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The Impact of WTO Agreements on Meat Demand in the Caribbean

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Introduction

Before the Uruguay Round of Negotiations, governments could use non-tariff barriers to trade to protect domestic producers by regulating the quantity of imports entering their countries in line with the needs of local consumers, producers and the economy as a whole. However, one of the commitments emanating from the Uruguay Round was that all non-tariff barriers to trade on agricultural goods should be converted to their tariffs equivalents, and over a ten-year period (1995 to 2004), these *ad valorem* tariffs ("bound" rates) should be decreased by 24 per cent from their base level. This process not only has the potential to reduce the price that the average consumer in the Caribbean pays for agricultural products like meat, but could also cause a significant decrease in consumption of locally-produced agricultural goods as cheaper imports become available (see Lewis-Bynoe, Griffith, Moore and Rawlins, 2000, for more details).

The initial impact of this regime shift has created quite a stir in the region as many producers, particularly in the meat industry, are claiming that the replacement of quotas by tariffs (the tariffication process) will drive them out of business because of the more competitive prices for imported substitutes. Statements such as: "Unless local producers get their house in order, the local market will be flooded with foreign foodstuffs" and "Time to do or die for food producers" were the norm in the popular media at the beginning of the 21st Century. However, evidence from the trade statistics of various countries suggests that the fears expressed by the local producers in the region may

be overstated (see for example, Craigwell and Moore, 2001a, b, c). To gauge whether these expectations are rational, conventional demand theory is utilised since a flood of meat imports should occur only if the demand for domestic meats is relatively elastic. However, consumer demand theory is silent on the type of empirical demand model to use. Recently, though, Barten (1993) has developed a general differential demand system (GDS), which has found favour among many researchers because it encompasses various popular empirical demand specifications like the differential almost ideal demand system (AIDS), the Netherlands Central Bureau of Statistics (CBS) model, the Rotterdam model and the Netherlands National Bureau of Research (NBR) model, and allows one to select the best-fit model by the simple application of a likelihood ratio test. In addition, the GDS model, which may lack firm theoretical justification, as argued by Tridimas (2000), can be employed to assess the validity of competing models with different dependent variables, unlike the non-nested approach proposed by Deaton (1978).

This study, therefore, utilises these five types of differential demand systems to examine the demand for the four main types of meat (beef, poultry, pork and mutton) in 14 Caribbean countries, with a goal of simulating the possible implications of the Uruguay Round of agreements. Simulations are done over varying periods because of the paucity of the data.

The structure of the paper is as follows. Section one gives a brief background of the tariffication process. Section two examines the data on the demand for meat in the Caribbean. Section three presents the empirical models, the estimation results and forecasts. Section four concludes.

1. The Tariffication Process: Background

The liberalisation process agreed to by members of the international community calls for the removal of national practices that restrict economic interaction among states. One

aspect of this process, as set down by the WTO agreements, is the reduction of tariffs and the progressive elimination of all non-tariff barriers. At the Uruguay Round of Negotiations, with the exception of certain agricultural products, for example, fish and fish products in the case of Barbados, Caribbean governments decided to follow the general rules by binding their agricultural products to their tariff equivalent, and reducing these *ad valorem* tariffs by 24 per cent from their base level over the period 1995 to 2004. This gradual process was to allow countries to make the necessary arrangements to become more competitive. Though import licences still remain in effect, their issuance became automatic with no restriction being placed on the amount of imports that do not violate public morals.

If these tariffs are sufficiently large, they can offer some protection to the agricultural sector. On the other hand, if the tariffs are not large enough, the country could be faced with an increase of cheaper imports of agricultural products. In this latter case where there was an influx of agricultural commodities entering the Caribbean market (volume trigger) or where there was a fall in the import price below a specified reference price (price trigger) special safeguard mechanisms, which take the form of additional tariffs, can be activated to cushion the potential adverse effect on Caribbean producers. For more details of the impact of trade liberalisation, especially on the Barbadian economy, see Lewis-Bynoe, Griffith, Moore and Rawlins (2000), as well as Griffith, Lewis-Bynoe and Moore (2002).

2. Meat Consumption in the Caribbean

The data used in this paper are annual time series for the four main categories of meat – beef, mutton, pork and poultry – utilised by consumers in 14 Caribbean countries: The Bahamas, Barbados, Belize, Cuba, Dominica, the Dominican Republic, Grenada, Guyana, Haiti, Jamaica, Saint Lucia, Saint Vincent, Suriname, and Trinidad and Tobago. The data were procured

from the Food and Agriculture Organisation (FAO) of the United Nations, and spanned the period 1961-1996.

The Caribbean consists of a diverse group of small, open economies. For example, eight of the 14 countries studied have populations of less than one million people and most of them have been able to achieve a relatively high standard of living; The Bahamas, for example, has a Gross National Product (GNP) per capita of approximately US$ 12,000, while Haiti and Guyana have per capita income levels below US$1,000 (see Table 3.1).

In the 1980s and 1990s, the services sectors, mainly tourism and international business services, began to play a more significant role in these economies. Nevertheless, during the period covered by this study, agriculture accounted for a large share of the economic output of these countries (above 10 per cent of Gross Domestic Product (GDP) in nine of the 14 countries examined) and for approximately 20 per cent of people employed.

Table 3.2 shows that total meat consumption in the Caribbean in 1996 was twice as much as in 1961. This increase was evident in all the countries, especially the Dominican Republic, whose share of total meat consumed rose from 13 per cent in 1961 to 33 per cent in 1996. The Dominican Republic's position, as the largest consumer of meat in the region, was partially due to its high rate of population growth, almost 2.5 per cent per year, compared to 1.3 per cent for the region as a whole. Dominica, Belize, Grenada and Saint Vincent, in spite of an expansion in meat consumption over the period, remained the smallest meat consumers, accounting for less than 1 per cent of total meat consumed regionally.

Table 3.1

Some Summary Economic Statistics for the Caribbean

	Bahamas	Barbados	Belize	Cuba	Dominica	Dominican Republic	Grenada	Guyana	Haiti	Jamaica	St Lucia	St Vincent	Suriname	Trinidad & Tobago
Agriculture value added (% of GDP - 1996)	2.0	5.8	18.9	n.a	21.5	13.3	10.6	36.2	38.8	8.0	10.9	14.9	26.0	2.3
GNP per capita (US$ - 1995)	11,830	6,610	2,650	n.a	2,900	1,390	2,840	630	300	1,580	3,580	2,320	880	3,860
Labour force in agriculture (% of total - 1990)	5.2	6.7	33.6	18.1	n.a	24.8	n.a	21.8	67.8	24.8	n.a	n.a	21.3	11.0

Source: World Development Indicators (2000)
Notes: n.a. means not available

Table 3.2

Meat Consumption in the Caribbean (metric tonnes)

Year	Bahamas	Barbados	Belize	Cuba	Dominica	Dominican Republic	Grenada	Guyana	Haiti	Jamaica	St Lucia	St Vincent	Suriname	Trinidad &Tobago	Total
1961	7,364	8,707	2,302	218,000	1,198	52,000	1,092	8,786	39,000	29,702	1,386	746	7,929	22,625	400,837
1970	14,429	15,889	4,100	303,000	2,139	70,000	2,427	15,052	54,000	56,838	3,453	1,572	10,138	28,658	581,695
1980	20,828	19,967	5,580	329,000	2,158	142,000	3,003	14,652	64,000	82,000	5,226	2,872	14,674	47,521	753,481
1990	26,597	26,410	8,851	414,000	3,808	208,000	3,656	7,115	57,000	105,000	9,110	5,980	16,332	38,316	930,175
1996	27,472	21,360	8,994	243,000	4,836	295,000	5,285	20148	72,000	131,000	12,745	6991	16,050	42,526	907,407

Source: Food and Agriculture Organisation (FAO)

The growth in total meat consumed during the sample period reflects, to a large extent, higher levels of poultry consumption. For example, while the average budget share of poultry in 1961 was only 16 per cent, by 1996 it had risen to 48 per cent (see Table 3.3). Pork consumption also increased on average from 19 per cent in 1961 to 22 per cent in 1996. In contrast, the average consumption shares of beef and mutton were lower in most Caribbean countries, with beef's share falling from 55 per cent in 1961 to 25 per cent in 1996 and mutton's share from 3 per cent to 2 per cent.

Table 3.3

Household Budget Shares of Meat in the Caribbean

Countries	Beef		Mutton		Pork		Poultry	
	1961	*1996*	*1961*	*1996*	*1961*	*1996*	*1961*	*1996*
High income								
Bahamas	0.48	0.29	0.06	0.04	0.31	0.19	0.14	0.48
Upper middle income								
Barbados	0.32	0.15	0.03	0.09	0.58	0.21	0.07	0.55
Grenada	0.39	0.19	0.02	0.02	0.21	0.26	0.23	0.51
St Lucia	0.27	0.12	0.07	0.08	0.52	0.14	0.14	0.63
Trinidad and Tobago	0.25	0.12	0.04	0.03	0.27	0.10	0.41	0.75
Lower middle income								
Belize	0.50	0.23	0.00	0.00	0.39	0.27	0.11	0.50
Cuba	0.66	0.28	0.00	0.01	0.12	0.33	0.10	0.32
Dominica	0.25	0.15	0.06	0.02	0.43	0.15	0.15	0.59
Dominican Republic	0.44	0.27	0.02	0.01	0.17	0.21	0.37	0.51
Guyana	0.56	0.17	0.03	0.04	0.15	0.03	0.21	0.76
Jamaica	0.52	0.15	0.10	0.04	0.22	0.06	0.14	0.75
St Vincent	0.29	0.07	0.05	0.02	0.42	0.20	0.15	0.70
Suriname	0.49	0.26	0.01	0.00	0.03	0.09	0.46	0.64
Lower income								
Haiti	0.36	0.40	0.08	0.06	0.44	0.36	0.05	0.08
Average	0.55	0.25	0.03	0.02	0.19	0.22	0.16	0.48

Source: Food and Agriculture Organisation (FAO)

Poultry consumption in Jamaica increased the most, recording a rise in budget share from 13.6 per cent in 1961 to 74.8 per cent in 1996. The largest consumer of beef in 1961 was Cuba, however, by 1996 Haiti had assumed this position. In this latter year, Haiti was also the biggest pork consumer, overtaking Barbados, the largest pork consumer in 1961. In the case of mutton, while Jamaica was the leading consumer in 1961, by 1996 Barbados had taken over this position.

Producer prices of meat rose in all of the 14 countries studied over the period 1966-1995 (see Table 3.4), reflective of the restrictive trade regimes implemented in these countries to protect local producers. Suriname and Guyana recorded the highest rates of producer price increases. In Suriname, the rise was astonishing, with the price being more than 1,000 times higher in 1995 than it was in 1966, mainly because of several large currency devaluations. An analysis of price and consumption patterns reveals that for 8 countries, the consumption of the various varieties of meat was closely related to price. For example, in the Bahamas the average price of poultry was lower than all the other categories of meat, which resulted in the budget share of poultry rising from 14 per cent in 1961 to 48 per cent by 1996.

Utilising the World Bank's income classification of countries, one can also examine the consumption of meat between countries with differing income levels. This analysis indicates that lower income countries were the largest consumers of beef, mutton and pork, while upper middle income countries were, on average, the largest consumers of poultry.

Table 3.4

Price Average for Four Categories of Meat (US dollars per tonne)

	Beef			Mutton			Pork			Poultry		
	1967	*1995*	*Average*	*1967*	*1994*	*Average*	*1967*	*1995*	*Average*	*1967*	*1994*	*Average*
Bahamas	848	8,900	3,518	901	8,500	3,498	678	5,900	2,443	394	3,600	1,427
	1967	*1995*	*Average*	*1967*	*1994*	*Average*	*1967*	*1995*	*Average*	*1967*	*1995*	*Average*
Barbados	1,200	10,200	5,372	790	11,900	5,257	720	10,600	5,689	660	4,600	2983
	1966	*1995*	*Average*	*1966*	*1994*	*Average*	*1966*	*1995*	*Average*	*1966*	*1995*	*Average*
Belize	970	4,300	2,458	1,100	4,400	2,670	1,420	5,100	3,262	710	3,900	1,978
	1967	*1995*	*Average*	*1967*	*1995*	*Average*	*1967*	*1995*	*Average*	*1967*	*1995*	*Average*
Cuba	475	2,500	1,281	356	2,300	1,025	427	2,300	1,194	570	2,900	1,590
	1967	*1995*	*Average*	*1967*	*1994*	*Average*	*1967*	*1994*	*Average*	*1967*	*1995*	*Average*
Dominica	1,660	15,800	7,114	1,490	15,400	6,523	1,590	15,200	6,818	1,030	10,900	4,609

Table 3.4 (Cont'd)

	Beef			Mutton			Pork			Poultry		
	1966	*1995*	*Average*	*1966*	*1995*	*Average*	*1966*	*1995*	*Average*	*1966*	*1995*	*Average*
Dominican Republic	1,000	32,000	9,701	1,050	20,000	5,990	700	30,000	8,670	868	16,000	4,479
	1966	*1995*	*Average*	*1966*	*1995*	*Average*	*1967*	*1995*	*Average*	*1966*	*1995*	*Average*
Grenada	1,390	10,500	5,974	1,260	2,957	5,991	1,110	5,300	3,575	1,890	8,600	5,708
	1966	*1995*	*Average*	*1966*	*1995*	*Average*	*1966*	*1995*	*Average*	*1966*	*1995*	*Average*
Guyana	1,708	348,000	6,8453	2,957	812,000	136,318	1,602	526,000	102,525	4,620	780,000	153,802
	1967	*1995*	*Average*	*1967*	*1995*	*Average*	*1967*	*1995*	*Average*	*1967*	*1995*	*Average*
Haiti	1,750	29,392	11,308	1,400	42,000	10,634	2,275	36,278	11,619	2,136	32,450	10,613
	1966	*1994*	*Average*	*1966*	*1994*	*Average*	*1966*	*1994*	*Average*	*1966*	*1994*	*Average*
Jamaica	578	45,000	10,032	600	47,000	11,598	322	27,000	7,038	529	32,000	7,057

Table 3.4 (Cont'd)

	Beef			Mutton			Pork			Poultry		
	1967	*1995*	*Average*	*1967*	*1995*	*Average*	*1967*	*1995*	*Average*	*1967*	*1995*	*Average*
St Lucia	1,320	8,500	4,997	2,640	15,500	9,665	1,030	12,500	5,790	2,110	9,200	6,450
	1967	1992	Average	1967	1992	Average	1967	1995	Average	1967	1995	Average
St. Vincent	1,460	9,800	4,271	3,590	8,900	5,754	1,030	7,400	3,380	2,040	10,500	4,883
	1966	*1995*	*Average*	*1966*	*1995*	*Average*	*1966*	*1995*	*Average*	*1966*	*1995*	*Average*
Suriname	1,570	600,000	37,966	1,000	1,000,000	39,247	1,490	700,000	41,697	1,150	500,000	31,688
	1966	*1995*	*Average*	*1966*	*1995*	*Average*	*1966*	*1995*	*Average*	*1966*	*1995*	*Average*
Trinidad and Tobago	1,808	16,840	8,525	1,900	16,950	8,452	1,852	8,070	4,882	1,279	8,500	3,807

Source: Food and Agriculture Organisation (FAO)

3. Empirical Models, Results and Forecasts

Several systems are used in the literature for consumer demand analysis. From an agricultural economic perspective, the most popular of these, in recent times, are the Rotterdam model, the Working model, the Translog model, the AIDS, the GDS, and two mixed demand systems: the CBS and the NBR. This paper utilises differential versions of the Rotterdam, the AIDS, the CBS, the NBR and the GDS, which encompasses the previous four models. More details on these models are developed in Appendix (3.1).

Results

The estimation of the five econometric models was done using the iterative three-stage least squares technique (I3SLS). These estimators are far easier to compute than those from the Full Information Maximum Likelihood (FIML) method, which are asymptotically efficient among all estimators. With normally distributed errors, I3SLS estimations are equivalent to those of FIML in large samples (see Greene, 1997).

The log-likelihood test statistic for each of the systems shows that the general system rejects the four other models, which implies that the GDS best fits the data (see Table 3.5). Accordingly, all of the results are based on the GDS model. The homogeneity restriction is accepted for all the countries, implying that expenditure is exogenous (Chambers, 1990; Attfield, 1985). The latter result is important given that the explanatory variable dlogQ is partially derived from the expenditure weights and meat consumption, implying that the possibility exists that it could be correlated with the error, that is, endogeneity and the estimation problems that come with it (see Greene, 1997).

Table 3.5

Results of the Likelihood Ratio Test

Model	Constraints on the Price Effects	Bahamas	Barbados	Belize	Cuba	Dominica	Dominican Republic	Grenada	Guyana	Haiti	Jamaica	St Lucia	St Vincent	Suriname	Trinidad and Tobago
GDS	Unrestricted	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Homogeneity	3.60	1.25	1.09	4.89	0.44	1.28	2.85	3.63	3.42	5.96	3.15	3.16	2.28	1.60
	Symmetry & Homogeneity	5.16	3.00	32.79	6.50	7.06	1.99	4.67	11.13	64.79	10.01	5.43	22.41	84.60	9.66
Rotterdam	Unrestricted	73.28	77.62	86.59	78.91	75.83	80.02	75.58	71.52	116.12	93.62	77.19	68.11	79.82	88.72
	Homogeneity	71.81	83.77	86.10	79.00	76.11	79.55	75.24	74.27	117.16	90.42	77.21	67.83	80.13	87.77
	Symmetry & Homogeneity	71.78	82.85	100.32	77.69	73.71	79.72	75.07	71.82	93.35	89.42	76.70	60.76	98.28	87.42

Table 3.5 (Cont'd)

		Bahamas	Barbados	Belize	Cuba	Dominica	Dominican Republic	Grenada	Guyana	Haiti	Jamaica	St Lucia	St Vincent	Suriname	Trinidad and Tobago
CBS	Unrestricted	73.79	74.50	82.42	74.99	76.41	82.56	73.61	114.39	108.97	93.45	77.93	72.38	81.74	82.74
	Homogeneity	72.28	79.11	82.13	75.26	76.68	81.86	73.93	116.64	110.81	89.31	77.87	75.57	80.94	81.94
	Symmetry & Homogeneity	71.93	78.36	89.44	74.34	75.44	82.28	73.83	117.70	100.01	87.86	79.15	79.13	90.39	81.34
AIDS	Unrestricted	74.77	79.64	82.15	74.77	76.79	85.58	73.54	116.40	109.20	108.08	78.20	72.24	95.36	81.74
	Homogeneity	84.13	86.01	82.13	81.74	80.30	132.89	74.20	114.98	222.63	125.34	75.76	75.68	152.57	82.72
	Symmetry & Homogeneity	89.13	101.99	143.07	85.46	75.17	141.57	74.61	134.44	165.42	121.83	77.16	67.92	80.51	79.72
NBR	Unrestricted	74.12	83.26	86.28	78.91	76.02	83.06	75.58	76.99	116.18	110.11	77.47	68.11	90.88	88.06
	Homogeneity	82.72	88.97	86.33	84.35	77.97	128.44	75.27	80.05	223.99	130.87	76.71	67.83	151.82	87.77
	Symmetry & Homogeneity	88.12	106.01	150.34	85.91	73.43	138.25	75.85	98.47	170.90	128.10	75.10	57.54	78.83	84.76

Note: The table value for $\chi^2(2)=5.991$ at the 5 per cent level.

One notices that for the Bahamas, Barbados, the Dominican Republic, Grenada and Saint Lucia, the symmetry restriction is also accepted, signifying that the GDS model with homogeneity and symmetry imposed is the preferred model for these countries. The rejection of symmetry for the other countries means that there is some conflict between the data and the theory of a representative consumer maximising a static utility function. This finding could suggest that a dynamic form of the model may be preferred. However, data constraints precluded the use of these types of models, and hence the model without symmetry is adopted for those other countries.

Table 3.6 presents income elasticities derived using Equation (3A) in the Appendix. In six of the 14 countries examined, the income elasticity of beef was more than one, which implies that beef can be considered a luxury item in these countries. However, in the other Caribbean economies, it exhibited the characteristics of a normal good, with income elasticities of between zero and one. It was found that pork was a luxury in four of the least developed Caribbean countries. Surprisingly, given the budget share of poultry, in 12 of the 14 countries evaluated, poultry was shown to be a luxury item, while mutton consumption exhibited the characteristics of an inferior good, reflective of the decline in mutton consumption registered over the sample period despite rising income levels.

Compensated own and cross price elasticities derived from Equations (4A) and (5A) in the Appendix are given in Table 3.6. Theoretically, a stable demand system requires the own price elasticity to be negative. From Table 3.6, this is not always the case, suggesting that these results should be interpreted with caution. Notwithstanding this, in Belize, Cuba, Dominica and Trinidad and Tobago the demand for beef was highly price elastic, with negative own-price elasticity estimates above one. In the case of pork, none of the negative own price elasticities estimated were greater than one. These results seem to mean that, for the most part, meat demand is not very responsive to price, which perhaps, is reflective of its growing share in the average consumer's budget.

Table 3.6

Estimated Income and Price Elasticities for Each Country

Bahamas

Type of Meat	Income Elasticities	Compensated own and cross price elasticities			
		Beef	Pork	Poultry	Mutton
Beef	0.80	0.36	-0.07	-0.25	-0.05
Pork	0.23		-0.01	0.06	0.05
Poultry	1.78			0.27	0.00
Mutton	-2.01				0.09

Barbados

Type of Meat	Income Elasticities	Compensated own and cross price elasticities			
		Beef	Pork	Poultry	Mutton
Beef	1.23	-0.24	0.09	0.21	-0.06
Pork	0.84		0.04	-0.07	-0.03
Poultry	1.11			-0.13	0.03
Mutton	-2.19				0.27

Belize

Type of Meat	Income Elasticities	Compensated own and cross price elasticities			
		Beef	Pork	Poultry	Mutton
Beef	1.14	-3.72	-0.48	0.03	4.17
Pork	0.85	-0.02	0.00	0.09	-0.07
Poultry	1.05	2.89	0.37	-0.10	-3.16
Mutton	-2.02	-9.00	-0.90	-0.50	10.40

Table 3.6 (Cont'd)

Cuba

Type of Meat	Income Elasticities	Compensated own and cross price elasticities			
		Beef	Pork	Poultry	Mutton
Beef	0.72	-1.06	-1.50	2.34	0.22
Pork	1.50	0.66	5.00	-4.37	-1.29
Poultry	1.24	1.67	-0.60	-1.57	0.50
Mutton	-2.46	1.88	-5.08	1.89	1.31

Dominican Republic

Type of Meat	Income Elasticities	Compensated own and cross price elasticities			
		Beef	Pork	Poultry	Mutton
Beef	0.48	0.02	-0.03	0.01	-0.00
Pork	1.32		0.37	-0.29	0.00
Poultry	1.34			0.09	0.00
Mutton	-2.13				0.01

Dominica

Type of Meat	Income Elasticities	Compensated own and cross price elasticities			
		Beef	Pork	Poultry	Mutton
Beef	1.30	-1.90	0.10	1.69	0.10
Pork	-0.18	3.46	0.97	0.33	-4.76
Poultry	2.12	-0.98	-0.74	-1.19	2.91
Mutton	-2.24	-9.31	0.47	4.56	4.27

Table 3.6 (Cont'd)

Grenada

Type of Meat	Income Elasticities	Compensated own and cross price elasticities			
		Beef	Pork	Poultry	Mutton
Beef	2.07	0.47	0.14	-0.52	-0.09
Pork	0.12		-0.44	0.27	-0.01
Poultry	0.79			0.14	0.03
Mutton	-1.98				0.46

Guyana

Type of Meat	Income Elasticities	Compensated own and cross price elasticities			
		Beef	Pork	Poultry	Mutton
Beef	0.55	-0.45	-0.00	0.26	0.20
Pork	0.13	-0.01	0.13	0.64	-0.76
Poultry	1.63	0.32	-0.12	-0.32	0.04
Mutton	-1.31	-0.01	-0.01	0.00	0.06

Haiti

Type of Meat	Income Elasticities	Compensated own and cross price elasticities			
		Beef	Pork	Poultry	Mutton
Beef	0.13	0.65	-0.18	0.19	-0.66
Pork	2.04	-0.91	0.29	-0.04	0.66
Poultry	1.14	1.25	-0.05	-0.55	-0.66
Mutton	-2.30	-0.32	-0.48	-0.19	0.98

Table 3.6 (Cont'd)

Jamaica

Type of Meat	Income Elasticities	Compensated own and cross price elasticities			
		Beef	Pork	Poultry	Mutton
Beef	0.91	-0.02	0.03	0.02	-0.02
Pork	0.87	-0.49	-0.15	0.28	0.36
Poultry	1.08	0.09	0.06	-0.10	-0.05
Mutton	-1.86	0.33	-0.45	0.25	-0.13

St. Lucia

Type of Meat	Income Elasticities	Compensated own and cross price elasticities			
		Beef	Pork	Poultry	Mutton
Beef	1.48	0.16	0.28	0.33	-0.77
Pork	0.70		-0.65	0.21	0.17
Poultry	1.02			-0.29	0.03
Mutton	-2.19				2.32

St. Vincent

Type of Meat	Income Elasticities	Compensated own and cross price elasticities			
		Beef	Pork	Poultry	Mutton
Beef	0.06	0.88	0.11	-0.40	-0.59
Pork	1.28	0.81	0.44	-0.11	-1.13
Poultry	1.19	-0.70	-0.27	0.17	0.80
Mutton	-1.53	-0.30	0.20	0.40	-0.30

Table 3.6 (Cont'd)

Suriname

Type of Meat	Income Elasticities	Compensated own and cross price elasticities			
		Beef	Pork	Poultry	Mutton
Beef	1.64	-0.06	0.14	-0.10	0.03
Pork	-0.20	-0.43	-0.35	0.16	0.63
Poultry	0.79	0.11	-0.03	0.04	-0.11
Mutton	-1.23	-0.16	0.10	-0.06	0.13

Trinidad and Tobago

Type of Meat	Income Elasticities	Compensated own and cross price elasticities			
		Beef	Pork	Poultry	Mutton
Beef	0.84	-2.18	0.01	-0.30	2.46
Pork	0.94	-0.02	-0.48	0.54	-0.04
Poultry	1.08	1.08	0.15	0.02	-1.25
Mutton	-1.86	-2.13	-0.28	-0.61	3.02

Table 3.7

Forecast of Cumulative Growth in Meat Demand (%)

		Bahamas	Barbados	Belize	Cuba	Dominican Republic	Dominica	Grenada	Guyana	Haiti	Jamaica	St. Lucia	St. Vincent	Suriname	Trinidad and Tobago
Beef	Pre 4 - years	5.756	-12.98	-18.81	-27.78	9.86	-3.65	112.52	25.79	0.00	-4.76	6.79	7.27	-21.27	-32.08
	Simulated price Decline	-0.88	-14.08	-0.84	-21.97	7.67	-0.65	-18.42	-9.86	8.26	-9.54	-20.31	-12.42	-13.37	-5.02
Pork	Pre 4 - years	4.75	4.01	4.63	-18.48	60.53	-31.11	5.47	-19.78	50.00	-11.11	27.25	50.47	-46.42	-10.91
	Simulated price Decline	4.23	-14.65	2.69	12.19	-3.06	48.36	3.60	-15.94	-10.95	0.93	-5.78	-39.75	0.86	-24.04
Poultry	Pre 4 - years	1.29	-20.31	-3.11	-46.36	21.05	39.35	6.99	200.40	16.67	36.67	12.77	29.10	-12.20	17.08
	Simulated price Decline	-2.19	11.07	-1.57	9.14	-3.02	-5.11	9.43	3.60	11.61	-10.66	5.35	18.50	5.99	4.39
Mutton	Pre 4 - years	21.10	-18.88	-40.63	-50.00	50.00	2.27	15.96	1.309	0.00	33.33	4.57	-9.71	-7.87	-29.78
	Simulated price Decline	0.00	-0.00	0.98	-0.03	0.00	-0.03	-0.19	0.00	-3.50	143.34	0.00	-0.01	0.03	-0.01

Forecasts

To make an out-of-sample forecast for meat consumption in the Caribbean the preferred GDS model of each country was utilised. The lack of data compelled the authors to use differing periods for the simulations. For eight countries, the period was from 1995 to 1999, from 1994 to 1998 for five countries; and from 1992 to 1996 for Saint Vincent. The forecast results, which are given in Table 3.7, assume that the budget shares remain constant, and that prices decline by a cumulative amount of 24 per cent (6 per cent per year, in line with the WTO arrangements) for the differing periods quoted above. A comparison of these simulated growth rates with those of the previous four years is calculated by the model.

The results show that a decrease in price as recommended under the WTO agreements would lead to increased consumption of poultry for nine countries, with four of them having a growth rate higher than that registered during the previous four-year period, and the other five slightly lower rates of growth. In the remaining five countries, consumption of poultry declines.

Consumption of pork would expand in seven countries, with two countries registering significant increases, compared to the previous four-year period. In the other countries, the consumption of pork declined, with six decreasing significantly in comparison with the four previous years. In most of the countries studied, the consumption of beef falls, which seems to be reflective of a shift in meat consumption from beef to poultry. The significant contractions in beef were also suggestive of the high price elasticity of demand for beef. It was found that a fall in price would not significantly affect mutton consumption regionally.

Conclusion

This study has examined the pattern of consumer demand for beef, mutton, pork and poultry in the Caribbean during the period 1961 to 1996. Five differential demand systems were estimated and through the use of a likelihood ratio test, it was found that the general demand system developed by Barten (1993) fits the data better than the other models. It was, therefore, used to simulate the possible changes in the consumption of meat that could occur in the Caribbean as a result of the tariff rate changes. In most Caribbean countries, poultry was classified as a luxury, while the results for beef, pork and mutton were mixed somewhat evenly. Consequently, it was found that a reduction in prices due to changes in the trading regimes of regional economies would result in increased consumption of poultry in most countries and reduced consumption of most other meats, especially beef.

These findings indicate that the demand for most meats, except poultry, is highly price elastic. Thus, the fears of regional producers of pork, beef and mutton about a flood of cheap imports should, in most instances, not materialise given the low price elasticity of demand. However, the simulation seems to indicate that regional poultry producers need to remain price competitive or they might experience a significant reduction in demand for their output if the tariff barriers on imported meats are removed. This requires that regional poultry producers decrease their production costs and negotiate for the special and differential treatment embodied in the Ministerial Declaration of the WTO. More specifically, in the area of market access for agricultural products, negotiations should centre on the following:

(i) the binding of existing margins of tariff preferences, which are granted to small developing countries and the maintenance of these preferences for a significantly long period to allow for adjustments in these economies;

(ii) stalling further tariff reductions until tariff levels in other member countries are commensurate with regional levels. Furthermore, export subsidies and trade distorting domestic support subsidies by developed countries must be eliminated;

(iii) the mitigation of sanitary and phytosanitary measures which can be used as a barrier to trade by developed countries;

(iv) the establishment of a technical assistance fund to assist the Caribbean Community in complying with standards and other import regulations required for entry into markets of developed countries; and

(v) the setting of relatively high trigger levels before action can be taken to restrict imports from smaller economies.

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Appendix 3.1

Consider the following form of the GDS, developed by Barten (1993):

$$
\begin{aligned}
w_i\, d\log q_i &= a_i + (d_i + \delta_1 w_i)\, d\log Q \\
&\quad + \Sigma_j [e_{ij} - \delta_2 w_i (\delta_{ij} - w_j)] d\log p_j + \varepsilon_i \qquad \text{(1A)} \\
d_i &= \delta_1 \beta_i + (1 - \delta_1)\theta_i \\
e_{ij} &= \delta_2 \gamma_{ij} + (1 - \delta_2)\pi_{ij} \\
i &= 1,2,3,4 \\
j &= 1,2,3,4
\end{aligned}
$$

where δ_{ij} is the Kronecker delta equal to unity if $i = j$, w_i is the budget share of good i, p_i is the price of good i, q_i is the quantity of good i, Q is the total real expenditure defined by $d\log Q = \Sigma_i w_i d\log q_i$, $(d_i + \delta_1 w_i)$ is the marginal budget share, $e_{ij} - \delta_2 w_i (\delta_{ij} - w_j)$ are the Slutsky coefficients, a_i are constants that capture possible trend effects, ε_i is the error term with classical properties and d represents the differential.

Using the two additional parameters, δ_1 and δ_2, Barten (1993) showed that this model nests the other four models. When $\delta_1 = 0$ and $\delta_2 = 0$, one obtains the Rotterdam model, first proposed by Barten (1964) and Theil (1965). The CBS model, which has the features of the Rotterdam and the Working system, is defined when $\delta_1 = 1$ and $\delta_2 = 0$ (see Keller and Van Driel, 1985). When $\delta_1 = 1$ and $\delta_2 = 1$, a differential version of the Deaton and Muellbauer (1980) AIDS model is obtained. The AIDS model is one of the most popular of all the demand systems, given its ease of estimation and interpretation. Finally, with the parameters $\delta_1 = 0$ and $\delta_2 = 1$, the NBR model of Neves (1987) is defined. This model has the Rotterdam income coefficients, but the AIDS price coefficients.

Consumer demand theory requires that the adding-up restrictions $\Sigma_i d_i = 1 - \delta_1$ and $\Sigma_i e_{ij} = 0$, the homogeneity restriction $\Sigma_j e_{ij} = 0$ and the symmetry restriction $e_{ij} = e_{ji}$ are upheld. In essence, these should be tested before imposition. This is done

using a likelihood ratio test (LRT), which allows one to choose the model that fits the data best. The form of the likelihood ratio test statistic is given below:

$$LRT = -2[\log L(\theta^*) - \log L(\theta)] \sim \chi^2(q) \quad \textbf{(2A)}$$

where θ^* is the vector of parameter estimates of either the Rotterdam, the AIDS, or their variants, and θ is the vector of parameter estimates of the general model. The test statistic has a chi-square distribution with q degrees of freedom, which is equal to the difference between the number of parameters in the general model and another model.

Finally, the income and price elasticities are calculated from the estimation results obtained from the chosen model. An estimate of income elasticity for a particular type of meat can be obtained by using the expression below.

$$\eta_i = [(d_i + \delta_1 w_i) / w_i] + 1 \quad \textbf{(3A)}$$

while the compensated own and cross price elasticities, which capture possible substitution effects are calculated as follows,

$$\eta_{ij} = [e_{ij} - \delta_2 w_i (\delta_{ij} - w_j)] / w_i \quad \textbf{(4A)}$$

$$\eta_{ij} = [e_{ij} - \delta_2 w_i (\delta_{ij} - w_j)] / w_i - \eta_i w_j \quad \textbf{(5A)}$$