 7 million metric tons in 1993 to 15 million metric tons by 2020. For Philippines, it is expected to quadruple from 1 million metric tons in 1993, to 4 million metric tons by 2020. As a consequence of this trend in meat consumption, demand for feed grains is projected to double from 15 million metric tons in 1993 to 30 million metric tons by 2020 (Delgado et al., 2000).

Demand for livestock and poultry meat products is influenced by food safety. Johnson (2009) reports a decrease in the international demand for pork and a subsequent drop in the prices of pork and pork products due to the H1N1 influenza virus or swine flu. Exporting countries were also affected by trade restrictions by the different pork importing countries including the United States. There were also pork importing countries that did impose trade restrictions because of sporadic animal-borne disease outbreak. These countries include Bolivia, Costa Rica, Guatemala, and the Philippines. Similarly, the outbreak of highly contagious H5N1 avian influenza in East and Southeast Asia in 2003 had a world wide impact on poultry production, consumption, domestic prices, export prices, and trade patterns in both the infected and the uninfected countries around the world. Major exporters were affected since the demand of meat products at the international market dropped substantially (Taha, 2003). Some analysts have estimated that the 2009 H1N1 outbreak lesser impact on the pork industry than Bovine Spongiform Encephalopathy had on the beef industry in 2003 and avian influenza on the poultry industry for 2005-2006 (Market Research.Com).

The Philippines is one of the world's important markets for beef, broiler chicken, and pork. Over the past two decades demand for meat has considerably increased due to an increase in population and income. Meat imports of the country in reached about 210,273 mt in 2009 (UN Comtrade, 2009) through shipments of frozen meat products, while 2.729 million metric tons from domestic sources played a significant role and have a very strong competitive position in the market (BAS, 2010). It is reported that the Philippines historically depends mainly on the domestic producers of meat with a comparative advantage in sustaining the country's demand for meat.

Table 3 shows the total consumption of beef in the Philippines by country of origin. It shows that the domestic production has dominating from 1994-2009 with an annual increasing trend of 42 percent. Similarly, the Philippines got the highest share of 94% in 1994. It had recorded the lowest share of 66% in 2001 wherein importation increased by almost 34% share in the Philippine beef market. In 2009, the Philippines have the highest source of beef with 79%, India with 10.22% as the second largest supplier of imported beef in the country and trade partners for almost 20 years, Australia with 4.6%, the rest of the World consist of Brazil and the United States with 4.13%, and New Zealand with 1.66%. Meanwhile,

Table 4 shows total broiler chicken consumption in the country and the Philippines have the largest share accounted 99% in 1994 and went down by 7% percent in 2009. By 2009, however, approximately 8% share of consumption contributed by the respective exporting countries such as the United States with 4.28%, the rest of the World coming from New Zealand, Malaysia, Brazil, and Canada with 2.30%, Australia with .57%, and China with .577%. Thus, imports of broiler chicken had decreasing trend in 1996-2000 but an increasing trend in 2001-2009.

On the other hand, Table 5 shows that the domestic source controlled the local pork market in the country. From 1994 to 2009, some 96% to 99% of the country's pork demand was supplied by the Philippines and approximately 3.5% share was imported from Brazil, China, and the rest of the World namely, Germany and France in 2009. Pork consumption in the Philippines in 2009 amounted to 1,413,848 mt followed by broiler chicken and beef with 952,244 mt and 405,488 mt respectively.

Table 3. Philippine beef consumption (in kg), by origin: 1994-2009.

YEAR	India	Australia	New Zealand	Philippines	ROW	Total beef consumption of the Philippines (kg/yr)
1994	6,069,009	6,797,044	305,191	225,918,060	561,574	239,650,878
	(2.53)	*(2.84)*	*(.13)*		*(94.27)*	*(.23)*
(100)						
1995	9,669,374	15,917,445	1,846,049	233,982,388	336,197	261,751,453
	(3.70)	*(6.08)*	*(.70)*		*(89.39)*	*(.13)*
(100)						
1996	20,972,282	21,713,052	2,664,548	234,319,787	412,807	280,082,476
	(7.48)	*(7.75)*	*(.95)*		*(83.67)*	*(.15)*
1997	10,843,295	28,509,345	6,847,092	214,615,779	923,258	261,738,769
	(4.14)	*(10.90)*	*(2.61)*		*(82)*	*(.35)*
(100)						
1998	9,939,168	21,087,443	4,307,703	163,082,097	317,458	198,733,869
	(5.00)	*(10.62)*	*(2.17)*		*(82.06)*	*(.16)*
(100)						
1999	10,708,188	21,366,168	2,613,958	180,083,329	257,773	215,029,416
	(4.98)	*(9.94)*	*(1.21)*		*(83.75)*	*(.12)*
(100)						
2000	26,396,879	15,002,337	2,819,057	164,483,765	564,431	209,266,460
	(12.61)	*(7.17)*	*(1.35)*		*(78.60)*	*(.27)*
(100)						
2001	49,532,562	18,661,882	3,692,222	153,513,682	5,307,092	230,707,440
	(21.47)	*(8.08)*	*(1.60)*		*(66.55)*	*(2.30)*
(100)						
2002	47,177,547	12,358,218	954,900	161,392,548	14,795,214	236,678,427
	(19.93)	*(5.23)*	*(.40)*		*(68.20)*	*(6.24)*
(100)						
2003	46,648,116	9,210,589	2,263,906	162,973,795	18,974,142	240,070,546
	(19.43)	*(3.84)*	*(.94)*		*(67.88)*	*(7.91)*
(100)						
2004	44,589,760	5,373,721	4,107,514	185,993,098	8,644,803	248,708,896
	(17.94)	*(2.16)*	*(1.65)*		*(74.78)*	*(3.47)*
(100)						
2005	46,888,356	6,105,948	2,795,807	208,918,610	17,584,599	282,293,320
	(16.63)	*(2.16)*	*(.99)*		*(74.00)*	*(6.22)*
(100)						
2006	46,506,508	4,078,752	1,942,603	236,565,200	24,718,917	313,811,980

	(14.82)	*(1.29)*	*(.62)*	*(75.38)*	*(7.89)*	
(100)						
2007	51,453,723	5,614,248	3,277,668	277,238,542	34,104,731	371,688,912
	(13.83)	*(1.50)*	*(.88)*	*(74.62)*	*(9.17)*	
(100)						
2008	53,061,494	16,569,859	759,872	316,600,200	11,595,613	398,587,038
	(13.31)	*(4.16)*	*(.19)*	*(79.43)*	*(2.91)*	
(100)						
2009	41,452,627	18,663,257	6,750,627	321,870,834	16,750,641	405,487,986
	(10.22)	*(4.62)*	*(1.67)*	*(79.37)*	*(4.14)*	
(100)						

Figures in parentheses are percentage shares
Sources: UN Comtrade and BAS 2010

Table 4. Philippine broiler chicken consumption (in kg), by origin: 1994-2009.

YEAR	China	USA	Australia	Philippines	ROW	Total chicken consumption of the Philippines (kg/yr)	
1994	52,714	160,647	8,250	368,038,620	4,439	368,264,670	
	(.01)	*(.04)*	*(2.24E-03)*	*(99.92)*	*(1.21E-03)*		
(100)							
1995	217,945	418,188	17,999	401,406,736	24,000	402,084,868	
	(.05)	*(.10)*	*(4.48E-03)*	*(99.83)*	*(5.96E-03)*		*(100)*
1996	2,523,632	785,728	1,948	455,349,795	208,664	458,869,767	
	(.55)	*(.17)*	*(4.24E-04)*	*(99.23)*	*(.04)*		
(100)							
1997	451,625	2,549,210	28,097	497,908,607	882,172	501,819,717	
	(.09)	*(.51)*	*(5.59E03)*	*(99.22)*	*(.17)*		
(100)							
1998	300,812	2,998,109	184,424	493,634,149	1,237,186	498,354,679	
	(.06)	*(.60)*	*(.04)*	*(99.05)*	*(.25)*		
(100)							
1999	321,624	33,637,765	1,333,525	525,305,312	2,000,733	562,598,959	
	(.06)	*(5.97)*	*(.24)*	*(93.37)*	*(.36)*		
(100)							
2000	572,594	15,557,402	159,905	550, 064,314	3,124,553	569,478,767	
	(.10)	*(2.73)*	*(.03)*	*(96.59)*	*(.55)*		
(100)							
2001	932,233	11,828,257	1,353,198	598,471,120	2,839,219	615,424,027	

	(.16)	*(1.92)*	*(.22)*	*(97.24)*	*(.46)*	
(100)						
2002	983,026	13,178,686	590,839	639,209,893	5,244,151	659,206,595
	(.15)	*(2.00)*	*(.08)*	*(96.97)*	*(.80)*	
(100)						
2003	712,978	14,438,453	499,714	648,651,920	8,575,069	672,878,134
	(.11)	*(2.15)*	*(.07)*	*(96.40)*	*(1.27)*	
(100)						
2004	144,922	17,017,984	1,293,272	684,454,599	8,316,991	711,227,769
	(.02)	*(2.39)*	*(.18)*	*(96.27)*	*(1.17)*	
(100)						
2005	282,928	12,214,175	5,011,580	638,549,622	13,113,545	669,171,852
	(.04)	*(1.82)*	*(.75)*	*(95.43)*	*(1.96)*	
(100)						
2006	644,476	20,282,388	3,234,813	691,431,375	10,898,144	726,491,196
	(.08)	*(2.80)*	*(.44)*	*(95.17)*	*(1.51)*	
(100)						
2007	707,088	22,107,949	5,887,320	780,342,349	17,742,734	826,787,440
	(.08)	*(2.67)*	*(.72)*	*(94.38)*	*(2.15)*	
(100)						
2008	431,731	17,364,605	5,803,208	853,011,396	23,370,393	899,981,333
	(.04)	*(1 .95)*	*(.64)*	*(94.78)*	*(2.59)*	
(100)						
2009	546,335	40,785,639	5,473,228	883,530,828	21,908,512	952,244,542
	(.05)	*(4.28)*	*(.57)*	*(92.78)*	*(2.30)*	
(100)						

Figures in parentheses are percentage shares
Sources: UN Comtrade and BAS 2010

Table 5. Philippine pork consumption (in kg), by origin: 1994-2009.

YEAR	China	Brazil	Philippines	ROW	Total pork consumption of the Philippines (kg/yr)
1994	565,944	2,388,337	739,429,140	5,033	742,388,454
	(.07)	*(.32)*		*(99.60)*	*(6.77E-04)*
(100)					

1995	581,961	2,977,497	799,382,644	172,977	803,115,079	
	(.07)	*(.37)*		*(99.53)*	*(.03)*	*(100)*
1996	2,508,640	2,191,049	854,043,163	314,352	859,057,234	
	(.29)	*(.25)*		*(99.42)*	*(.03)*	*(100)*
1997	3,473,121	14,342,246	897,093,956	161,950	902,163,273	
	(.38)	*(.16)*		*(99.42)*	*(.04)*	*(100)*
1998	6,402,138	633,527	928,032,199	4,095	935,071,959	
	(.68)	*(.06)*		*(99.25)*	*(4.37E-04)*	*(100)*
1999	6,702,778	717,356	978,876,186	125,653	986,421,973	
	(.68)	*(.07)*		*(99.23)*	*(.02)*	*(100)*
2000	5,055,912	903,968	1,009,853,816	4,675	1,015,818,371	
	(.49)	*(.08)*		*(99.41)*	*(4.60E-04)*	*(100)*
2001	6,403,663	3,447,008	1,048,103,718	746	1,054,855,135	
	(.60)	*(.03)*		*(99.36)*	*(7.07E-05)*	*(100)*
2002	9,631,362	980,073	1,101,126,495	12,346	1,111,750,276	
	(.86)	*(.08)*		*(99.04)*	*(1.11E-03)*	*(100)*
2003	7,023,571	1,088,704	1,144,870,639	17,599	1,153,000,513	
	(.61)	*(.09)*		*(99.29)*	*(1.52E-03)*	*(100)*
2004	8,228,747	1,201,172	1,130,011,139	38,963	1,139,480,280	
	(.72)	*(.10)*		*(99.17)*	*(3.42E-03)*	*(100)*
2005	9,334,057	932,924	1,153,264,724	13,611	1,163,545,016	
	(.80)	*(.08)*		*(99.11)*	*(1.16E-03)*	*(100)*
2006	12,176,688	1,041,719	1,287,193,000	37,351	1,300,448,758	
	(.93)	*(.08)*		*(98.98)*	*(2.87E-03)*	*(100)*
2007	9,510,611	915,662	1,334,819,433	5,212,766	1,350,458,471	
	(.70)	*(.06)*		*(98.84)*	*(.40)*	*(100)*
2008	3,795,762	1,153,584	1,346,003,136	6,704,126	1,357,656,608	
	(.28)	*(.08)*		*(99.15)*	*(.49)*	*(100)*

2009	6,227,437	15,113,707	1,371,409,542	21,097,373	1,413,848,658
	(.44)		*(1.07)*	*(96.99)*	*(1.50)*
(100)					

Figures in parentheses are percentage shares
Sources: UN Comtrade and BAS 2010

Rationale of the Study

Meat consumption in the Philippines over the last two decades has two main characteristics, namely: an increasing of livestock and poultry meat consumption and a rapid increase of meat imports. To meet the increasing domestic demand for livestock and poultry meat and meat products, the Philippines imports beef, broiler chicken, and pork. It is therefore interesting to examine the sensitivity of Philippine import and domestic demand for meat to the change in the Philippine income and import prices. Estimates of the parameters of the demand for meat import could greatly help in formulating policy decisions especially in analyzing and achieving trading targets.

Existing literature on the demand for meat in the Philippines is typically modeled as a function of own-price, prices of competing products, and other potential demand shifters like total meat expenditure. However, meat demand studies in United States have concluded that the impact of competing meat prices specifically for beef consumption is not stable (Eales and Unnevehr 1993; and Moschini and Meilke 1989; McGuirk et al., 1995). This suggests that meat consumption pattern is determined by other factors. The demand shifters will be utilized to model structural change of meat demand in the Philippines.

The Almost Ideal Demand System (AIDS) model of (Deaton and Muelbauer, 1980a) has been used by some of the researchers Henneberry et al. (2007) and Yang et al. (1994) who both showed that AIDS is more efficient compared with the other methods of estimating demand function, while the Source-Differentiated AIDS is convenient for empirical demand analysis to provide an accurate estimation on various types of meat and the price and income elasticities according to its source. This study uses SDAIDS to estimate the demand function for meat in the Philippines, to determine the effects of imported meat in comparison with domestic meat products using the estimates of expenditure and price elasticities. SDAIDS is also used to differentiate goods from different origins in analyzing the Philippine import and domestic demand for beef, broiler chicken, and pork. Trend variables are included in the SDAIDS model and the general demand restrictions of adding-up, homogeneity, and symmetry are imposed.

Objectives of the Study

This study aims to estimate the demand for meat in the Philippines using Source-Differentiated Almost Ideal Demand System (SDAIDS). More specifically, the study aims:

1. to present the profile and prices of meat (beef, broiler chicken, and pork) by country of origin from 1994-2009; and
2. to estimate demand and income elasticities for meat (pork, broiler chicken, and beef) of the Philippines from 1994-2009 using SDAIDS.

Significance of the Study

Understanding meat demand and its characteristics is important to give more accurate evaluation of the factors that affect consumers' behavior for meat products. With rapid population growth and an increasing per capita income as well as lifestyle change resulting from urbanization, it is predicted that demand for meat will further increase in the Philippines. Forecasting the changes in the demand for meat could be facilitated by a more precise estimate of the demand parameters and the price and income elasticities of demand. Therefore, policy makers and development planners could use this study as a basis for policy formulation. The results of the study may also be used for policy evaluation and for policy simulation by using estimates of demand responsiveness to prices and expenditure (Wahl et al. 1993). For trade analysts, the results of the study may provide additional information to better understand the changes in the demand for meat (beef, broiler chicken, and pork) in the Philippines. This study may be useful also to strategic planners, international marketing, executives and import/domestic managers concerned with the market for meat products since the results of the study may provide information to design an effective production and import supply plan. Estimate of Source-differentiated Almost Ideal demand System (SDAIDS) model may provide an insight on the demand for meat from different importing countries.

Scope and Limitations

This study will estimate the demand for meat in the Philippines. Three type of meat are the focus of the study, namely: beef, broiler chicken, and pork. One limitation of the study is that statistical data on the consumption pattern of meat products are often incomplete or not available. Annual data of retail price and per capita consumption of beef, broiler chicken, and pork for the period 1994-2009 are used in this study while wholesale prices of meat are not used due to their unavailability. In addition, quantity and expenditure of the Philippines from exporting countries were acquired from the United Nations Commodity Trade Statistics (UN, Comtrade). The analysis is also limited to the top meat exporting countries to the Philippines such as beef from India, Australia, and New Zealand; broiler chicken from China, Australia, and USA, and pork from Brazil and China and the Rest of the World taking into consideration the number of years the country has exported meat to the Philippines. The rest of the world (ROW) is compose countries that export beef, broiler chicken, and pork irregularly to the Philippines and in mir amount. The countries under ROW are: Brazil and USA for beef, Brazil, New Zealand, Malaysia, and Canada for broiler chicken, and Germany and France for pork.

METHODOLOGY

Theoretical Framework

International trade is widely acknowledged as an essential element in broadening the prospects for economic expansion. To this extent, international trade has been described as an engine for economic growth. It promotes domestic efficiency, international specialization and international competitiveness, ultimately leading to greater levels of global output. Undoubtedly, the process of global expansion critically depends on foreign trade activities.

The process of economic expansion or growth sets in motion a growing demand for capital and consumer goods as well as raw materials to sustain the expansion. Harrod and Hague (1963) have stressed the need to sustain increasing levels of consumption, investment and production as growth progresses. Clearly, economic growth necessitates the provision of additional resources as it occurs. However, the provision of this extra resource cannot be sustained out of domestic supply alone, implying that imports of foreign resources are necessary to fill the gap between a growing domestic aggregate demand and a limited supply (Cheelo, 1998).

International trade has significant dynamic effects that can provide strong stimulus to economic growth. It improves a developing country's access to new production technologies, to international capital, and to labor skills leading to an outward shift of the production possibility frontier. Foreign trade overcomes the limitations of a small domestic market, enabling the country to take advantage of specialization and scale economies. It helps promote growth of national income without being subject to a binding demand constraints (Bautista and Tecson, 2003). Export demand refers to the demand by foreign countries for goods and services produced domestically while import demand refers to demand by domestic residents for foreign produced goods and services.

Following the assertions of the traditional theory of imports demand determinants, scholars maintain that national income is an important determinant of imports in any open economy, hence, a positive relationship between imports and national income is often postulated (Harrod and Hague, 1963). This relationship has a microeconomic foundation, which states that the aim of the consumer is to maximize satisfaction so that higher income would mean higher demand for goods and services.

Import prices are similarly asserted to be important in determining imports demand. Cave and Jones (1985) postulated that if the price of imports rises, three ingredients contribute to a

decline of import demand: (a) a substitution effect in consumption where the rise in import price serves to lessen the demand on the importable and more consumption will go to its substitute products; (b) an income effect where the rise in the price of imports lowers real income and therefore lowers imports; and (c) a production effect where the rise in import price serves to attract resource from other industries to the import-competing industry, so that importable commodities decrease.

Figure 1 presents the conceptual framework of the study. It shows that international trade generally plays an important role in an open economy because it provides benefits by allowing countries to export goods whose production makes relatively heavy use of resources that are locally abundant while importing goods whose production makes heavy use of resources that are locally scarce. International trade allows countries to specialize in producing narrowing ranges of goods, allowing them to gain greater efficiencies of large-scale in livestock production (Krugman & Obstfeld, 2000). Import demand for meat, specifically pork, beef, and broiler chicken is highly dependent to the prices of exporting country of meat and real income (expenditure) of importing country including the Philippines as domestic source. The law of demand states that the price of meat from a particular source influences the import demand of the Philippine market from that source. The price of imported meat products from exporting countries influences the Philippine demand for meat. In addition, meat from other countries and the domestic source of meat can be either a substitute or a complementary source of goods or not related. Countries like India, Australia, New Zealand, Philippines, and the rest of the World (ROW) e.g. USA, and Brazil

Conceptual Framework

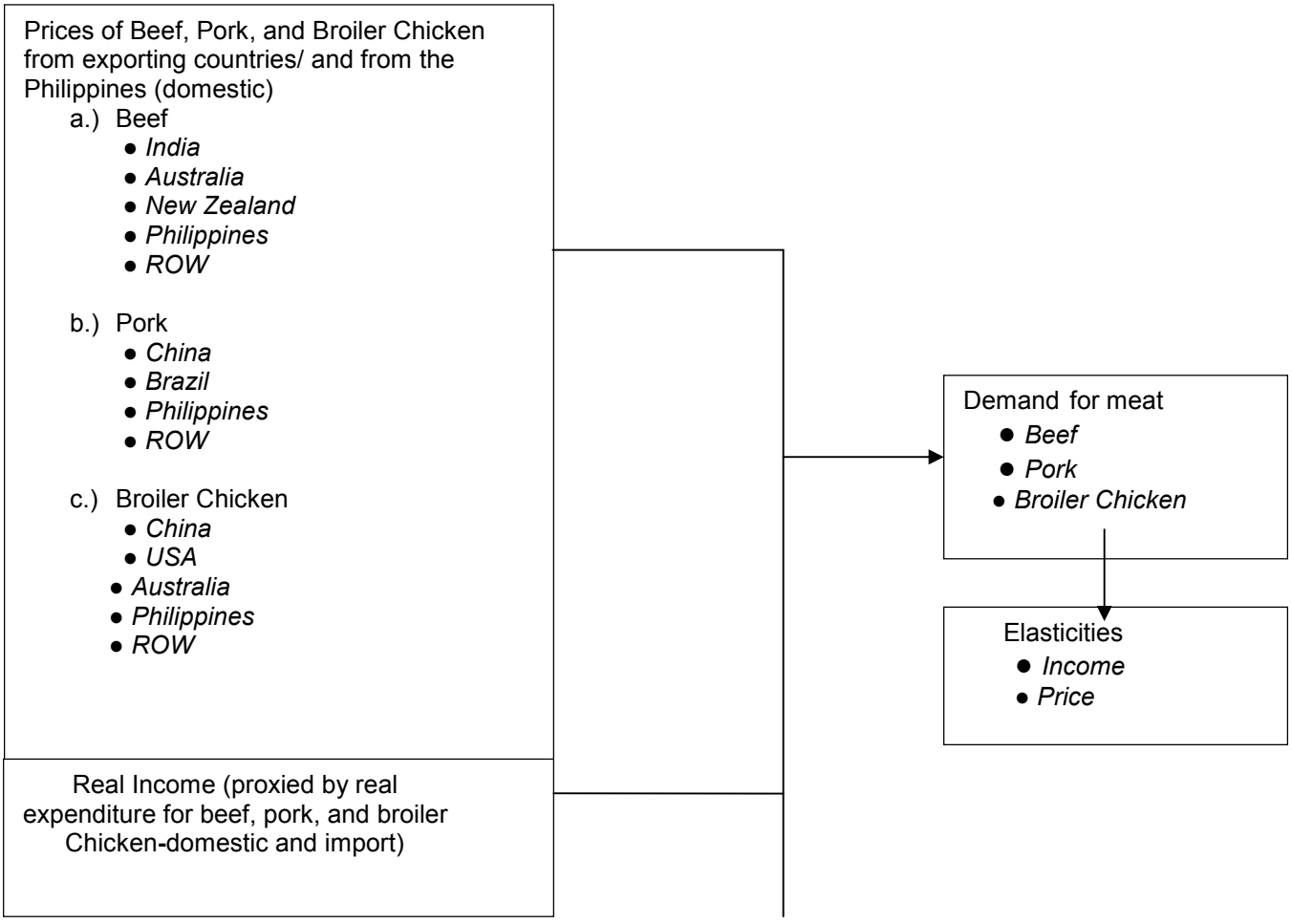

Figure1. Factors affecting demand for meat in the Philippines.

are considered complement, if an increase of the price of one source of imported beef will lead to a decrease in consumption of the other sources of imported beef products. Likewise, domestic production and foreign meat suppliers of broiler chicken in the Philippine market like China, USA, Australia, and ROW (New Zealand, Malaysia, Brazil, and Canada) and imported pork products from China, Brazil, and ROW (Germany and France) have complementary relationship if the price rises of a particular source tend to reduce the demand of broiler chicken and pork from a specific source. This implies that the consumption of one product from a certain source requires the consumption of another.

On the other hand, substitutability of source-differentiation of meat (beef, broiler chicken, and pork) will have a positive relationship with the price of a certain source. This is noted that an increase in the price from a particular source, thus, Philippines tend to shift to a substitute source of imported or domestic source hence increasing the demand of the latter (Wadud et al., 2002).

Real income influences the Philippine import and domestic demand for meat. In particular, the effect of real income on the import demand for meat depends on whether the imported meat from a particular source is an inferior or normal good. With normal good, demand varies in the same direction as the Philippine income, thus, an increase in Philippine income will result to an increase in the demand for meat from a certain source country. However, if the imported meat from a particular country is an inferior good then the demand for that imported meat decreases as Philippine income increases (http:www.basiceconomics.Info/supply-and-demand.ph).

Data and Variables

This study uses secondary data from various sources. These data consist of the volume and values of imported sources beef, broiler chicken, and pork from 1994-2009 obtained from UN Comtrade Trade Statistics website. Import values include cost, insurance and freight (CIF). The source (exporting) countries of beef are India, Australia, New Zealand and the rest of the World (ROW) consisting of Brazil and USA. Exporting countries of broiler chicken to the Philippines are: China, USA, Australia, and ROW composed of New Zealand, Malaysia, Brazil, and Canada while China and Brazil are the major sources of imported pork products and the ROW which includes Germany and France. Import prices were calculated by dividing the value of meat products by the quantity from each exporting country. Total expenditure is used as proxy for income. The monetary unit used in this study is the US dollar. The per capita consumption and retail prices of beef, broiler chicken, and pork were obtained from the Bureau of Agricultural Statistics (BAS) website.

Model Specification

This study proceeds with Source-Differentiated Almost Ideal Demand System (SDAIDS), a modified version of the AIDS model, which allows for source differentiation of various types of meats without imposing block separability. Empirical applications of the AIDS model to import demand system typically assumed product aggregation, which allows the model to consist only of share equations for a good from different origins (e.g., Alston et al., 1990). One of the main advantages of SDAIDS includes estimates that do not suffer from aggregation bias over import sources or over goods. The SDAIDS model is generally estimated using instrumental variable techniques (Yang and Koo, 1994) which are expected to result in more reliable parameter estimates.

The Source Differentiated AIDS Model

The derivation of the AIDS model starts with an expenditure function, representing the Price Independent Generalized Logarithmic (PIGLOG) preference (Deaton and Muellbauer, 1980). For the source differentiated AIDS (or simply SDAIDS) model, the expenditure function is rewritten to approximate the importer's behavior that differentiates goods from different origins. The expenditure function given utility u is:

$$\ln [E(p, u)] = (1 - u).\ln[a(p)] + u.\ln[b(p)], \quad (1)$$

where,

$$\ln[a(p)] = \alpha_0 + \sum\sum_{i\ h} \ln(P_{ih}) + \frac{1}{2}\sum\sum\sum\sum \gamma^*_{ihjk} \ln(p_{ih}) \ln(p_{jk}), \quad (2)$$

and

$$\ln [b(p)] = \ln[a(p)] + \beta_0 \prod\prod P_{ih}^{\beta_{ih}}, \quad (3)$$

where α, β, γ^* are parameters and P's are the prices of imported and domestic meat products. The subscripts i and j denote goods (i,j = 1,...,N), and h denote products are not necessarily the same for all goods. Good *i* may be imported from *m* different origins, while good j may have *n* origins (when $i \neq j$, h =1, . . ., n).

By substituting equations (2) and (3) into (1), the expenditure function can be rewritten as:

$$\ln [E(p, u)] = \alpha_0 + \sum\sum_{i\ h} \alpha_{ih} \ln(p_{ih}) + \frac{1}{2}\sum\sum\sum\sum \gamma^*_{ihjk} \ln(p_{ih}) \ln(p_{jk}) + \beta_0 u \prod\prod P_{ih}^{\beta_{ih}} \quad (4)$$

"By Shephard's lemma, the budget share of good *i* imported from origin h can be obtained by differentiating ln[E(p, u)] with respect to $\ln(p_{ih})$. Thus, the budget share (w_{ih}) is a function of prices and utility as"(Yang and Koo, 1994)

$$w_{ij} = \alpha_{ih} + \sum\sum_{i\ j} \gamma_{ihjk} \ln(p_{ik}) + \beta_{ih} u \beta_0 \prod\prod P_{ih}^{\beta_{ih}} \quad (5)$$

where $\gamma^*_{ihjk} = 1/2(\gamma^*_{ihjk} + \gamma^*_{jkih})$.

Solving equation (4) with respect to u and substituting this into equation (5) results in the SDAIDS in expenditure share form (Equation 6). This study utilized the following model, specified by Yang and Koo (1994), as derived from (1) to (5);

$$w_{ij} = \alpha_{ij} + \sum\sum_{i\ j} \gamma_{ijk} \ln(P_{jk}) + \beta_{ij} \ln \left(\frac{E}{P^*} \right) \quad (6)$$

where:

w_{ij}= market share of the i^{th} exporting country on the total expenditure of the Philippines for meat j

α_{ij} = constant coefficient in the i^{th} share equation corresponding to meat j

γ_{ijk} = slope coefficient associated with the export price of country k in the i^{th} share equation of meat j

P_{jk} = price of meat j coming from the country k

β_{ij} = slope coefficient associated with expenditure in the i^{th} share equation for meat j

E_j= total expenditure of the Philippines for meat j

P*= exact or Divisia price index

In equations (2) and (3), j ranges from 1 to 3 (1 if beef, 2 if broiler chicken, 3 if pork). On the other hand, i stand for countries of origin, including the Philippines for each type meat j. For example, for beef, the countries of origin are India, Australia, New Zealand, Philippines, and ROW. For broiler chicken, the source countries are China, USA, Australia, Philippines, and ROW. For pork, China, Brazil, Philippines, and ROW as the main source countries.

In many empirical researches of demand systems, the Linearized AIDS (LA/AIDS) model with the linearly approximated price index has often been employed to overcome the problem of non-linearity. A common approximation for the price index is the linearized Stone's Price Index. Recently, however, Feenstra and Reindsdorf (2000) demonstrated the superiority of an exact price index for the AIDS model. They derived an exact price by making use of the associated Divisia price index, defined as the expenditure-weighted integral of the change in prices along a path between two points. The Divisia price index can be measured using data on prices and expenditure shares at the two endpoints, and the midpoint of this path exactly measures the index of change in expenditure needed to obtain a constant level of utility at the two price points. The Divisia price index is claimed to measure exactly the change in expenditure needed to obtain a constant level of utility at the two price points.

Theoretical demand restrictions of adding-up, homogeneity, and Slutsky symmetry can be imposed using parameter constraints on the AIDS model (Deaton and Muelbauer, 1980), and these are as follows:

(a) Adding Up

$$\Sigma\Sigma\alpha_{ij} = 1 \; ; \qquad \Sigma\gamma_{ij} = 0$$

$$\Sigma\Sigma\gamma_{ij} = 0 \; ; \qquad \Sigma\,\Sigma\beta_{ij} = 0 \tag{10}$$

This restriction implies that once homogeneity and symmetry are satisfied the sum of the market shares of each exporting country is equal to one. Adding-up restrictions on the parameters ensures that the sum of market shares of the individual expenditure on meat j is equal to the total expenditure

(b) Homogeneity

$$\sum_j \gamma_{ij} + \sum_{j \neq i} \gamma_{ji} = 0; \tag{11}$$

γ_{ij}= cross price coefficient associated with j^{th} export country in the i^{th} share equation

Homogeniety restrictions state that the system of function of degree zero implies that the share for each product source *i* will not be changed if total expenditure E and all prices P_i are increased by the same percentage (Deaton and Muelbauer, 1980). It also implies that the consumers in the country react only to real prices and income. The sum of the Marshallian own-price and cross price elasticity for a particular meat j is zero taking account of signs (Tomek and Robinson, 1981) market share (Wi) will not change if relative prices ($\ln P_j$) and real expenditure ($\ln E/P_j$) will change by the same percentage.

(c) Symmetry

$$\gamma_{ij} = \gamma_{ji} \quad , \qquad i \neq j \qquad (12)$$

where:

γ_i= cross price coefficient associated with i^{th} export country in the i^{th} share equation

γ_j= cross price coefficient associated with j^{th} export country in the j^{th} share equation

This restriction is defined as the substitution effect of a change of P_j in market share w_i is equal to the substitution effect of a change in P_i on W_j. This means that an increase in the price of good from source i will cause an increase in the quantity demanded from source j caused by an increase in the price of good from source i (Deaton and Muelbauer, 1980). The cross-price effect, however, of changes in price of meat j products on the demand for another sources are equal.

Estimation of Elasticity

The estimated parameters of SDAIDS equation form the basis of elasticity, which measures the percentage response of the market share to a one percent change in prices or total expenditure. The Marshallian elasticity is used in this study. This elasticity formula is also used by Yang, S. and Koo W. (1994), Lee et al. (1994), Fabiosa J. and Ukhova Y. (2000), Taljaard et al. (2004), and Wadud (2006) in their respective AIDS model study.

Marshallian Own-Price Elasticity

$$\eta_{ii} = -1+(\gamma i/wi)-\beta_i \qquad i=1,2,\ldots\ldots,5 \qquad (13)$$

where:

η_{ii}= Marshallian own-price elasticity of commodity i
γ_i = slope coefficient associated with the own-price in the i^{th} share equation

w_i= market share in the i^{th} source
β_i = slope coefficient associated with expenditure in the i^{th} share equation

The Marshallian own-price elasticity measures the responsiveness of the Philippine import demand from source i for beef like India, Australia, New Zealand, Philippine, and ROW to a change in the export price of country i expected, this will yield a negative sign due to the inverse relationship of price and quantity demanded. If the absolute value of own-price elasticity is greater than 1, the demand of the commodity is considered elastic, i,e., quantity demanded is responsive to changes in price. In the contrary, if the absolute value of own-price elasticity is less

than 1, the demand of the commodity is inelastic and considered not to be responsive to changes in price.

Marshallian Cross-Price Elasticity

$$\eta_{ij} = (\gamma_{ij} - \beta_i w_j)/w_i \qquad i=1,2,\ldots\ldots,5 \qquad (14)$$

where:

η_{ij} = Marshallian cross-price elasticity of commodity i

γ_{ij}= slope coefficient associated with the cross-price of good in the j^{th} share equation.

β_i= slope coefficient associated with expenditure in the i^{th} share equation

w_j = market share in the j^{th} commodity

w_i= market share of the i^{th} commodity

The Marshallian cross-price elasticity measures the responsiveness of import demand coming from source i with same commodity and source like India to a change in the price of imports from country j like Australia for beef. If the absolute value of cross-price elasticity is positive then the two sources are considered substitute. If it is negative, the two sources complement each other.

Income Elasticity

$$€_y = 1 + \frac{\beta_i}{w_i} \qquad i=1,2,\ldots\ldots,5 \qquad (15)$$

where:

$€_y$= expenditure elasticity

β_i= slope coefficient of real total income (expenditure)

w_i= market share of the i^{th} source

Expenditure elasticity is used as a proxy of income elasticity in this study. It measures the percent change in the market share of a commodity from a one percent change in total expenditure. If the expenditure elasticity is positive, the commodity from a certain source is considered normal. If the expenditure elasticity is negative, the commodity from certain source is considered inferior. Equations (13), (14), and (15) are used also for the other types of meat (broiler chicken and pork).

Meanwhile, to estimate the annual growth rate of volume of meat (beef, broiler chicken, and pork) consumption in terms of metric tons in the Philippines from 1994 to 2009 using simple linear model express as:

$$\ln Y = a + bt \qquad (16)$$

where:

ln Y = the natural log of meat (beef, broiler chicken, and pork) consumption

t = time in year (1, 2, 3,……,16)

b = growth rate of volume of meat consumption

Equation 16 is also used for expenditure and prices of the Philippines for domestic and imported on other types of meat (beef, broiler chicken and pork), by source under study.

Empirical Application and Estimation

This study estimates the Philippine's import and domestic demand for beef, pork, and broiler chicken coming from the different sources or origin. The exporting countries of beef products to the Philippines are: India, Australia, New Zealand, and ROW consist of USA, and Brazil. Major suppliers of pork to the Philippines are: China, Brazil, and ROW are Germany and France. Top exporting countries of broiler chicken to the Philippines are: USA, China, Australia, and ROW are New Zealand, Malaysia, and Canada. Below are the demand equations for beef. The demand functions for pork and broiler chicken are similarly derived. Equation (9) can now be expressed as:

$$w_I = \beta_0 + \beta_1 \ln X_I + \beta_2 \ln X_A + \beta_3 \ln X_{NZ} + \beta_4 \ln X_{PHL} + \beta_5 \ln X_{ROW} + \beta_6 \ln RE + \varepsilon_I \quad (17)$$

$$w_A = \beta_0 + \beta_1 \ln X_A + \beta_2 \ln X_I + \beta_3 \ln X_{NZ} + \beta_4 \ln X_{PHL} + \beta_5 \ln X_{ROW} + \beta_6 \ln RE + \varepsilon_A \quad (18)$$

$$w_{NZ} = \beta_0 + \beta_1 \ln X_{NZ} + \beta_2 \ln X_I + \beta_3 \ln X_A + \beta_4 \ln X_{PHL} + \beta_5 \ln X_{ROW} + \beta_6 \ln RE + \varepsilon_{NZ} \quad (19)$$

$$w_{PHL} = \beta_0 + \beta_1 \ln X_{PHL} + \beta_2 \ln X_I + \beta_3 \ln X_{NZ} + \beta_4 \ln X_A + \beta_5 \ln X_{ROW} + \beta_6 \ln RE + \varepsilon_{PHL} \quad (20)$$

$$w_{ROW} = \beta_0 + \beta_1 \ln X_{ROW} + \beta_2 \ln X_I + \beta_3 \ln X_{NZ} + \beta_4 \ln X_A + \beta_5 \ln X_{PHL} + \beta_6 \ln RE + \varepsilon_{ROW} \quad (21)$$

where:

w_I = share of total expenditure of beef from India
w_A = share of total expenditure of beef from Australia
w_{nz} = share of total expenditure of beef from New Zealand
w_{PHL} = share of total expenditure of beef from the Philippines
w_{ROW} = share of total expenditure of beef from the rest of the world

The description for w_I, w_A, w_{NZ} ,w_{PHL} *and* w_{ROW} follows the above description with respect to beef source while the X's are the independent variables namely: own-price, price of meat from exporting countries ($X_{i's}$) and real income (RE) of the Philippines. The β's are the parameters to be estimated.

In the above equations by equation basis, the system of demand may be estimated using the Ordinary Least Square (OLS). The study used time series data which means that an observation on the demand equation represents one point in time to estimate the demand and income (proxy for expenditure) elasticites. This opens the possibility that contemporaneous correlation exists. Because of this, OLS is not considered as Best Linear Unbiased Estimator (BLUE). To solve this problem, numerous studies utilize the Seemingly Unrelated Regression (SUR) in multi-equation regression models, which is appropriate when the disturbances are contemporaneously correlated (Zellner, 1962).

The SUR estimation uses a system of equations, which are related through the cross-equation covariance of the error (Zellner, 1962). Using the SUR estimator increases with the correlation between equation regressors and gained efficiency with adding-up, homogeneity, and symmetry restrictions imposed. The reason for applying SUR lies in the fact that the common factors might exist and influence all equations at the same time induces a correlation between the equations error terms. The Seemingly Unrelated Regression (SUR) of equations 16 to 20 can be expressed in matrix form as:

$$
\begin{aligned}
Y_I &= X_I\beta_I + \varepsilon_I \\
Y_A &= X_A\beta_A + \varepsilon_A \\
Y_{NZ} &= X_{NZ}\beta_{NZ} + \varepsilon_{NZ} \\
Y_{PHL} &= X_{PHL}\beta_{PHL} + \varepsilon_{PHL} \\
Y_{ROW} &= X_{ROW}\beta_{ROW} + \varepsilon_{ROW}
\end{aligned}
\qquad (22)
$$

where:

Y_I= time series observations on share of India for Philippine import of beef
Y_A= time series observations on share of Australia for Philippine import of beef
Y_{NZ}= time series observations on share of New Zealand for Philippine import of beef
Y_{PHL}=time series observations on share of beef from the Philippines
Y_{ROW}= time series observations on share of the rest of the world for Philippine import of beef

Note that, Y_{PHL} contains all time series observations of the Philippines share equation for import and domestic source of meat. The description for Y_I, Y_A, Y_{NZ}, Y_{PHL}, and Y_{ROW} follows are similarly defined. Similar definition applies to X_{PHL} which contains all time series observations on the explanatory variables in the market share equation of the Philippines and X_I, X_A, X_{NZ}, X_{PHL} and X_{ROW}.

$$
X_{PHL}= \begin{pmatrix}
1 & \ln P_{1I} & \ln P_{1A} & \ln P_{1NZ} & \ln P_{1PHL} & \ln P_{1ROW} & \ln(X_1/P_1) \\
1 & \ln P_{2I} & \ln P_{2A} & \ln P_{2NZ} & \ln P_{2PHL} & \ln P_{2ROW} & \ln(X_2/P_2) \\
. & . & . & . & . & . & . \\
. & . & . & . & . & . & . \\
1 & \ln P_{nI} & \ln P_{nA} & \ln P_{nNZ} & \ln P_{nPHL} & \ln P_{nROW} & \ln(X_n/P_n)
\end{pmatrix} \qquad (23)
$$

The system of equations in (17-22) could further be written compactly as the "super model" in (eq. 25) given in the framework of a single equation linear model, after which SUR estimation, follows:

$$Y = X\beta + \varepsilon \qquad (25)$$

where:

$$Y = \begin{pmatrix} Y_I \\ Y_A \\ Y_{NZ} \\ Y_{PHL} \\ Y_{ROW} \end{pmatrix} \quad X = \begin{pmatrix} X_I & 0 & 0 & 0 & 0 \\ 0 & X_A & 0 & 0 & 0 \\ 0 & 0 & X_{NZ} & 0 & 0 \\ 0 & 0 & 0 & X_{PHL} & 0 \\ 0 & 0 & 0 & 0 & X_{ROW} \end{pmatrix} \quad \beta = \begin{pmatrix} \beta_I \\ \beta_A \\ \beta_{NZ} \\ \beta_{PHL} \\ \beta_{ROW} \end{pmatrix} \qquad (26)$$

Parameters and elasticities were estimated using **SHAZAM** version 9.0 and annual growth rate was estimated using **MICROSOFT EXCEL.**

RESULTS AND DISCUSSION

Consumption Pattern of Meat in the Philippines (1994-2009)

The rapid growth of meat consumption in the Philippines is expected to strengthen considerably in the future due to a positive economic growth rate over the past 10 years with a remarkable increase of 7% in Gross Domestic Product (GDP) in the country for 2007 and an increasing population growth of 2.3% per annum that will take the population from its 92 million in 2009 to over 152 million within the next three decades (NSO, 2010). In effect, most of the households sector has capacity to purchase of meat (beef, broiler chicken, and pork). Thus, consumption of broiler chicken is the highest annual growth rate of 5.6% followed by pork with 4% and beef with 3% from the period1994 to 2009 shown in Figure 2. By weight, pork is the highest demand trend in the Philippine market compared with broiler chicken and beef in metric tons.

In 1994 to 2009, Bureau of Agricultural Statistics (BAS) reports, that the average per capita meat consumption of Filipinos for beef, broiler chicken, and pork in terms of kilogram (kg) ranged from 1.90 kg - 1.99 kg; 5.49 kg - 9.58 kg; and 11.03 kg – 14.87 kg. During the same period beef, broiler chicken, and pork consumption increased by about 105%, 175%, and 135%, respectivelyThe volume of meat imports in 2009 for beef has 83,617 mt followed by broiler chicken with 68,713 mt , and pork with 42,439 mt. During the period from 2004 and 2008, the volume of meat import grew at an average rate of about 7.5% per annum, driven by buoyant economic conditions, stronger consumer demand for meat and poultry products, short falls in local supplies of meat products due to disease outbreaks, and improved market access arising from trade liberalization by the government (Philippine External Trade Statistics for Import, 2008).

During the same period, beef, broiler chicken, and pork were increased from 239,651 mt to 405,488 mt, 368,264 mt to 952,244 mt, and 742,388 mt to 1,413,848 mt in 1994- 2009.

The increasing demand of beef imports has a significant impact to the Philippine market due to major local manufacturers of meat products, such as canned beef and hotdogs. Thus, the growth of the food service sector and, in particular, fast food chains, should fuel the continued demand for beef (Austrade.gov.ph).

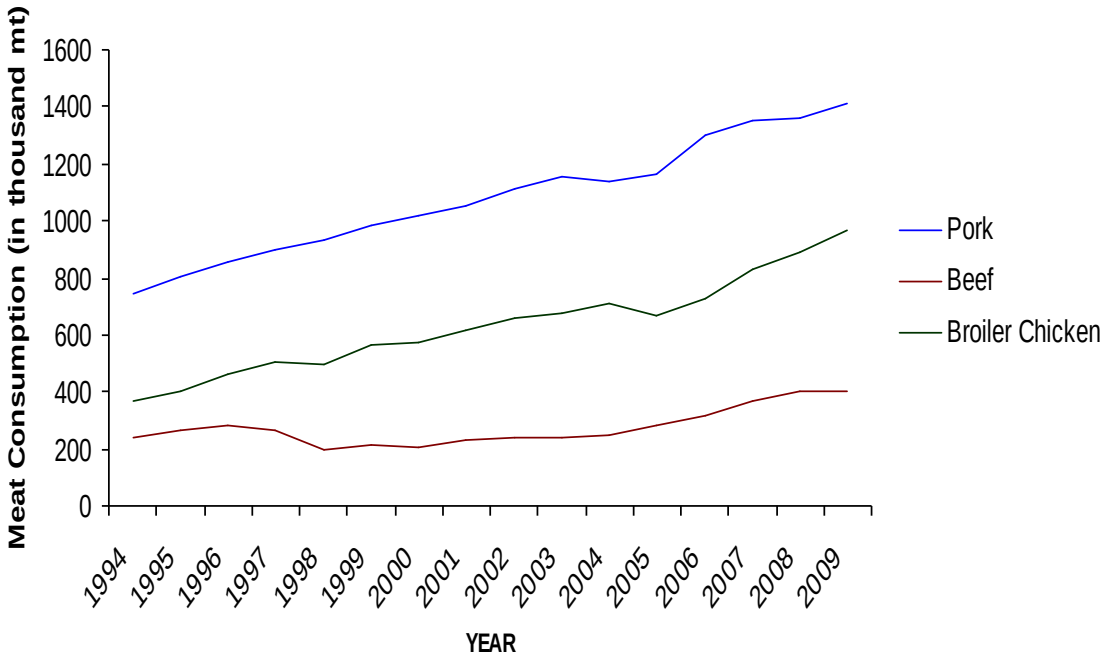

Figure 2. Volume of meat consumption (mt) in the Philippines, 1994-2009.
Source: UN Comtrade and BAS, 2011

Table 6 shows the average annual expenditure of domestic and imported meat (beef, broiler chicken, and pork) in the Philippines during the period 1994 to 2009 according to its source. The country spent for beef ranging from $4,418,979 to $455,938,386 and the total average annual expenditure was $540,341,132. During the same period, Philippines is the highest average annual expenditure with $455,938,386 followed by India has $41,053,245, Australia has $21,375,566, ROW has $17,554,506, and New Zealand has $4,418,979 while the percent contribution to total expenditure registered Philippines, India, Australia, ROW, and New Zealand have 84.38%, 7.60%, 3.95%, 3.25%, and 0.82%, respectively.

By source, expenditure of the country for beef during 1994 to 2009 ranged from $6,615,220 to $108,776,061; $5,628,678 to $44,904,319; $335,710 to $14,243,822; $333,124,690 to $655,362,414; and $1,711,101 to $59,342,232 from India, Australia, New Zealand, Philippines, and ROW, respectively. Over the same period, the annual growth rate of Philippine expenditure for beef shows an increasing trend coming from ROW, India, New Zealand, Australia, and Philippines are: 25%, 18%, 8%, 2%, and 1.3%, respectively. It is indicated that the yearly domestic share in the Philippine beef market exhibit a downward trend from 1994 to 2001 as importation of beef increased because of aging cattle population and high cost of labor and other inputs of beef production. Thus, imported beef has increased considerably as an important component of the supply of beef in the Philippine market.

Historically, the domestic production of beef in the country is the largest supplier, while Australia is known as the second leading beef exporter in the world with a share of 17.76% followed by India with 10.45% (FAS, and USDA, 2008). These countries are exporters of beef to the Philippines for almost two decades. Australian beef export is the second largest share in the Philippine beef supply during the period 1994 to1999. From 2000-2009 imported beef from India accounting second largest share in the Philippine beef market which is the lowest price compared with other exporting countries of beef in the Philippines since 100 percent of beef industry depends on grass-fed (AHS, 2006).

In addition, the average annual expenditure of domestic and imported broiler chicken in the Philippines ranging from $740,387 to $1,326,455,835 with total average expenditure of about $1,345,257,822 by its source covered by the study. However, Philippines the highest average annual expenditure of about $1,326,455,835. This is followed by USA, ROW, Australia, and China with $11,153,034, $5,875,949, $1,032,616, and $740,387; respectively. In terms of percent contribution to total expenditure Philippines registered 98.60%, while USA, ROW, Australia, and China posted 0.83%, 0.44%, 0.07%, and 0.06%, respectively. From 1994 to 2009 the Philippines spent from China, USA, Australia, Philippines, and ROW ranging from $13,028 to $1,139,501; $214,110 to $22,405,451; $11,588 to $3,520,291; $942,841,224 to $2,367,862,619; and $4,350 to $21,500,762.

The annual growth rate of ROW has 49%, next is Australia with 30%, USA with 27%, China with 8%, and Philippines with 5% which exhibited an increasing trend consumption of the country for broiler chicken. From 2001-2009, USA remained as the second largest market share in the country, followed by China, Australia, and ROW. Philippines, however, occupied as the huge supplier of broiler chicken in the country which has the biggest poultry industry with minimal volume of import.

Average annual expenditure of domestic and imported pork products in the Philippines covered by the study ranging from $4,351,121 to $2,592,912,134 has a total of $2,610,881,404. Accordingly, Philippines average expenditure, however, by its source registered Philippines has $2,592,912,134 followed by China has $9,171,890, Brazil has $4,446,259, and ROW has $4,351,121 while percent contribution to total expenditure exhibit that the Philippines is the highest posted 99.31%, next is China with 0.35%, Brazil and ROW with 0.17%.

By source, the country's expenditure from 1994 to 2009 ranged from $1,893,185,687 to $4,292,511,866 next is China, Brazil, and ROW ranged from $792,322 to $17,777,965; $527,452 to $28,111,495; and $4,283 to $28,692,427. Over the same period, the annual growth rate of 33%, 9%, 4%, and 1.36% for ROW, China, Philippines, and Brazil implies an increasing trend over time. Thus, expenditure of the Philippines for meat (beef, broiler chicken, and pork) established an increasing trend over the years. These trend continuously increased influences by the Philippine income and an increase of population.

Profile of Meat Prices in the Philippines

For the last two decades, Philippines importing meat products increased continuously which aims to strengthen the domestic supply and eventually meet the increasing consumption. Thus, average annual export and domestic prices of beef, broiler chicken and pork by origin during the period 1994 to 2009 is presented in Table 7. It shows that the average annual export and domestic prices of beef for the period 1994 to 2009 ranged from $1.21 to $3.29. By its source, the average annual price of beef from the Philippines has $2.14, India has $1.21, Australia has $1.51, New Zealand has $1.47, and ROW has $3.29. The movement of the prices of beef by its price variability shows an increasing trend

Table 6. Average annual expenditure of domestic and imported meat (US Dollar), Philippines, 1994-2009.

Meat	Country	Average annual expenditure 1994-2009	Percent contribution to total expenditure	Range		Annual growth rate (%)
				Minimum	Maximum	
Beef	India	41,053,245	7.60	6,615,220	108,776,061	18.0
	Australia	21,375,566	3.95	5,628,678	44,904,391	2.0
	New Zealand	4,418,979	0.82	335,710	14,243,822	8.0
	Philippines	455,938,836	84.38	333,124,690	655,362,414	1.30
	ROW	17,554,506	3.25	1,711,101	59,342,232	25.0
	TOTAL	540,341,132	100			
Broiler Chicken	China	740,387	0.06	13,028	1,139,501	8.0
	USA	11,153,034	0.83	214,110	22,405,451	27.0
	Australia	1,032,616	0.07	11,588	3,520,291	30.0
	Philippines	1,326,455,835	98.60	942,841,224	2,367,862,619	5.0
	ROW	5,875,949	0.44	4,350	21,500,762	49.0
	TOTAL	1,345,257,822	100			
Pork	China	9,171,890	0.35	792,322	17,777,965	9.0
	Brazil	4,446,259	0.17	527,452	28,111,495	1.36
	Philippines	2,592,912,134	99.31	1,893,185,687	4,292,511,866	4.0
	ROW	4,351,121	0.17	4,283	28,692,427	33.0
	TOTAL	2,610,881,404	100			

accounting ROW with 62% as the highest. These were followed by India, New Zealand, Australia, and Philippines with 30%, 28%, 24%, and 9% (Table 7), respectively. These prices have generally established an increasing trend over the years. Similar to other traded commodities, export prices of beef differs according to its source of origin.

From 1994 to 2009, prices of beef from India ranging from $0.85 to $2.05 while other sources, namely; Australia, New Zealand, Philippines , and ROW with $1.2 to $2.71; $0.99 to $2.38; $1.84 to $2.46; $1.07 to $7.64, respectively. Hence, prices of beef according to its source exhibit an escalating trend for almost two decades. In addition, domestic average retail price of beef dominate for the period 2001 to 2007 while of the exporting countries for beef consists of India, Australia, New Zealand, and ROW with wholesale price basis. Among the source-differentiated beef products, India registered lowest and stable price gained a large portion to the market share in the country for a long period of time.

India has a comparative advantage since the opportunity cost of producing beef products is lesser compared with the other countries that makes competitive price in the world market. It should also be noted that India is the leading beef suppliers in the country for almost two decades because of the lowered cost and high volume demand of frozen beef as a source of the Philippine beef processing industry included Australia, New Zealand, and ROW consist of Brazil and USA known as the highest quality of beef products and the most expensive in the world. Over the same period, the highest annual growth rate of prices for beef by origin registered ROW with 30%, followed by New Zealand with 8%, Australia with 4.8%, and India with 4.5% shows an increasing trend while the Philippines has negative 1.5% with a decreasing trend based from the study result.

The average annual export and domestic prices of broiler chicken by origin ranged from $0.61 to $2.19 as shown in Table 7. However, by source-differentiated the average annual prices of broiler chicken from China, USA, Australia, Philippines, and ROW registered $1.32, $0.96, $2.03, $2.19, and $0.61. In addition, the movement of domestic and export prices of broiler chicken through price variability from China, USA, Australia, Philippines, and ROW with 36%, 62%, 131%, 19% and 27% respectively which shows an increasing trend. During 1994 to 2009 the annual prices of broiler chicken from China, USA, Australia, Philippines, and ROW ranged from $0.95 to $2.04; $0.53 to $3.04; to $0.43 to $5.95; $1.63 to $2.78; and $0.38 to $0.98, respectively. It also noted that in 1994 to 2009 the annual growth rate of prices by its source, registered China has 2.5%, USA has 2.4%, Australia has 42.7%, and ROW has 0.9% shows an increasing trend, however, for the Philippines displayed a decreasing trend of 1.2%.

Average annual export and domestic prices of pork by origin ranged from $1.52 to $3.34 and are shown in Table 7. By source, registered China has $1.52, Brazil has $2.12, Philippines has $2.41, and ROW has $3.34 for the average annual price of pork. The movement of export prices posted an increasing trend of which the price variability shows ROW as the highest with 57%. This was followed by Brazil with 24%, China with 18% and Philippines with 19%. It is indicated that prices from different origin ranged from $1.26 to $2.24; $1.4 to $3.31; $1.77 to $3.18; and $0.87 to $6.49 from China, Brazil, Philippines, and ROW, respectively. Thus, the annual growth rate of prices of pork with different sources indicated an increasing trend for China, Philippines, and ROW with 2.9%, 1%, and 1.56%, respectively. Brazil, however, posted a decreasing trend of 1.5%.

Moreover, China has a stable export price among the top exporters of pork in the country followed by Brazil and the Philippines. These countries captured the biggest share of the Philippine pork market since pork commodity is the highest per capita consumption of the Filipinos (BAS, 2010).

Table 7. Average annual export and domestic prices of meat (US Dollar/kg), by origin, 1994-2009.

Meat	Country	Average annual price USD/kg. 1994-2009	Percent Variability CV (price)	Range		Annual growth rate (%)
				Minimum	Maximum	
Beef	India	1.21	30	0.85	2.05	4.50
	Australia	1.51	24	1.20	2.71	4.80
	New Zealand	1.47	28	0.99	2.38	8.0
	Philippines	2.14	9	1.84	2.46	-1.50
	ROW	3.29	62	1.07	7.64	30.0
Broiler Chicken	China	1.32	36	0.95	2.04	2.50
	USA	0.96	62	0.53	3.04	2.40
	Australia	2.03	131	0.43	5.95	42.70
	Philippines	2.19	19	1.63	2.78	-1.20
	ROW	0.61	27	0.38	0.98	0.90
Pork	China	1.52	18	1.26	2.24	3.0
	Brazil	2.12	24	1.40	3.31	-1.50
	Philippines	2.14	19	1.77	3.18	1.0
	ROW	3.34	57	0.87	6.49	1.56

Estimation of Meat Demand

The common treatment of a separate import demand specification in the literature is usually motivated by product differentiation. This is done using the Source-Differentiated Almost Ideal Demand System. The Source-Differentiated Almost Ideal Demand System (SDAIDS) model aims to estimate source-specific import and domestic demand elasticities for meat (beef, broiler chicken, and pork) in the Philippine market. This approach allows substitution between domestic and imported meat products to avoid econometric problems in generating estimated demand parameters (Fabiosa, 2000).

The SDAIDS model estimates the demand of meat (pork, broiler chicken, and beef) considering domestic and imported meats was disaggregated as differentiated products, thereby allowing substitution between domestic and imported meat referring to the general model in Equation 6 and similarly derived the elasticity estimates of the sources of beef, broiler chicken, and pork. This study used Ordinary Least Square (OLS) estimation which minimizes the sum of the square errors and utilized Seemingly Unrelated Regression (SUR) estimation technique to estimate of import and domestic demand parameters using SDAIDS model (see tables 8, 9, and 10).

Since the sum of the meat expenditures shares (w_{ij}) is equal to one, the demand system composed of prices and expenditure share equations for the three Source-Differentiated meats is singular. Therefore, without loss of generality, the last equation of the system of equations is dropped for estimation purposes. The coefficients of the dropped equation were calculated from the adding-up, homogeneity, and symmetry restrictions in order to satisfy and calculate the estimated demand parameters of SDAIDS model in the Philippine market from 1994 to 2009.

Table 8. Estimated demand parameters of beef using SDAIDS, Philippine market, 1994-2009.

Source	Estimated Parameters						
	β_0	β_1	β_2	β_3	β_4	β_5	β_6
India	-1.253 ns	-1.397 ns	-0.215 ns	1.773 ns	-0.160 ns	-0.939E-09 ns	0.632*
	(1.339)	*(1.525)*	*(0.290)*	*(1.422)*	*(0.052)*	*(0.126E-08)*	*(0.318)*
Australia	1.291*		-0.840 ns	0.973*	0.083*	-0.286E-10 ns	0.381*
		(0.373)		*(0.145)*	*(0.254)*	*(0.029)*	*(0.731E-09)* *(0.157)*
New Zealand	-7.316 ns			-2.793 ns	0.048 ns	0.803E-09 ns	-0.038 ns
		(1.426)			*(1.369)*	*(0.0615)*	*(0.166E-08)* *(0.083)*
Philippines	-0.610 ns				0.101E-08 ns	0.101*	0.314*
		(0.244)				*(0.214E-08)*	*(0.436-E09)* *(0.083)*
ROW	8.887*					-0.577E-08 ns	-1.244 ns
		(0.9997)					*(0.281E-08)* *(0.557)*

Values in parentheses are standard errors of estimates
* - Significant at 10%
ns - not significant
Legend:
β_0= Intercept
β_1= ln(price of beef from India)
β_2= ln(price of beef from Australia)
β_3= ln(price of beef from New Zealand)

β_4= ln(price of beef from Philippines)
β_5= ln(price of beef from ROW)
β_6= ln(total real income)

Table 9.Estimated demand parameters of broiler chicken using SDAIDS,Philippine market, 1994-2009.

Source	Estimated Parameters						
	β_0	β_1	β_2	β_3	β_4	β_5	β_6
China	10.166 ns	17.615 *	-1.035*	-17.299 ns	0.755 ns	-0.036*	0.344*
	(23.051)	*(31.336)*	*(0.528)*	*(31.565)*	*(0.632)*	*(0.018)*	*(0.145)*
USA	37.703*		-0.589*	0.113 ns	1.551*	-0.039*	0.402*
	(6.496)			*(0.318)*	*(0.449)*	*(0.528)*	*(0.007)*
	(0.072)						
Australia	33.534*			19.294*	-2.086*	-0.022*	-0.224*
	(20.492)				*(31.806)*	*(0.582)*	*(0.016)*
	(0.088)						
Philippines	-14.829*				0.012*	0.012*	-0.166*
	(6.921)						*(0.072)*
	(0.07)	*(0.082)*					
ROW	-65.574*					-0.124*	0.107 ns
	(18.194)						*(0.024)*
	(0.126)						

Values in parentheses are standard errors of estimates
** - Significant at 10% level
ns - not significant

Legend:
β_0= Intercept
β_1= ln(price of broiler chicken from China)
β_2= ln(price of broiler chicken from USA)
β_3= ln(price of broiler chicken from Australia)
β_4= ln(price of broiler chicken from Philippines)
β_5= ln(price of broiler chicken from ROW)
β_6= ln(total real income)

Table 10. Estimated parameters of pork using SDAIDS, Philippine market, 1994-2009.

Source	Estimated Parameters						
	β_0	β_1	β_2	β_3	β_4	β_5	
China	-19.337 ns	1.006*	-0.397**	-0.773 ns	0.166*	0.724E-08 ns	
	(62.612)	*(0.462)*	*(.396)*	*(0.208)*	*(0.078)*	*(0.338E-07)*	
Brazil	-100.42*		-0.065 ns	0.461*	-0.127*	0.481E-07*	
	(63.278)			*(0.3970)*	*(0.168)*	*(0.076)*	*(0.326E-07)*
Philippines	-36.663 ns			0.212 ns	0.095*	0.185E-07 ns	
	(46.247)				*(0.208)*	*(0.062)*	*(0.237E-07)*
ROW	157.42*				-0.133 ns	-0.857E-08*	

(94.699) *(0.126)*

(0.487E-07)

Values in parenthesis are standard errors of estimates

** - Significant at 10% level (2-tailed estimate)

ns - not significant

Legend:

β0= Intercept

β1= ln(price of pork from China)

β2= ln(price of pork from Brazil)

β3= ln(price of pork from Philippines)

β4= ln(price of pork from ROW)

β5= ln(total real income)

Philippine Meat Demand Elasticity

Economic theory predicts that the own-price elasticities for individual source-differentiated meats are all negative. This is because of the inverse relationship between own-price for various sources of meat and the quantity demanded. It is noted, however, broiler chicken from China and beef from ROW have positive own-price elasticities but they are not statistically significant. Thus, own-price elasticity of Philippines domestically produced beef is -1.314 and beef from Australia is -2.032, broiler chicken from USA with -1.418 and ROW with -1.105, and pork from China is -1.052, Brazil is -1.001, Philippines is -1.005, and ROW is -1.001 are greater than one and statistically significant (except for pork from the Philippines, Brazil and ROW). This suggests as the price of export and domestic meat (beef, broiler chicken, and pork) increases by 10% the domestic demand of imported beef coming from Australia will decrease by 20.32% and Philippines with 13.14%, for broiler chicken coming from USA with 14.17% and ROW with 11.05%, and for pork coming from China, Brazil, Philippines, and ROW with 10.52%, 10.01%, 10.05%, and 10.01% respectively.

Table 11. Marshallian demand elasticities of beef, Philippine market, 1994-2009.

Source	Price Elasticities					Income Elasticity
	India	Australia	New Zealand	Philippines	ROW	
India	-0.517 ns	0.203 ns	-0.236 ns	-0.383*	-0.176 ns	0.496*
Australia		-2.032*	-0.139*	0.528*	0.181 ns	1.295*
New Zealand			-0.580*	- 3.845 ns	-1.024 ns	1.006 ns
Philippines				-1.314 ns	-0.086*	0.485*
ROW					0.244 ns	0.860*

** - Significant at 10%

ns - not significant

ROW includes Brazil and USA

Table 12. Marshallian demand elasticities of broiler chicken, Philippine market 1994-2009.

Source	Price Elasticities					Income Elasticity
	China	USA	Australia	Philippines	ROW	
China	0.388 ns	-0.136*	-0.448 ns	-0.165 ns	0.017*	1.034*
USA		-1.418*	0.256 ns	-0.526*	0.062*	1.011*
Australia			-0.201*	-0.235*	0.055*	0.993*
Philippines				-0.835*	-0.024*	1.011*
ROW					-1.105*	0.998 ns

** - Significant at 10% level (2-tailed estimate)
ns - not significant
ROW includes Brazil, Canada, Malaysia, and New Zealand

Table 13. Marshallian Demand Elasticities of pork, Philippine market, 1994-2009.

Source	Price Elasticities				Income Elasticity
	China	Brazil	Philippines	ROW	
China	-1.052*	0.004 ns	0.021*	0.002*	0.999 ns
Brazil		-1.001 ns	-0.013*	-0.001*	0.999*
Philippines			-1.005 ns	-0.001 ns	0.999 ns
ROW				-1.001 ns	0.999*

** - Significant at 10% level (2-tailed estimate)
ns - not significant
ROW includes France and Germany

Inelastic and significant own-price responses were found for beef from New Zealand with 0.580, broiler chicken coming from Australia with 0.201, and Philippines with 0.835. The inelastic own-price elasticities of the source-differentiated beef and broiler chicken indicated that they are not responsive to the export and domestic prices. Cross-price elasticities indicate substitutability or complementary relationship among products from various sources. Thus, the positive inelastic cross-price elasticities between Australian beef and Philippines of 0.528 shown in Table 11 denote substitutability. The same interpretation of cross- price elasticities for broiler chicken between China and ROW of 0.017, USA and ROW of 0.062, and Australia and ROW of 0.055 could be made (Table 12). Similarly, sources of pork with substitutability relationship are found between China and Philippines with 0.021 and China and ROW with 0.002 (Table 13). Although the values of cross-price elasticities show a weak substitutability among sources of meat (beef, broiler, chicken, and pork) these show that the country could source its meat supply from different countries as dictated by prevailing prices. This suggest that if the export prices of beef from Australia and broiler chicken from China, USA, and Australia and pork from China increase by 10%, the Philippines will shift to local beef suppliers by about 5.28% and for pork by about 0.21%. Importation of broiler chicken and pork from ROW will increase by about 1.34% and .02%.

On the other hand, negative cross-price elasticities indicate complementary between and among source-differentiated meat (beef, broiler chicken and pork). With this, several restrictions imposed on the data (e.g. adding- up, homogeneity, and symmetry) may account for the apparent complementary relationships (Yang et al., 1994). Co-movements of exchange rates also may be a factor since the value was used as a proxy for price and the role of exchange rates may not be rejected.

The Source-Differentiated AIDS model shows that in the Philippine beef market, all income elasticities are positive and most of them are statistically significant (except for New Zealand). Beef coming from Australia has the highest income elasticity of 1.295. This captures the demand of local manufacturers for high quality grain-fed and grass-fed beef (AHS, 2006).

Beef coming from New Zealand has an income elasticity of 1.006. The rest have less than 1 income elasticities, thus, ROW has 0.860, India has 0.496, and Philippines has 0.485. The result of the study implies that as the Philippines income increases, demand for beef coming from Australia, New Zealand, ROW, India will also increase.

Income elasticities for broiler chicken are positive and statistically significant except for ROW. Broiler chicken from China registered the highest income elasticity of 1.034, followed by Philippines and USA with 1.011. On the other hand, broiler chicken from ROW and Australia are income inelastic. This suggests as the Philippine income increases, demand of broiler chicken from China, USA, ROW, and Australia will not increase proportionally.

Income elasticities of pork are positive and statistically significant except for the Philippines and China. Both the Philippines and China exhibited the same income elasticity equal to 0.999 (Table 13) or unitary elasticity. This means that as the Philippine income increases, demand of import and domestic pork products will increase with the same percentage.

The findings of the study revealed that meat (beef, broiler chicken and pork) is a normal good. It is noted that export and domestic prices could not affect the demand of meat (beef, broiler chicken, and pork). Consumption as the population and income influences the incr demand over time. The study also found out that consumption of pork is very high Philippines, followed by broiler chicken.

SUMMARY and CONCLUSIONS

Meat consumption in the Philippines has increased by about 1,333,386 million mt in 1994 to 2,576,811 million mt in 2009. On the other hand, importation of meat increased from about 16,918 mt in 1994 to 210,273 mt in 2009. Population and income are factors other than prices that affect the country's meat demand. Hence, as the Philippine population continues to increase, total meat consumption also increases.

The top exporting countries for beef to the Philippines are: India, Australia, New Zealand, and ROW consisting of USA and Brazil. For broiler chicken, China, USA, Australia, and ROW (Brazil, New Zealand, Malaysia, and Canada) are the top exporting countries to the Philippines, and for pork, China, Brazil, and ROW (Germany and France) are the top exporting countries. Historically, Philippine domestic production is the biggest supplier of beef, broiler chicken, and pork in the country, while imported meat products essentially augment the meat supply and to meet the expected demand.

In 1994 to 2009, total average annual expenditure for meat (beef, broiler chicken, and pork) of the Philippines was $4.49 billion. Thus, domestic production captured the major share accounted 94% of the total supply in the country. Importation of meat products spent by the Philippines noted a minimal share recorded from the United Nation Commodity Trade Statistics (UN Comtrade, 2010). The significant increased also of the movement on prices among the various sources of meat indicated that imported beef from ROW (USA and Brazil) has 62%, broiler chicken from Australia has 131%, and pork from ROW (Germany and France) has 57%, respectively, have a volatile characteristics resulted from a lower importation of frozen meat products over time. It is noted that pork consumption in the country is highest while beef is the lowest. Among the meat consumed in the Philippines, broiler chicken has the lowest price followed by pork with beef the most expensive. Broiler chicken is also a substitute for pork and beef particularly for the lower income groups in the country.

Results of this study may shed light on the Philippine consumer's and local manufacturers' preferences with regards to imported and domestic sources of meats. The calculated income (proxied by expenditure) elasticities noted that among the Philippines domestically produce meats; broiler chicken is the most highly responsive to an increase in

consumer's income. The result shows that the Philippines broiler chicken has gain a highest position in the market relative to the other sources of this commodity, namely USA, Australia, ROW, and China.

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