Caribbean Demand of U. S. and Rest-of-the-World Starchy Food (Wheat, Rice, Corn, and Fresh Potatoes): A Restricted Source Differentiated Almost Ideal Demand System

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November, 2000

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Abstract

This study provides elasticity estimates of the Caribbean demand for U. S. and Rest-of-the-World starchy foods (unmilled wheat and flour, rice, corn and fresh potatoes) using the Restricted Source Differentiated Almost Ideal Demand System (RSDAIDS) model. Caribbean per capita import demand curves for U.S. and Rest-of-the-World (ROW) are own-price unitary elastic for U. S. wheat, and own-price inelastic for U.S. rice and ROW wheat and rice. The implication is that reductions by any means in U. S. or ROW export prices of wheat and rice will increase U.S. or ROW exported quantities in the Caribbean, while at the same time securing food security through import quantity in the Caribbean. Wheat is not produced in the Caribbean. U. S. wheat price policy oriented toward a reduction in the export price of wheat to the Caribbean may increase the U. S. wheat market share in the Caribbean. For wheat and rice, no competition across source exists. Instead, there exists a complementarity relationship across source for each of the two products. In other words, the Caribbean distinguishes between the wheat or rice coming from the U. S. and the wheat or rice coming from the Rest-of-the-World.

Key words: Caribbean demand, elasticity estimates, food security, price policies, Restricted Source Differentiated Almost Ideal Demand System (RSDAIDS), starchy food.

Introduction

Starchy foods are an important dietary component for people in the Caribbean. The four highest volume starchy staples in the Caribbean are wheat, rice, corn, and fresh potatoes. There is no wheat production in the Caribbean region. Rice, corn and fresh potatoes are produced only in a few of the Caribbean countries (Table 2.1).

Table 2. 1. Countries Producing the four Staple Foods (Wheat, Rice, Corn, and Potatoes) in the Caribbean

Staple	Caribbean producer-countries
Wheat	None
Rice	Dominican Republic, Haiti, Jamaica , Puerto-Rico, Trinidad-Tobago
Corn	Antigua-Barbados, Bahamas, Barbados, Dominican Republic, Grenada, Dominica, Guadeloupe, Haiti, Jamaica, Montserrat, Puerto-Rico, St-Lucia, St-Vincent, Trinidad-Tobago
Potatoes	Bermuda, Dominica, Dominican Republic, Guadeloupe, Haiti, Jamaica, Montserrat, St Kitts and Nevis

Source: FAO

Caribbean production of starchy foods is frequently insufficient to satisfy the needs of the growing population. Therefore, the products are imported from the United States and from the Rest-of-the-World.

As shown in Table 2.2, Caribbean total wheat imports varied from year to year and exceeded 15,000 hundreds metric tons each year over a fifteen-year period (1982-96). In 1996, total wheat imports in the region were as high as 46,791 hundreds metric tons. The U. S. share of the Caribbean total volume of wheat imported exceeded 20 percent from 1982 to 1996. In 1995, this share reached its highest level of 41.16 percent over the fifteen-year period. More than half of the volume of wheat (unmilled and flour) imported in the Caribbean comes from the Rest-of-the World, which includes all wheat exporting countries but U. S.

Table 2.2. Caribbean Wheat (Unmilled and Flour) Imports from the U. S., and from the Rest-of-the-World (ROW) from 1982 to 1996.

Year	Imports from U. S. (MT)	Imports from ROW (MT)	Total Imports (MT)	U. S. Share of Total Imports (%)	ROW share of Total Imports (%)
1982	490,491	1,542,749	2,033,240	24.12	75.88
1983	542,501	1,785,449	2,327,950	23.30	76.70
1984	597,601	1,681,899	2,279,500	26.22	73.78
1985	720,745	1,597,955	2,318,700	31.08	68.92
1986	706,606	1,668,094	2,374,700	29.76	70.24
1987	711,284	1,768,516	2,479,800	28.68	71.32
1988	675,388	1,675,912	2,351,300	28.72	71.28
1989	657,801	1,607,199	2,265,000	29.04	70.96
1990	662,582	1,453,218	2,115,800	31.32	68.68
1991	609,272	1,712,428	2,321,700	26.24	73.76
1992	666,802	1,553,698	2,220,500	30.03	69.97
1993	671,832	1,259,668	1,931,500	34.78	65.22
1994	416,663	1,485,937	1,902,600	21.90	78.10
1995	686,931	982,169	1,669,100	41.16	58.84
1996	782,855	3,896,245	4,679,100	16.73	83.27

Sources: USDA data from Foreign Agricultural Trade of the U. S. (FATUS) Calendar Year (column 2)
FAO and USDA data used to compute column 3

Table 2.3 shows that U. S. export price (F.O.B. prices) of wheat was lower than the Rest-of-the-World price from 1982 to 1987. However, starting in 1988, U.S prices exceeded Rest-of-the-World prices, except in 1993. In 1996, the ratio of U. S. price to the Rest-of-the-World price was as high as 1.65. Over the period, the U. S. average export price of the wheat exported to the Caribbean was $168.98 per metric ton, and the Rest-of-the-World average export price was $161.12 per metric ton.

Table 2. 3. U.S. and Rest-of-the-World Export Price Ratio for Wheat (Unmilled and Flour) Exported to the Caribbean (F.O.B. Prices in $ / MT)

Year	U. S. Export Price[1] of Wheat ($ / MT)	ROW Export Price of Wheat ($ / MT)	Price Ratio U. S. / ROW
1982	169.26	230.44	0.73
1983	174.91	191.03	0.92
1984	172.71	202.25	0.85
1985	150.72	188.36	0.80
1986	134.26	159.37	0.84
1987	125.04	134.34	0.93
1988	159.24	124.70	1.28
1989	174.62	159.14	1.10
1990	166.40	144.77	1.15
1991	143.09	126.72	1.13
1992	166.84	124.17	1.34
1993	177.90	185.69	0.96
1994	187.95	156.92	1.20
1995	202.58	150.33	1.35
1996	229.17	138.58	1.65

Being only a total of about thirty small countries constituted of either one island, part of an island, or several islands, the Caribbean absorbs only a small fraction of the U. S. total

[1] U. S. and ROW Exports prices are calculated by dividing U. S. and ROW exports value by quantities exported.

wheat exports to the World. Table 2. 4 indicates that no more than 2.5 percent of the U. S. total wheat exports went to the Caribbean. However, the Caribbean bears a potential for the expansion of the wheat market for both the U.S. and the Rest-of-the-World, given its growing population. According to the Economic Commission for Latin America and the Caribbean, Caribbean population was 17,195 thousands of people in 1982 and raised to 22,053 thousands in 1996, i. e. an increase in population of 28.25 percent over fifteen years.

Table 2.4. World and Caribbean Total Quantity Imported from the U. S., and Caribbean Shares of Total Quantity Imported from the U. S. for Wheat (Unmilled and Flour) from 1982 to 1996.

Year	World Total of U. S. Wheat Exports (MT)	Caribbean Total Imports of Wheat from U. S. (MT)	Caribbean Share of total U. S. Wheat Exports (%)
1982	41,799,723	449,299	1.07
1983	40,387,589	556,427	1.38
1984	43,335,378	611,048	1.41
1985	26,159,952	735,656	2.81
1986	26,125,073	713,654	2.73
1987	32,067,002	724,998	2.26
1988	41,731,227	690,997	1.66
1989	37,525,138	660,913	1.76
1990	28,285,960	667,196	2.36
1991	31,940,373	613,024	1.92
1992	34,654,569	675,577	1.95
1993	36,728,131	677,221	1.84
1994	31,679,796	422,197	1.33
1995	33,458,389	692,137	2.07
1996	31,499,939	782,855	2.49

Source: USDA in Foreign Agricultural Trade of the U. S. (FATUS) Calendar Year.

Caribbean rice production was quite substantial and varied from one year to another between 1982 and 1996. Table 2.5 shows that rice production in the Caribbean ranged from 437 thousands to 705 thousands metric tons between 1982 and 1996. While the Caribbean population followed an upward trend over the period, domestic rice production and imports fluctuated. However, beginning 1990 Caribbean total imports of rice increased considerably, and had more than double from 1993 to 1996, as compared to the lowest level of 335 thousands metric tons of total imports in1984. Despite the increasing population, per capita and yearly rice availability increased from 50 to 70 kilograms from 1988 to 1996. The share of imports in total rice availability in the Caribbean was quite high and varied over time. For the entire period, its lowest level was 34.15 percent in 1984, and its highest level was 62.12 percent in 1993.

The U. S. share of the total quantity of rice imported in the Caribbean increased from 1982 to 1987 to the expense of the Rest-of-the-World. It decreased from 1989 to 1994 to the benefit of the Rest-of-the-World. Over the period, the lowest U. S. share (20.28 percent) of Caribbean total quantity of rice imports occurred in 1982 and the highest one (58.33 percent) occurred in 1989. Furthermore, average U. S. share was 38.39 percent and average Rest-of-the-World share was 61.61 percent.

Table 2.5. Caribbean Rice Production, Rice Imports from the U. S. and from the Rest-of-the-World (ROW), Rice Availability, Exporters' Shares of Caribbean Rice Imports, and Import Share of Availability from 1982 to 1996 .

Year	Production of Rice (1000 MT)	Imports of Rice from U.S. (MT)	Imports of Rice from ROW (MT)	Total Imports (MT)	Total Availab. (MT)	Population (1000 people)	Avail. per person (Kg)	U.S. Share of tot. imprts (%)	ROW Share of tot. imprts (%)	Import Share of Availab. (%)
1982	585	74,460	292,782	367,242	952,242	17,195	60	20.28	79.72	38.57
1983	624	85,661	287,098	372,759	996,759	17,555	60	22.98	77.02	37.40
1984	646	90,936	244,084	335,020	981,020	17,927	50	27.14	72.86	34.15
1985	578	114,956	290,304	405,260	983,260	18,116	50	28.37	71.63	41.22
1986	615	183,949	233,751	417,700	1,032,700	18,838	50	44.04	55.96	40.45
1987	600	252,611	206,909	459,520	1,059,520	19,183	60	54.97	45.03	43.37
1988	576	191,693	164,447	356,140	932,140	19,532	50	53.83	46.17	38.21
1989	599	258,337	184,533	442,870	1,041,870	19,878	50	58.33	41.67	42.51
1990	548	294,367	248,553	542,920	1,090,920	20,229	50	54.22	45.78	49.77
1991	437	268,147	305,093	573,240	1,010,240	20,332	50	46.78	53.22	56.74
1992	705	219,993	417,627	637,620	1,342,620	20,671	60	34.50	65.50	47.49
1993	556	268,023	643,577	911,600	1,467,600	21,012	70	29.40	70.60	62.12
1994	640	189,145	648,055	837,200	1,477,200	21,357	70	22.59	77.41	56.67
1995	633	380,565	558,055	938,620	1,571,620	21,703	70	40.55	59.45	59.72
1996	662	316,847	518,173	835,020	1,497,020	22,053	70	37.94	62.06	55.78

Sources: FAO Production Yearbook (column2)
USDA (FATUS, Calendar Year): column 3
ROW imports are computed using calculated Caribbean imports data from FAO Trade Yearbook and Caribbean imports data from U. S. found in FATUS, Calendar Year.

In general the U.S price of rice tended to be lower than the Rest-of-the-World price during the first six years, except in 1983 and 1984 (Table 2.6). The average U. S price for the six-year period was $394.91, while the average Rest-of-the World price was $436.70. However, from 1988 to 1996, the two prices were close to each other, with the U. S. price slightly higher than the Rest-of-the-World price. During this nine-year period, average U. S price was $336.38 and average Rest-of-the-World price was $320.02. Over the entire fifteen-year period, the ratio of U.S price to the Rest-of-the-World price exceeded one, two-thirds of the time. However, the average U. S. price was $359.79 and the average Rest-of-the-World price was $366.69 per metric ton.

Table 2.6. U.S. and Rest-of-the-World Export Price Ratio for Rice Exported to the Caribbean (F.O.B. Prices in $/MT)

Year	U. S. Export Price[2] of Rice ($ / MT)	ROW Export Price of Rice ($ / MT)	Price Ratio U. S. / ROW
1982	479.19	528.52	0.91
1983	489.35	387.82	1.26
1984	472.70	448.04	1.06
1985	392.02	446.19	0.88
1986	292.82	428.05	0.68
1987	243.35	381.55	0.64
1988	371.69	309.00	1.20
1989	335.43	313.84	1.07
1990	337.98	310.03	1.09
1991	355.54	355.00	1.00
1992	349.32	333.85	1.05
1993	275.89	290.33	0.95
1994	315.49	298.14	1.06
1995	308.87	310.29	1.00
1996	377.20	359.66	1.05

A substantial portion of the total U. S. rice exports goes to the Caribbean. Table 2.7 shows that the Caribbean absorbed between 2 and 11 percent of the total volume of U. S. rice exports between 1982 and 1996. In 1990, 11.73 percent of the volume of U. S. rice exports were purchased by the Caribbean. Therefore, the Caribbean represents an important buyer of rice from the U. S.

Table 2.7. World and Caribbean Total Quantity of Rice Imported from the U. S., and Caribbean Shares of the World Total Quantity of Rice Imported from the U. S. from 1982 to 1996.

Year	World Total of U. S. Rice Exports (MT)	Caribbean Total Imports of Rice from U. S. (MT)	Caribbean Share of total U. S. Rice Exports (%)
1982	2,574,047	74,460	2.89
1983	2,415,568	85,661	3.55
1984	2,194,226	90,936	4.14
1985	1,963,877	114,956	5.85
1986	2,546,830	183,949	7.22
1987	2,493,809	252,611	10.13
1988	2,303,093	191,693	8.32
1989	3,046,522	258,337	8.48
1990	2,509,047	294,367	11.73
1991	2,319,128	268,147	11.56
1992	2,180,712	219,993	10.09
1993	2,776,177	268,023	9.65
1994	2,983,219	189,145	6.34
1995	3,275,176	380,565	11.62
1996	2,839,044	316,847	11.16

Source USDA (FATUS, Calendar Year)

Caribbean corn production ranged between 170 and 290 thousands metric tons, and varied from year to year, as well as imports, over the fifteen-year period. Imports represented a major component of the total volume of corn available. Table 2.8 indicates that the volume of corn imports was about four-fifths of the total volume of corn available in the region during the period. In 1990, the share of the imported corn in the total volume of corn available in the Caribbean was as high as 86.59 percent.

[2] U. S. and ROW Exports prices are calculated by dividing U. S. and ROW exports value by quantities exported.

In general, the U. S. share of the total volume of corn imported in the region exceeded 50 percent over the entire period. Conversely, the Rest-of-the-World share was below 50 percent. From 1991 to 1996, the U. S. share was above 60 percent. In 1994, this share reached its highest level of 86.45 percent.

Corn availability per person did not follow any specific trend from 1982 to 1996. It ranged from 0.06 to 0.09 metric ton. In 1989, its highest level of 90 kilograms was reached and coincided with the highest level of domestic production of 290 thousands metric tons.

Table 2.8. Caribbean Corn Production, Corn Imports from the U. S. and from the Rest-of-the-World (ROW), Corn Availability, Exporters' Shares of Caribbean Corn Imports and Import Share of Availability from 1982 to 1996.

Year	Production of Corn (1000 MT)	Imports of Corn from U.S. (MT)	Imports of Corn from ROW (MT)	Total Imports (MT)	Total Availab. (MT)	Population (1000 people)	Avail. per person (Kg)	U.S. Share of tot. imprts (%)	ROW Share of tot. imprts (%)	Import Share of Availab. (%)
1982	208	486,395	422,035	908,430	1,116,430	17,195	60	53.54	46.46	81.37
1983	228	597,696	357,790	955,486	1,183,486	17,555	70	62.55	37.45	80.73
1984	267	527,490	468,710	996,200	1,263,200	17,927	70	52.95	47.05	78.86
1985	170	469,638	374,162	843,800	1,013,800	18,116	60	55.66	44.34	83.23
1986	265	479,948	519,552	999,500	1,264,500	18,838	70	48.02	51.98	79.04
1987	233	675,895	528,305	1,204,200	1,437,200	19,183	70	56.13	43.87	83.79
1988	213	726,608	593,792	1,320,400	1,533,400	19,532	80	55.03	44.97	86.11
1989	290	766,188	668,812	1,435,000	1,725,000	19,878	90	53.39	46.61	83.19
1990	210	804,637	551,163	1,355,800	1,565,800	20,229	80	59.35	40.65	86.59
1991	198	789,781	263,219	1,053,000	1,251,000	20,332	60	75.00	25.00	84.17
1992	283	862,824	138,776	1,001,600	1,284,600	20,671	60	86.14	13.86	77.97

Table 2.8 (continued)

Year	Production of Corn (1000 MT)	Imports of Corn from U.S. (MT)	Imports of Corn from ROW (MT)	Total Imports (MT)	Total Availab. (MT)	Population (1000 people)	Avail. per person (Kg)	U.S. Share of tot. imprts (%)	ROW Share of tot. imprts (%)	Import Share of Availab. (%)
1993	255	984,770	235,430	1,220,200	1,475,200	21,012	70	80.71	19.29	82.71
1994	281	840,935	131,765	972,700	1,253,700	21,357	60	86.45	13.55	77.59
1995	249	965,025	538,775	1,503,800	1,752,800	21,703	80	64.17	35.83	85.79
1996	285	1,011,455	212,345	1,223,800	1,508,800	22,053	70	82.65	17.35	81.11

Sources: FAO Production Yearbook (column2)
USDA (FATUS, calendar year): column 3
ROW imports are computed using calculated Caribbean imports data from FAO Trade Yearbook and Caribbean imports data from U. S. found in FATUS, calendar year.

The U. S. price (F.O.B. price) of the corn exported to the Caribbean remained in the interval of $100-$130 for thirteen years out of the fifteen year, while the Rest- of- the-World prices ranged from $112.39 to $267.89 over the period (Table 2.9). Yearly price comparison indicates that the U. S. export price of corn was always below the Rest-of-the-World price, except in 1995 where it was slightly above it. For the entire period, the average U. S price (F.O.B. price) of the corn exported to the Caribbean was $116.81 per metric ton, and the average Rest-of-the-World price was $176.59

Table 2.9. U.S. and Rest-of-the-World Export Price Ratio for Corn Exported to the Caribbean (F.O.B. Prices in $/MT)

Year	U. S. Export Price[3] of Corn ($ / MT)	ROW Export Price of Corn ($ / MT)	Price Ratio U. S. / ROW
1982	117.40	224.00	0.52
1983	127.84	187.84	0.68

[3] U. S. and ROW Exports prices are calculated by dividing U. S. and ROW exports value by quantities exported.

Table 2.9 (continued)

Year	U. S. Export Price[4] of Corn ($ / MT)	ROW Export Price of Corn ($ / MT)	Price Ratio U. S. / ROW
1984	147.96	193.98	0.76
1985	124.22	175.94	0.71
1986	103.20	128.39	0.80
1987	83.71	115.63	0.72
1988	105.48	129.09	0.82
1989	113.39	164.81	0.69
1990	113.98	164.41	0.69
1991	108.56	112.39	0.97
1992	107.89	256.59	0.42
1993	106.20	219.38	0.48
1994	111.25	267.89	0.42
1995	119.43	117.83	1.01
1996	161.65	190.71	0.85

The Caribbean share of the World total quantity of corn imported from the U.S. was small. Indeed, only between 1 and 2.46 percent of the total quantity of corn exported by the U. S. went to the Caribbean between 1982 and 1996 (Table 2.10). This share did not follow any specific pattern over the period. The highest share of 2.46 percent was reached in 1993.

[4] U. S. and ROW Exports prices are calculated by dividing U. S. and ROW exports value by quantities exported.

Table 2.10. World and Caribbean Total Quantity of Corn Imported from the U. S., and Caribbean Shares of the Total Quantity of Corn Imported from the U. S. from 1982 to 1996.

Year	World Total of U. S. Corn Exports (MT)	Caribbean Total Imports of Corn from U. S. (MT)	Caribbean Share of total U. S. Corn Exports (%)
1982	48,789,208	486,395	1.00
1983	47,528,000	597,696	1.26
1984	48,940,427	527,490	1.08
1985	43,931,815	469,638	1.07
1986	27,030,110	479,948	1.78
1987	40,765,456	675,895	1.66
1988	46,283,560	726,608	1.57
1989	56,444,899	766,188	1.36
1990	52,003,938	804,637	1.55
1991	44,361,003	789,781	1.78
1992	42,992,617	862,824	2.01
1993	40,045,911	984,770	2.46
1994	35,645,041	840,935	2.36
1995	60,017,511	965,025	1.61
1996	52,177,803	1,011,455	1.94

Source: USDA (FATUS, calendar year)

Caribbean fresh potato production varied from 29 to 61 thousands metric tons over the period (Table 2.11). This production was insufficient to satisfy the needs of the population. A high portion of the fresh potatoes consumed in the Caribbean is imported. Imports and domestic production together provided a constant quantity of 10 kilograms available per person over the period. The share of total imports in the total quantity of fresh potatoes available in the region mostly exceeded 60 percent. The highest share was reached in 1986 and was 80.63 percent.

The U. S. share of total imports of fresh potatoes was low. It ranged from 0.77 percent to 4.36 percent over the period. Conversely, the Rest-of-the-World share of the Caribbean total imports of fresh potatoes exceeded 95 percent.

Table 2.11. Caribbean Fresh Potatoes Production, Fresh Potatoes Imports from the U. S. and from the Rest-of-the-World (ROW), Fresh Potatoes Availability, Exporters' Shares of Caribbean Fresh Potatoes Imports and Import Share of Availability from 1982 to 1996 .

Year	Production of Potatoes (1000 MT)	Imprts of Pot. from U.S. (MT)	Imprts of Pot. from ROW (MT)	Total Imports (MT)	Total Availab. (MT)	Population (1000 people)	Avail. per person (Kg)	U.S. Share of tot. imprts (%)	ROW Share of tot. imprts (%)	Import Share of Availab. (%)
1982	30	3,474	100,880	104,354	134,354	17,195	10	3.33	96.67	77.67
1983	37	3,272	86,214	89,486	126,486	17,555	10	3.66	96.34	70.75
1984	37	2,421	89,767	92,188	129,188	17,927	10	2.63	97.37	71.36
1985	33	714	91,546	92,260	125,260	18,116	10	0.77	99.23	73.65
1986	29	1,416	119,301	120,717	149,717	18,838	10	1.17	98.83	80.63
1987	47	1,010	98,465	99,475	146,475	19,183	10	1.02	98.98	67.91
1988	48	1,051	87,530	88,581	136,581	19,532	10	1.19	98.81	64.86
1989	51	2,404	73,733	76,137	127,137	19,878	10	3.16	96.84	59.89
1990	44	1,624	92,490	94,114	138,114	20,229	10	1.73	98.27	68.14
1991	48	1,571	88,359	89,930	137,930	20,332	10	1.75	98.25	65.20
1992	51	1,306	103,444	104,750	155,750	20,671	10	1.25	98.75	67.26
1993	37	1,713	114,675	116,388	153,388	21,012	10	1.47	98.53	75.88
1994	39	1,434	107,767	109,201	148,201	21,357	10	1.31	98.69	73.68
1995	61	2,081	99,068	101,149	162,149	21,703	10	2.06	97.94	62.38
1996	54	3,791	83,065	86,856	140,856	22,053	10	4.36	95.64	61.66

Sources: FAO Production Yearbook (column2)
USDA (FATUS, calendar year): column 3
ROW imports are computed using calculated Caribbean imports data from FAO Trade Yearbook and Caribbean imports data from U. S. found in FATUS, calendar year.

Over the period, the U. S. export price (F.O.B. price) of fresh potatoes to the Caribbean always exceeded the Rest-of-the-World export price, except in 1991 (Table

2.12). The ratio of the U. S. price to the Rest-of-the-World price had no specific pattern and varied between 1.37 to 1.96 from 1982 to 1990, and between 1.01 to 2.04 from 1992 to 1996. For the entire period, the U. S. average export price of fresh potatoes per metric ton was $424.12, and the Rest-of-the-World average export price per metric ton was $296.89.

Table 2.12. U.S. and Rest-of-the-World Export Price Ratio for Fresh Potatoes Exported to the Caribbean (F.O.B Prices in $/MT)

Year	U. S. Export Price[5] of Fresh Potatoes ($ / MT)	ROW Export Price of Fresh Potatoes ($ / MT)	Price Ratio U. S. / ROW
1982	390.04	250.36	1.56
1983	391.50	268.04	1.46
1984	474.60	303.66	1.56
1985	372.55	272.06	1.37
1986	448.45	229.29	1.96
1987	433.66	263.33	1.65
1988	398.67	250.62	1.59
1989	462.98	294.64	1.57
1990	556.64	317.07	1.76
1991	360.92	378.29	0.95
1992	386.68	350.15	1.10
1993	333.33	298.32	1.12
1994	405.16	336.07	1.21
1995	356.56	352.57	1.01
1996	590.05	288.81	2.04

Table 2.13 shows that the Caribbean share of the world total quantity of fresh potatoes imported deteriorated after 1990. From 1982 to 1986, it varied between 1.17 percent and

4.37 percent. It reached a peak of 10.29 percent in 1987, because the World total imports of potatoes were low. It varied between 2.17 percent and 5.79 percent between 1988 to 1990, and was less than 1 percent from 1991 to 1995.

Table 2.13. World and Caribbean Total Quantity of Fresh Potatoes Imported from the U. S., and Caribbean Shares of the World Total Quantity of Fresh Potatoes Imported from the U. S. from 1982 to 1996.

Year	World Total of U. S. Corn Exports (MT)	Caribbean Total Imports of Corn from U. S. (MT)	Caribbean Share of total U. S. Corn Exports (%)
1982	152,081	6,077	4.00
1983	143,821	6,286	4.37
1984	131,024	4,782	3.65
1985	112,691	1,324	1.17
1986	128,766	5,010	3.89
1987	60,395	6,212	10.29
1988	179,442	10,389	5.79
1989	283,227	8,227	2.90
1990	339,715	7,378	2.17
1991	331,396	3,196	0.96
1992	425,165	2,420	0.57
1993	474,967	2,559	0.54
1994	577,298	3,299	0.57
1995	629,820	5,008	0.80
1996	652,443	8,362	1.28

Source: USDA

Table 2.14 shows that wheat, rice and corn had an average price lower in the U. S. than in the Rest-of-the-World during the 1982-1996 period. However, the average price of fresh potatoes in the U. S. exceeded the average price of fresh potatoes in the Rest-of-the-World.

[5] U. S. and ROW Exports prices are calculated by dividing U. S. and ROW exports value by quantities exported.

Table 2.14. Caribbean Average Prices of Imported Starchy Food (Unmilled Wheat and Flour, Rice, Corn, Fresh Potatoes) from the U. S. and the Rest-of-the-World (1982-1996).

Product	U. S. Average Prices ($/MT)	Rest-of-the-World Average Prices ($/MT)
Wheat	168.98	161.12
Rice	359.79	366.69
Corn	116.81	176.59
Potatoes (fresh)	424.12	296.89

The shares of total per capita expenditures on imports of each starchy food are presented in Table 2.15. In general, the Caribbean spends a lower share of its per capita budget for importing starchy food in the U.S. than in the Rest-of-the-World for all the starchy foods, except corn. Furthermore, the U. S. has a lower export price (net of transportation cost) per metric ton than the Rest-of-the-World, for rice and corn.

Table 2.15. Caribbean per Capita Budget Shares of Starchy Food (Unmilled Wheat and Flour, Rice, Corn, and Fresh Potatoes) Imported from the United States and the Rest-of-the-World (1982-1996).

Product	U. S. Shares %	Rest-of-the-World Shares %
Wheat	15.82	41.02
Rice	5.00	8.33
Corn	18.01	9.33
Potatoes (fresh)	0.05	2.44

In summary, imports represent an important part of the total volume of the starchy foods [wheat (unmilled and flour), rice, corn, and fresh potatoes] available for consumption in the Caribbean. This suggests that food security via total volume of starchy staple available for people to eat in the Caribbean can be achieved only through imports, outside any improvement in domestic production. These staples are imported either from the U. S. or from the Rest-of-the- World, which includes countries other than the U. S. and the Caribbean exporting the four staples to the Caribbean. These two suppliers (U. S. and ROW) have different and sometimes fluctuating market shares in the Caribbean for the four starchy foods. From 1982 to 1996, the U. S. had a higher average export price for wheat than the Rest-of-the-World. More than half of the volume of wheat imported in the Caribbean came from the Rest-of-the-World. For rice, the U. S. had an average export price lower than the Rest-of-the-World, but average U. S. share was lower than average Rest-of the-World share, with a tendency for the U. S. to gain some market share through time. For corn, the U. S. had a lower average price than the Rest-of-the-World, and its share of the Caribbean total imports is higher than the Rest-of-the-World share. For fresh potatoes, the U. S. had a higher price than the Rest-of-the-World and its share of the Caribbean total imports was low. In general the Caribbean spent a higher share of its per capita budget for importing starchy foods from the Rest-of-the-World than from the U. S., except for corn.

Several countries or regions in the world, including developed, developing and less developed ones, import the four staples from the United States. The Caribbean as a whole, as a developing area, generally has a low share of the world total volume of wheat, corn, and fresh potatoes imported from the U.S.

An interesting question that the above presentation of the data suggests is about how one can expect price changes by any means (policies or market adjustment mechanism) in either the U. S. or in the Rest-of-the-World to affect the Caribbean import demand for starchy foods. There is a linkage between imports of starchy foods, food availability in the Caribbean, and foreign supplier market shares. Consequently, changes in the Caribbean import demands of starchy foods due to changes in the foreign supplier prices will impact on both food availability and foreign supplier market share in the Caribbean. Indeed, in the absence of any technological progress to bring about an increase in Caribbean domestic production, higher imports correspond to improvement in Caribbean food availability. Furthermore, if the Caribbean imports more from any of the two sources (U. S. or Rest-of-the-World), the Caribbean market share for this source will increase. In addition, we do not know whether a starchy food from two different origins (U. S. and Rest-of-the-World) is in source-competition or in source-complementarity. We do not know either the magnitude of the possible impact of price changes in the U. S. or in the Rest-of-the-World on the Caribbean imports of starchy foods from the two sources.

As far as Caribbean food availability through imports, as well as U. S. and Rest-of-the-World market shares in the Caribbean through Caribbean imports are concerned, there is a need for determining the responsiveness of the Caribbean starchy food import demand to price changes in the U. S. and the Rest-of-the-World. Given its relatively small share of the total U. S. and total Rest-of-the-World market, the Caribbean is a price taker and does not influence the U. S. and the Rest-of-the-World prices of starchy foods. Therefore, U. S. and Rest-of-the-World prices are exogenous for the Caribbean.

Objectives

The general objective of this paper is to estimate the Caribbean demand of starchy food (wheat, rice, corn, and fresh potatoes) imported from the United States and the Rest-of-the-World and to present the Caribbean import demand elasticities for these staples, using a Restricted-Source-Differentiated Almost Ideal Demand System (RSDAIDS).

This study aims at achieving the three following specific objectives:

1. Determine the impact of price changes in the U. S. and the Rest-of-the-World on Caribbean demand for starchy foods coming from these two foreign suppliers (along with the impact on Caribbean food availability and foreign suppliers market share).
2. Determine whether competition or complementarity relationship exists between a U. S. starchy food and a starchy food from the Rest-of-the-World suppliers of the Caribbean
3. Identify the potentialities for U. S. market expansion in the Caribbean.

Theoretical Model: The Restricted Source Differentiated Almost Ideal Demand System (RSDAIDS)

The Restricted Source Differentiated Almost Ideal Demand System (RSDAIDS) was proposed by Yang and Koo (1994). The Almost Ideal Demand System (AIDS) (Deaton and Muellbauer, 1980a) is modified to allow source differentiation. Two-stage budgeting and separability assumptions are embedded in the RSDAIDS models

The Caribbean is assumed to allocate its import budget to starchy food (wheat, rice, corn, and potatoes), other food products, and non-food products at the first budgeting stage. Once expenditures on imported starchy foods are determined from this first stage, the Caribbean region is assumed to allocate these expenditures to wheat, rice, corn and fresh potatoes. The necessary and sufficient condition for this allocation is that the utility function generating the behavior is weakly separable. Starchy food imported by the Caribbean is assumed to be separable from all other imported food and non-food items and from domestically-produced starchy food. Weak separability requires that the marginal rate of substitution between any two staples belonging to the starchy food group be independent of the quantity consumed of any commodity belonging to the other food-product group or non-food-product group.

The AIDS model has its ground in a Price Independent Generalized Logarithmic (PIGLOG) type of preference from which is derived a cost or expenditure function (Deaton and Mueller 1980a). However, an AIDS model that differentiates by source (Source Differentiated AIDS or SDAIDS) incorporates in the expenditure function the importer's behavior that differentiates goods from different origins (Yang and Koo, 1994). Under the restriction of block substitutability, the Source Differentiated AIDS model becomes the Restricted Source Differentiated AIDS model. Block substitutability means that only an aggregate price of the other products enters the equation of a given source-differentiated product. In other words, Caribbean demand for U.S. rice has the same price response to U. S. wheat and Rest-of-the-World wheat. That is to say that the cross-price effects are not source differentiated between products, while the cross-price effects are source differentiated within a product (Andayani and Tilley).

With the bloc substitutability assumption, the Restricted Source Differentiated AIDS model can be written in the following way:

$$w_{ih} = \alpha_{ih} + \sum_{k} \gamma_{ihik} \ln(p_{ik}) + \sum_{j \neq i} \gamma_{ihj} \ln(p_j) + \beta_{ih} \ln\left(\frac{E}{P}\right) \qquad (1)$$

where $\ln(p_j) = \sum_k w_{jk} \ln(p_{jk})$, w_{ih} is the budget share of good *i* imported from source *h*, α_{ih} is an intercept term, γ_{ihik} is the price coefficient of good i from the different sources k (with k including h) in the equation of good *i* from origin *h*, p_{ik} is the price of good *i* imported from sources *k (*with k including h*)*, γ_{ihj} is a cross-price coefficient of the non-source differentiated or aggregated good j in the equation of good i from origin h, p_j is the price of the non-source differentiated or aggregate good *j (*fo*r j* not equal to *i),* β_{ih} is the real expenditure coefficient, *E* is group expenditures, and *P* is the Stone price index [6].

The demand restrictions of adding-up, homogeneity and symmetry for the RSDAIDS are as follows:

$$\sum_i \sum_h \alpha_{ih} = 1; \quad \sum_h \gamma_{ihik} = 0; \quad \sum_i \sum_h \gamma_{ihj} = 0; \quad \sum_i \sum_h \beta_{ih} = 0; \qquad \text{(Adding-up)} \qquad (2)$$

[6] The Stone index is a linear approximation (Deaton and Muellbauer). In this context of RSDAIDS the Stone index is ln(P)= $\sum_i \sum_h w_{ih} \ln(p_{ih})$ where *i* and *h* are respectively good and source, w is budget share and p is price.

$$\sum_{k}\gamma_{ihik} + \sum_{j\neq i}\gamma_{ihj} = 0\,; \qquad \text{(Homogeneity)} \qquad (3)$$

$$\gamma_{ihik} = \gamma_{ikih} \qquad \text{(Symmetry)} \qquad (4)$$

Marshallian elasticities are computed from the estimated parameters using the following formulas proposed by Yang and Koo :

$$\varepsilon_{i\,hih} = -1 + \frac{\gamma_{ihih}}{w_{ih}} - \beta_{ih}$$: own price elasticity (5)

$$\varepsilon_{ihik} = \frac{\gamma_{ihik}}{w_{ih}} - \beta_{h}\left(\frac{w_{ih}}{w_{ih}}\right)$$: cross- price elasticity with same good but a different origin (k different from h) (6)

$$\varepsilon_{ihj} = \frac{\gamma_{ihj}}{w_{ih}} - \beta_{ih}\left(\frac{w_{j}}{w_{ih}}\right)$$: cross-price elasticity with a different good. (7)

$$\eta_{i} = 1 + \frac{\beta_{ih}}{w_{ih}}$$: expenditure elasticity (8)

Hicksian elasticities are computed using the following formulas:

$$\delta_{i\,hih} = -1 + \frac{\gamma_{ihih}}{w_{ih}} + w_{ih}$$: own price elasticity (9)

$$\delta_{ihik} = \frac{\gamma_{ihik}}{w_{ih}} + w_{ik}$$: cross- price elasticity with same good but a different origin (k different from h) (10)

$$\varepsilon_{ihj} = \frac{\gamma_{ihj}}{w_{ih}} + w_{j}$$: cross-price elasticity with a different good. (11)

Standard errors of the estimated elasticities can be obtained from the variance-covariance matrix of the parameter estimates. T statistics can be computed by dividing the elasticities by their standard error.

Model Specification and Procedure

The model in equation 1 is applied to the Caribbean starchy food import demands. The model is specified as a system of eight equations of the following form:

$$Wheat_{U.S.} = f(P_{wheat,U.S}, P_{wheat,ROW}, P_{rice}, P_{corn}, P_{potatoes}, Expenditure_{starchy}) \qquad (12)$$

$$Wheat_{ROW} = f(P_{wheat,U.S}, P_{wheat,ROW}, P_{rice}, P_{corn}, P_{potatoes}, Expenditure_{starchy}) \qquad (13)$$

$$Rice_{U.S.} = f(P_{rice,U.S.}, P_{rice,ROW}, P_{wheat}, P_{corn,} P_{potatoes}, Expenditure_{starchy}) \qquad (14)$$

$$Rice_{ROW} = f(P_{rice,U.S.}, P_{rice,ROW}, P_{wheat}, P_{corn,} P_{potatoes}, Expenditure_{starchy}) \qquad (15)$$

$$Corn_{U.S.} = f(P_{corn,U.S.}, P_{corn,ROW}, P_{wheat}, P_{rice}, P_{potatoes}, Expenditure_{starchy}) \qquad (16)$$

$$Corn_{ROW} = f(P_{corn,U.S.}, P_{corn,ROW}, P_{wheat}, P_{rice}, P_{potatoes}, Expenditure_{starchy}) \qquad (17)$$

$$Potatoes_{U.S.} = f(P_{potatoes,U.S.}, P_{potatoes,ROW}, P_{wheat}, P_{rice}, P_{corn}, Expenditure_{starchy}) \qquad (18)$$

$$Potatoes_{ROW} = f(P_{potatoes,U.S.}, P_{potatoes,ROW}, P_{wheat}, P_{rice}, P_{corn}, Expenditure_{starchy}) \qquad (19)$$

where the left-hand sides are per capita budget shares of the source-differentiated starchy foods (wheat, rice, corn, potatoes), P stands for price, ROW stands for Rest-of-the-World, and expenditure on starchy foods is per capita real expenditure.

The estimation method used is seemingly unrelated regression (SUR). One equation is dropped to avoid singularity. Homogeneity restrictions are tested and imposed. Source differentiation and block substitutability give a peculiar feature to the model. Each pair of one-product-source-differentiated equations has the same explanatory variables and represents a subset of the system of eight equations. The eight equations constitute a system because the dependent variable in each equation is a share of total import expenditure on starchy food. The right-hand side variables are not totally identical across all eight equations, given the assumptions of one- product source differentiation and block substitutability. With such a feature, symmetry restrictions among goods are not possible (Yang and Koo, 1994).

There are estimation problems using a nonlinear price index to deflate expenditures. It is suggested that the Stone index be used as a linear approximation. However, the use of this index may generate a simultaneity problem, given that dependent variable and expenditure shares in the index would be the same. Remedies are to use the lagged share (Eales and Unnevehr) or the average share (Haden) in the computation of the Stone index. In this study, the lagged budget share is used to construct the Stone index that deflates expenditures. Moschini argues that the Stone index is not invariant to units of measurement and suggests using mean-scaled prices to overcome such a problem. This suggestion is used in this study.

Caribbean demands of starchy food are estimated on per capita basis. Consequently, total expenditures on starchy food as well as budget shares of each staple are computed on per capita basis. Total expenditures are divided by the Caribbean population, as well as total quantities imported of the four staples.

Normality, misspecification, separability, product aggregation, homogeneity, symmetry, and endogeneity tests are conducted.

Normality and Misspecification Tests

The Shapiro-Wilk test is used to test normality. Misspecification tests including normality, joint conditional mean and joint conditional variance tests are performed, using the method proposed by McGuirk et al. (1995). The joint conditional mean test investigates structural change, non-linearity, and temporal dependence. The joint conditional variance test investigates the presence of dynamic and static heteroskedasticity.

Separability Test

Two prominent studies on separability in demand analysis are from Hayes, Wahl, and Williams (1990) and from Moschini, Moro, and Green (1994). The Hayes, Wahl and Williams' approach has been used in most studies dealing with the RSDAIDS model. This method of testing for separability is also applied in this paper.

In Moschini, Moro and Green's view (p.62) the separability test proposed by Hayes, Wahl, and Williams " is consistent with direct weak separability only if the subutility groups are homothetic (thus, it cannot be used to justify second-stage demand systems)." They suggested a likelihood ratio test for testing proposed local separability restrictions (in equation 20 of their paper). Their approach is also used in this paper to test for separability. We perform their separability test with homogenity and symmetry imposed.

The separability assumption is tested to determine whether or not individually or jointly the starchy foods in the model are separable from other starchy foods. If this form of separability holds for each equation, prices of other starchy foods are not relevant arguments in a given equation of the starchy food model. The following restriction on the RSDAIDS model is to be tested for block separability using the Hayes, Wahl, and William's approach:

$$\gamma_{ihj} = w_{ih}\gamma_{ij} \quad \nabla\ j \neq i\ , \qquad (20)$$

where γ_{ij} is the cross-price parameter between groups i and j, and it is estimated from a non-source differentiated AIDS model under the assumption of perfect substitution among all the starchy foods in the model (i.e. no quality difference among starchy staples from different origins).

The separability restriction proposed by Moschini, Moro, and Greene is as follows:

$$\gamma_{ik} = -\alpha_i\alpha_k + (\gamma_{jm} + \alpha_j\alpha_m)\frac{(\alpha_k + \beta_k)(\alpha_k + \beta_k)}{(\alpha_j + \beta_j)(\alpha_m + \beta_m)} \qquad (21)$$

where the alphas are intercept terms, the betas are real expenditure coefficients, the gammas are price coefficients, i and j are goods in the same group, k and m are also goods in the same group (with a possibility that i = j or k = m).

Product Aggregation (or Source Differentiation) Test

Testing product aggregation is equivalent to testing the restrictions that the parameters (intercept, own-price, and source-differentiated cross-price parameters) of the RSDAIDS model are the same as in a non-source-differentiated AIDS model. For the purpose of this test, the following restrictions are imposed on the RSDAIDS model:

$$\alpha_{ih} = \alpha_i \quad \nabla\ h \in\ i\ , \qquad (22)$$

$$\gamma_{ihjk} = \gamma_{ij} \quad \nabla\ h, k \in\ i\ , j,$$

$$\beta_{ih} = \beta_i \quad \nabla\ \mathrm{h} \in\ \mathrm{i}.$$

Homogeneity and Symmetry Tests

Separate and joint tests of homogeneity and symmetry are performed. The homogeneity and symmetry restrictions tested are the ones shown in equations 3 and 4 (with homogeneity and symmetry, adding-up is redundant). If the null hypothesis of existence of homogeneity and symmetry is rejected, these restrictions must be imposed in the estimation process.

Endogeneity Test

The Wu-Hausman endogeneity test as described by Blundell (1987) is conducted. For the purpose of this test, we regress the natural logarithm of the real expenditure variable in the RSDAIDS on the natural logarithm of the aggregate prices of the commodities in the model, and on the natural logarithm of the Caribbean total gross domestic product adjusted for the exchange rate differences among countries. From this regression, we recover the residual. Then, the model with the budget share equations is re-estimated with the inclusion of this residual as an additional explanatory variable. By jointly testing (with an F-test) whether or not the coefficients of the residual in the budget shares equation of the model are significantly equal to zero, we determine whether or not the real expenditure variable is exogenous or endogenous. The null hypothesis is that the real expenditure variable is exogenous.

Data

United States and Rest-of-the-World prices of exports of starchy food (wheat, rice, corn, potatoes) to the Caribbean are one set of variables that are important in this study. Other important variables are quantities of the commodities under consideration imported by the region from the United States and the Rest-of-the-World. Prices are computed as total value of imports divided by quantity imported. The data available for this study are annual and cover a period of fifteen years (from 1982 to 1996).

Wheat is imported in different forms: unmilled wheat, wheat flour, bulgur wheat, and other wheat products. Wheat is aggregated into a single product in both value and quantity terms. In the aggregation of wheat, bulgur wheat and other wheat products are excluded because they are more likely for tourists and others in restaurants. Rice and corn enter our analysis as non-processed products. Potatoes are imported as fresh and as frozen product. However, only fresh potatoes are considered in this study because frozen potatoes are more likely for tourists and others in restaurants.

For each product or product specification, United States exports quantities and total exports values for all parts of the world are given in Foreign Agricultural Trade of the United States (USDA). Total quantities and values of imports of each of the products for all countries are available in the FAO Trade Yearbook (FAO). Therefore, total import quantities, and values of imports from the Rest-of-the-World for the Caribbean region are computed using the data from the FAO reference and the data from the USDA reference. The latter data correspond to import quantities and values of imports from the United States for the Caribbean. Prices are computed as total value divided by total quantity. Production data are from the FAO Production Yearbook (FAO).

Import expenditures on starchy food in the region are computed as the sum of import expenditures on each product, with import expenditures on each product equal to import price multiplied by quantity imported. Total import expenditures on starchy food and quantity imported of each product are calculated on a per-capita basis. Population data for the Caribbean region are from Economic Commission for Latin America and the Caribbean. Caribbean gross domestic product (GDP) is computed as a per capita average over fifteen Caribbean countries for which GDP data are from International Monetary Fund (IMF). Countries GDP are first converted into U.S. dollars by division by the exchange rate[7] which is available in the same source in units of domestic currency per U. S. dollar. .

Results

The normality assumption of the error terms in all the estimated equations is not rejected[8] at 0.05 level of significance. In the joint conditional mean test (misspecification test), we fail to reject the null hypotheses[9] of no structural change, no non-linearity and no temporal dependence, for all the estimated equations at the 0.05 level of significance. In the joint conditional variance test (misspecification test), we fail to reject the null

[7] The IMF reference presents the market exchange rate of the countries either as end-of-period value or as period average. Whatever is available is used, however; when both are available, the period average was chosen.

[8] The Shapiro-Wilk test statistics and their p-values for the seven estimated demand equations (equations 12-18) are:
equation 12: 0.9417 and 0.4797 equation 13: 0.9187 and 0.2408 equation 14: 0.9494 and 0.5898
equation 15: 0.9668 and 0.8532 equation 16: 0.9658 and 0.8399 equation 17: 0.9425 and 0.4907
equation 18: 0.9564 and 0.6979

[9] In the joint conditional mean tests, the p-values for testing for structural change, functional form, and autocorrelation in the seven estimated equations (equations 12-18) are respectively:
equation 12: 0.6808, 0.9699, and 0.4040 equation 13: 0.5867, 0.7657, and 0.3415
equation 14: 0.2841, 0.3923, and 0.9681 equation 15: 0.2794, 0.2790, and 0.6306
equation 16: 0.5953, 0.7490, and 0.4627 equation 17: 0.2814, 0.1850, and 0.4894
equation 18: 0.1417, 0.1803, and 0.8860

hypotheses[10] of no dynamic and no static heteroskedasticity at the same level of significance.

The results of the tests for separability based on Hayes, Wahl, and Williams' suggestion are presented in Table 2.16 which also includes the product aggregation test results and the auxiliary regression of real expenditures to test for endogeneity. The F-test statistic for the null hypothesis that wheat is separable from all starchy foods (i.e. rice, corn and potatoes) is 19.43. For rice and corn, the test statistics are 6.05, 9.79, respectively. Individual and joint hypotheses are rejected at the 0.01 level of significance. We reject the null hypothesis of block separability. We also reject the null hypotheses (individual and joint) of product aggregation. The F-statistic for the joint test of product aggregation is 19919.7. Therefore, there is strong evidence that the source-differentiated model is appropriate.

The F-test statistics for testing homogeneity and symmetry are 5.15 and 5.38, respectively with p values of 0.0002 and 0.0001. These two restrictions have been imposed in the estimation process.

The Wu-Hausman endogeneity test indicates that group expenditures is exogenous in all the equations of the model. Indeed, the null hypothesis that there is no relationship between group expenditures and the error term of the auxiliary regression in table 2.16 below is not rejected at the 0.05 level of significance. This model is free of concerns of group expenditure endogeneity problem that may arise in the AIDS model (LaFrance).

[10] In the joint conditional variance tests, the p-values for testing for static and dynamic heteroskedasticity in the seven estimated equations (equations 12-18) are respectively:

equation 12: 0.4176, 0.9808 equation 13: 0.5552, 0.2896
equation 14: 0.2157, 0.7813 equation 15: 0.3025, 0.2360,
equation 16: 0.1609, 0.1302 equation 17: 0.8577, 0.1983
equation 18: 0.9357, 0.4874

Table 2.16. Results of Block Separability, Product Aggregation, and Endogeneity Test for the RSDAIDS Model

Type of Test	Test Results
Block Separability	H0: Wheat is separable from all other starchy foods. F = 19.43** df:6 for numerator and 59 for denominator
	H0 : Rice is separable from all other starchy foods. F = 6.05** df: 6 for numerator and 59 for denominator
	H0: Corn is separable from all other starchy foods. F = 9.79** df: 6 for numerator and 59 for denominator
	H0: All of the above F = 11.60** df: 18 for numerator and 59 for denominator
Source Differentiation	H0: Wheat can be aggregated. F = 714.19** df: 5 for numerator and 68 for denominator
	H0: Rice can be aggregated. F = 172.94** df: 5 for numerator and 68 for denominator
	H0: Corn can be aggregated. F = 156.75** df: 5 for numerator and 68 for denominator
	H0: Potatoes can be aggregated. F = 78635.1** df: 5 for numerator and 68 for denominator
	H0: All of the above F = 19919.7** df: 20 for numerator and 68 for denominator
Auxiliary Regression of Real Expenditures to Test for Endogeneity	$\ln(E/P) = \underset{(1.03)}{-2.71^{**}} - \underset{(0.51)}{1.17^{*}}LP_{Wheat} + \underset{(2.01)}{1.41}LP_{Rice} + \underset{(1.06)}{2.22^{*}}LP_{Corn}$ $\underset{(8.15)}{-16.17^{*}}LP_{Potatoes} \underset{(0.72)}{-0.76}Lag_{RealExp} \underset{(0.003)}{-0.0007}LogGDP$

Note: (*) and (**) denote significance at the 10% and 5%, respectively. Number in parentheses are standard errors.

The Moschini, Moro, and Greene likelihood ratio test of separability indicates that each of the starchy foods is separable from all other starchy foods (just like the Hayes, Whal and Williams' test) at the 5 percent level of significance. The calculated likelihood ratio test statistic is 17.755 with 2 degrees of freedom is greater than the critical value of 5.99 of a chi-square with 2 degrees of freedom, implying a rejection of the joint null hypothesis that all the starchy foods are separable from each other.

The estimated budget shares equations[11] are as follows:

$$W_{wheat,U.S} = \underset{(0.113)}{0.1072} \underset{(0.030)}{-0.0059} \ln P_{Wheat,U.S.} \underset{(0.035)^{**}}{-0.1118} \ln P_{Wheat,ROW} \underset{(0.348)}{-0.1307} \ln P_{Rice} \quad (23)$$

$$\underset{(0.170)}{+0.0452} \ln P_{Corn} \underset{(0.341)}{+0.2032} \ln P_{Potatoes} \underset{(0.072)}{-0.0308} \ln \textit{Real expenditure}$$

$$W_{Wheat,ROW} = \underset{(0.204)^{**}}{0.9421} \underset{(0.035)^{**}}{-0.1118} \ln P_{Wheat,U.S.} \underset{(0.063)^{**}}{+0.2791} \ln P_{Wheat,ROW} \underset{(0.575)^{**}}{+1.7498} \ln P_{Rice} \underset{(0.288)}{-0.1460} \ln P_{Corn}$$

$$\underset{(0.589)^{**}}{-1.7711} \ln P_{Potatoes} \underset{(0.131)^{**}}{+0.3264} \ln \textit{Real expenditure} \quad (24)$$

$$W_{Rice,U.S.} = \underset{(0.044)}{0.0330} \underset{(0.014)}{+0.0059} \ln P_{Rice,U.S.} \underset{(0.011)^{**}}{-0.0777} \ln P_{Rice,ROW} \underset{(0.042)^{**}}{-0.1457} \ln P_{Wheat} \underset{(0.093)}{+0.0266} \ln P_{Corn}$$

$$\underset{(0.072)^{**}}{+0.1909} \ln P_{Potatoes} \underset{(0.028)}{-0.0088} \ln \textit{Real expenditure} \quad (25)$$

[11] In the budget shares equations the values in parentheses are standard errors, and two asterisks (**) denote significance of the coefficients at 0.05

$$W_{Rice,ROW} = -0.1439 - 0.0777 \ln P_{Rice,U.S.} + 0.0175 \ln P_{Rice,ROW} + 0.1202 \ln P_{Wheat} +$$

(0.103) (0.011)** (0.022) (0.097)

$$+0.1705 \ln P_{Corn} - 0.2305 \ln P_{Potatoes} - 0.1443 \ln \textit{Real expenditure} \quad (26)$$

(0.163) (0.132) (0.065)**

$$W_{Corn,U.S.} = 0.0256 + 0.1861 \ln P_{Corn,U.S.} + 0.0073 \ln P_{Corn,ROW} - 0.2936 \ln P_{Wheat} - 1.5222 \ln P_{Rice}$$

(0.082) (0.034)** (0.014) (0.077)** (0.226)**

$$+1.6223 \ln P_{Potatoes} - 0.0917 \ln \textit{Real expenditure} \quad (27)$$

(0.216)** (0.052)

$$W_{Corn,ROW} = 0.0126 + 0.0073 \ln P_{Corn,U.S.} - 0.0123 \ln P_{Corn,ROW} - 0.0027 \ln P_{Wheat} - 0.0126 \ln P_{Rice}$$

(0.161) (0.014) (0.029) (0.143) (0.370)

$$+0.0203 \ln P_{Potatoes} - 0.0493 \ln \textit{Real expenditure} \quad (28)$$

(0.362) (0.102)

$$W_{Potatoes,U.S.} = 0.0011 + 0.0008 \ln P_{Potatoes,U.S.} - 0.0002 \ln P_{Potatoes,ROW} + 0.0015 \ln P_{Wheat} - 0.0017 \ln P_{Rice}$$

(0.0007) (0.0002) (0.0003)** (0.0007)** (0.001)

$$-0.0005 \ln P_{Corn} + 0.0004 \ln \textit{Real expenditure} \quad (29)$$

(0.002) (0.0005)

Marshallian and Hicksian elasticity estimates are computed based on the budget share equations. These elasticity estimates and their standard errors are in Tables 2.17, and 2.18, respectively. In general, the own-price coefficients of Caribbean per capita demand for both U. S. and Rest-of-the-World starchy foods are negative and significant, except for the demand for U. S. corn and the demand for U. S. potatoes where they are positive and non significant. We perform our analysis only on the basis of significant elasticity estimates.

Table 2.17 indicates that the own-price Marshallian per capita demand elasticities for U. S. wheat and U. S. rice are higher than the own-price Marshallian per capita demand elasticities for the Rest-of-the-World wheat and rice. Caribbean per capita demand for U. S wheat is unitary elastic to U.S. wheat price, and Caribbean per capita demand of rice from the U. S. is own-price inelastic. Furthermore, Caribbean per capita demands for the Rest-of-the-World wheat and rice are own-price inelastic, and Caribbean per capita demand for the Rest-of-the-World corn is own-price elastic.

From the U. S. perspective alone, the implication of these results is that reduction in the price of the U. S wheat would be more effective than reduction in the price of U. S. rice in addressing eventual issue of food security through imports in the Caribbean, or equivalently, in increasing U. S. exports to the Caribbean. Because the own- price elasticity estimates for U. S corn and U. S. potatoes are not significant, no conclusion related to own-price elasticities of Caribbean per capita demand for U. S. corn and U. S. potatoes can be drawn.

From the Rest-of-the-World perspective alone, changes in the wheat price would have the same impact on Caribbean per capita demand for the Rest-of-the-World wheat as would changes in the rice price on Caribbean per capita demand for the Rest-of-the-world rice. A 1 percent change in the price of wheat and rice in the Rest-of-the-World would lead to less than 1 percent change in the Caribbean per capita demands for these two staples, given that these demands are own-price inelastic.

Table 2.17. Marshallian Elasticities for Starchy Food (Wheat Unmilled and Flour, Rice, Corn, and Fresh Potatoes) Import Demand in the Caribbean (1982-1996).

Product equation	Variables	U. S. equation	Rest-of-the- World (ROW)
Wheat (unmilled	$LogPWHT_{US}$	-1.01 ** (0.23)	-0.40** (0.12)
and flour)	$LogPWHT_{ROW}$	-0.63 ** (0.22)	-0.65 ** (0.15)
	$LogP_{RICE}$	-0.80 (2.23)	4.16 ** (1.42)
	$LogP_{CORN}$	0.34 (1.11)	-0.57 (0.73)
	$LogP_{POTATOES}$	1.29 (2.15)	-4.34** (1.43)
	$Log(Exp/P)$	0.81 (0.46)	1.80** (0.32)

Table 2.17 (continued)

Product equation	Variables	U. S. equation	Rest-of-the- World (ROW)
Rice	$LogP_{RICE\,US}$	-0.87 **	-0.85**
		(0.29)	(0.14)
	$LogP_{RICE\,ROW}$	-1.54 **	- 0.65 **
		(0.23)	(0.28)
	$LogP_{WHEAT}$	-2.81 **	2.43**
		(0.78)	(1.12)
	$LogP_{CORN}$	0.58	2.52
		(1.92)	(2.03)
	$LogP_{POTATOES}$	3.81 **	-2.72
		(1.43)	(1.59)
	$Log(Exp/P)$	0.82	- 0.73
		(0.56)	(0.78)
Corn	$LogPCORN_{US}$	0.12	0.17
		(0.22)	(0.26)
	$LogPCORN_{ROW}$	0.09	-1.08 **
		(0.08)	(0.33)
	$LogPWHEAT$	-1.34 **	0.27
		(0.39)	(1.57)
	$LogP_{RICE}$	-8.31**	0.01
		(1.28)	(4.07)
	$LogP_{POTATOES}$	9.02 **	0.23
		(1.20)	(3.88)
	$Log(Exp/P)$	0.49	0.47
		(0.29)	(1.10)

Table 2.17 (continued)

Product equation	Variables	U. S. equation	Rest-of-the- World (ROW)
Potatoes	$LogP_{POTATOES\,US}$	0.61 (0.41)	
	$LogP_{POTATOES\,ROW}$	-0.40 (0.57)	
	$LogPWHEAT$	2.80 (1.42)	
	$LogP_{RICE}$	-3.67 (2.05)	
	$LogPCORN$	-1.19 (3.40)	
	$Log(Exp/P)$	1.84 (0.99)	

$Log(Exp/P)$ stands for logarithm of deflated per capita expenditures in imports of starchy food in the Caribbean.
$LogP$ stands for logarithm of price.
** denotes that elasticity is significant at the 0.05 level of significance
The numbers in parentheses are standard errors.

In the very short term, it is plausible to assume that price changes of a staple from one source do not affect the demand for this staple in the other source. Under this condition, Caribbean short-term security in wheat and rice consumption through imports will be better achieved by reducing (ceteris paribus) U. S. wheat and rice prices than by reducing (ceteris paribus) Rest-of-the-World wheat and rice prices. This is due to the larger size of the U. S. own-price elasticities for wheat and rice. Everything else kept constant, reducing U. S. prices of wheat and rice would increase Caribbean imports from U. S. more than would reducing Rest-of-the-World prices. Therefore, everything else constant, for wheat and rice, U. S market share through Caribbean imports would increase more if a price reduction occurs in the U.S than if it occurs in the Rest-of-the-World. For corn, a 1 percent change in the Rest-of-the-World price would generate a more than 1 percent change in the Caribbean per capita demand (elasticity is 1.08). Consequently, reduction in the Rest-of-the-World corn price would have a substantial impact on Caribbean security in corn consumption. Furthermore, keeping everything else fixed, this price reduction would increase the Rest-of-the-World market share for corn in the Caribbean.

In the intermediate or long runs, price changes of a staple from one source are likely to have repercussion effects on the demand of the same staple from the other source. Therefore, a 1 percent change in the U. S wheat price would lead to a change in the opposite direction of 1 percent in the per capita demand for U. S. wheat, and of 0.4 percent in the per capita demand for ROW wheat in the Caribbean (i.e. the per capita demand for U. S. wheat is unitary elastic to U. S. price, and the per capita demand for ROW wheat is inelastic to U. S. price). Caribbean wheat security through imports from both sources can be achieved through reduction in the price of the U. S. wheat. Keeping the prices of all the other starchy staples constant (i.e. ceteris paribus assumption), a reduction in the U. S. price of wheat by 1 percent will increase U. S. and Rest-of-the-World wheat exports to the Caribbean by 1 percent and 0.4 percent respectively. Depending on the size of the price reduction and the initial market shares, the U. S. may even gain wheat market share over the Rest-of-the World in the Caribbean[12] through the price reduction. However, a ceteris paribus reduction in the price of the Rest-of-the-World wheat will always favor the Rest-of-the-World in terms of market share in the Caribbean, while also improving food security in the Caribbean through increased imports of wheat from both sources (note Caribbean per capita demand elasticities to the Rest-of-the-World price are –0.65 and –0.63 for U. S. wheat and ROW wheat, respectively).

For rice, a ceteris paribus reduction in the U. S export price to the Caribbean would certainly improve Caribbean food security through increased imports of rice from both sources. However, U. S. market share gain over the Rest-of-the-World would be more difficult to achieve, given the quasi-equality of the two elasticity estimates for the U. S. price of rice in both the U. S. and the ROW equations (-0.87 and –0.85, respectively). If the reduction occurred in the price of the ROW rice, it would also improve Caribbean food security through increased imports of rice from both sources, but with a possibility for the U. S. to gain market share over the ROW, depending on the size of the ROW price reduction and initial shares conditions (Caribbean demand elasticities to ROW price of rice are -1.54, and –0.65 in the U. S and the ROW equations, respectively).

For corn, reduction in the ROW price would improve food security in the Caribbean through increased imports of corn from the Rest-of-the-World (for certain). At the same time, this price reduction may favor the Rest-of-the-World in terms of market share gain,

[12] Let's assume that a high price reduction occurred in the U. S. and the market shares of the two sources (U. S. and ROW) were close to each other. The increase of 1 percent in Caribbean demand for U. S. wheat for every 1 percent reduction in the U. S price is higher than 0.4. This latter value is the corresponding percent increase in the Caribbean demand for the ROW wheat for a 1 percent reduction in the U. S. wheat

based on the extent of the price reduction and initial market share conditions (elasticity estimate is –1.08)

In addition, the source-differentiated Marshallian cross-price elasticities between wheat from the U. S. and from the Rest-of-the-World (as well as between rice from the U. S. and from the Rest-of-the-World) are negative and significant. Therefore, there is no competition among sources for these two products. This suggests that wheat and rice from the U. S. and from the Rest-of-the-World might be considered as two different products in the Caribbean. For corn, the source-differentiated Marshallian cross-price elasticities in the U. S. and the Rest-of-the-World equations are also negative but not significant. The same is true in the U. S. potatoes equation.

Focusing only on the significant Marshallian elasticity estimates, we have no conclusion about the nature of the cross relationship between the Caribbean per capita demand for U. S. wheat and the price of the three other staples (rice, corn and potatoes). However, in the Caribbean, rice from all sources seems to be a substitute for the Rest-of-the-World wheat (cross-price elasticity = 4.16), and complement to the U. S corn (cross-price elasticity = -8.31. Potatoes from all sources seems to be complement to the Rest-of-the-World wheat (cross-price elasticity = -4.34), and substitute to the U.S rice (cross-price elasticity=3.81) and to the U. S. corn (cross-price elasticity = 9.02). Wheat from all sources appears to be substitute to the Rest-of-the-world rice (cross-price elasticity =2.43), but complement to the U. S. rice (cross-price elasticity = -2.81) and to the U. S. corn (cross-price elasticity = -1.34).

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price. In absolute term, the U.S share may overshoot the Row share for this product in the Caribbean, given the size of the price reduction in the U. S. and the closeness of the two shares before this price reduction.

Growth that brings about increased per capita real expenditure in starchy food consumption in the Caribbean is likely to increase Caribbean per capita demand for the Rest-of-the-World wheat (elasticity=1.80). However, there is no evidence that growth in the Caribbean would affect its demand for U. S. starchy foods in general, and for the Rest-of-the-World rice and corn, given that the related elasticity estimates are not significant.

Table 2.18. Hicksian or Compensated Price Elasticities for Starchy Food (Wheat Unmilled and Flour, Rice, Corn, and Fresh Potatoes) Import Demand in the Caribbean (1982-1996).

Product equation	Variables	U. S. equation	Rest-of-the- world (ROW)
Wheat (unmilled	$LogPWHT_{US}$	-0.88** (0.19)	-0.11 (0.09)
and flour)	$LogPWHT_{ROW}$	-0.30 (0.22)	0.09 (0.15)
	$LogP_{RICE}$	-0.69 (2.20)	4.40 ** (1.40)
	$LogP_{CORN}$	0.55 (1.08)	-0.08 (0.70)
	$LogP_{POTATOES}$	1.31 (2.15)	-4.29** (1.44)

Table 2.18 (continued)

Product equation	Variables	U. S. equation	Rest-of-the- world (ROW)
Rice	$LogP_{RICE\,US}$	-0.83 **	-0.88 **
		(0.28)	(0.13)
	$LogP_{RICE\,ROW}$	-1.47 **	-0.71 **
		(0.22)	(0.27)
	$LogP_{WHEAT}$	-2.34 **	2.01
		(0.85)	(1.17)
	$LogP_{CORN}$	0.80	2.32
		(1.86)	(1.95)
	$LogP_{POTATOES}$	3.83 **	-2.74
		(1.44)	(1.59)
Corn	$LogPCORN_{US}$	0.21	0.26
		(0.19)	(0.15)
	$LogPCORN_{ROW}$	0.13	-1.04**
		(0.08)	(0.31)
	LogPWHEAT	-1.06 **	0.54
		(0.43)	(1.53)
	$LogP_{RICE}$	-8.32 **	-0.002
		(1.25)	(3.97)
	$LogP_{POTATOES}$	9.03**	0.24
		(1.20)	(3.88)

Table 2.18 (continued)

Product equation	Variables	U. S. equation	Rest-of-the- world (ROW)
Potatoes	$LogP_{POTATOES\,US}$	0.61 (0.41)	
	$LogP_{POTATOES\,ROW}$	-0.36 (0.58)	
	$LogPWHEAT$	3.85 ** (1.57)	
	$LogP_{RICE}$	-3.42 (2.08)	
	$LogPCORN$	-0.68 (3.28)	

$Log(Exp/P)$ stands for logarithm of deflated per capita expenditures in imports of starchy food in the Caribbean.
$LogP$ stands for logarithm of price.
** denotes that elasticity is significant at 0.05 level of significance.
The numbers in parentheses are standard errors.

Discussions

The estimated elasticities may slightly change as a result of incorporating tariffs and /or quotas into the model. Trade liberalization has become an issue in the Caribbean since the creation of the Caribbean Common Market (CARICOM) in 1973. As an economic integration, CARICOM, which currently includes 13 countries in the region (see appendix), virtually removes trade barriers between the participant countries and adopts a common external tariff to imports for countries other than the ones in the CARICOM

(Kazarian and Ames, 2000). A common practice in all developing nations including the Caribbean was to impose high tariff rates on imports as a means of increasing government revenues or of protecting domestic production. For instance, Haiti initiated trade liberalization policies in 1987 in a context where tariff rates on rice and corn were as high as 50 percent (Dameus, 1988). Efforts undertaken by GATT / WTO [13] toward eliminating trade barriers through the Uruguay Round entail more trade relaxation or liberalization policies around the world. As an example, from 1993 to 1998, the CARICOM countries reduced their tariff structure from 0-35 percent to 0-20 percent (Association of Caribbean States, 1997). Trade agreements have been a major tool used throughout the second half of the twentieth century to open trade among nations. In this regard, efforts are being made to extend the North American Free Trade Agreement (NAFTA), which currently involves U. S., Canada, and Mexico, to all nations in the American continent, except Cuba. Discussions around this issue[14] will be held on Spring 2001 in Quebec. Kazarian and Ames mentioned that other trade agreements involving the Caribbean countries are:

1) CARIBCAN: a free trade agreement between the Caribbean and Canada
2) Caribbean Basin Initiative (CBI): initiated by the American President Ronald Reagan in the early 1980's. Its objectives were to improve the Caribbean economy and political atmosphere through trade and investment and to remove U. S. tariffs on some products exported by some of the Caribbean countries.

[13] GATT stands for General Agreement on Tariff and Trade.
WTO stands for World Trade Organization

[14] Thirty-five (35) representatives of the nations in the American continent will be present in Quebec in the meeting called the Summit of the Americas (source: http://www.haitionline.com/2000/904.htm)

3) Lome Convention: involves the European Union and some developing countries in Africa, the Caribbean and the Pacific Ocean. Its objective is to allow duty free entry of goods from these developing countries into the European Union countries.
4) Bilateral trade agreements: for instance, Trinidad and Tobago is involved in a free trade agreement with Venezuela and is looking forward to having trade agreements with Mexico and with Colombia.

In an expanding free trade environment where the Caribbean is involved as an actual or potential partner, our estimated elasticities might need some adjustment in magnitude to take into account actual and future trade liberalization policies in the Caribbean. However, it is likely that the needed adjustment is not as high as one might expect. The following reasoning might help clarify this point. More trade liberalization may or may not result in an important increase in the Caribbean imports of starchy foods. On one hand, economic theory tells us that trade generates growth[15]. A country growth can be measured by the growth rate of its gross domestic product (GDP). Increased GDP in the Caribbean through trade is likely to partly shift Caribbean consumption from starchy staples to meat. The marginal propensity to spend on starchy staples is less than 1 at a certain level of GDP. On the other hand, if the Caribbean population keeps on increasing, imports of starchy foods may increase to satisfy the needs of the increased population despite the growth. Therefore, the overall impact of both growth from trade liberalization and increased population might only be a slight increase in our elasticity estimates under the assumption of Caribbean fixed exogenous import prices. However, these import prices are likely to change as a result of international market adjustment. It is not certain whether the world prices of starchy foods will increase or decrease. If the demand of starchy foods in the international market increases, the world prices will increase. At the same time, given the general context of trade liberalization, countries producing the starchy foods will do so more efficiently by using their comparative advantage. As a result, the world supply of starchy foods is likely to increase and this increase will tend to reduce the world prices of starchy foods. When both the likely increase in demand and the likely increase in supply are considered, the overall price change in the international market depends only on the elasticities of the excess demand and excess supply schedules in the world market. If the world price of starchy foods increases or decreases, our elasticity estimates will decrease or increase. As a whole, in a changing world environment with more trade agreements and trade liberalization policies, with increasing population, and with possible randomness in the world supply of starchy foods, we do not know for sure whether our elasticity estimates will increase or decrease in the future. However, we do know that, no matter the direction of the change, the size of this change is likely to be small, given the interaction of several different counteracting factors.

The import demand elasticities resulting from the study are not expected to be affected by the amount of food aid (in terms of wheat and flour, rice, and corn) received by a very few countries in the Caribbean only some years within the time period of the data. Tables 2.A1, 2.A2, and 2.A3 in appendix show the Caribbean total consumption share of the U. S. aid for wheat and flour, rice, and corn during the years the aid was given by the United States. Indeed, food aid in terms of wheat and flour

[15] This is the argument of export-growth theory.

does not generally exceed 5 percent of the Caribbean total consumption of wheat and flour. For rice, the aid does not exceed 5 percent of the Caribbean total consumption of rice over the five-year data period. For corn, the aid was given only during three years.

Because complete data series by countries for all the variables of interest could not be obtained, we were not able to work on specific Caribbean countries as we initially planned to. Using available Caribbean aggregate data was the only remaining choice. Furthermore, in the partitioning of the Caribbean import sources, data on exports of starchy foods by country of destination, or identically data on Caribbean imports of starchy foods by country of origin would allow us to consider all the possible Caribbean import sources in our model. Unfortunately, available data on exports or imports for countries other than the U. S. are not partitioned by destination or source. Partitioned trade data by destination or source are detailed country-specific data that can only be obtained from the countries themselves. In an attempt to incorporate Canada as a third Caribbean import source, we contacted the Canadian Ministry of Agriculture for their data on exports of starchy foods to the Caribbean. Unfortunately, their data were so incomplete that it was worthless to consider them in our analysis. Given the difficulty in obtaining the necessary data for incorporating more sources into our analysis, we were only left with the alternative of considering only two Caribbean import sources, the U. S. and the Rest-of-the-World. A second aggregation was made by grouping all countries other than the U. S. and the Caribbean countries into the so called Rest-of-the-World.

Using aggregated import data across Caribbean countries and an aggregate Rest-of-the-World source prevents from interpolating the elasticity results to a single Caribbean country and to any other possible Caribbean import source outside the U. S. However, the elasticity estimates for the U. S. source are precise.

If data series on imports of starchy foods by source for all the Caribbean countries were available, the Caribbean import demand by source could have been computed as a weighted average of import quantities across all Caribbean countries, where the weights could have been the ratio of each Caribbean country population to the total Caribbean population. In the absence of such data, we were left with the alternative of using per capita import quantities. This may not correspond to a representative Caribbean household, but it is the best that could be done in a limited data situation.

Summary and Conclusion

Caribbean production of starchy staples (unmilled wheat and flour, rice, corn, and fresh potatoes) is insufficient to satisfy domestic consumption. As a result, imports of starchy foods play a major role in securing food in the Caribbean. Caribbean foreign suppliers of starchy foods are both the United States and the Rest-of-the-World, which export their products at different prices to the Caribbean. Available data showed that average prices of rice and corn exported to the Caribbean over the 1982-1996 period was lower in the U.S. than in the Rest-of-the-World. However, for wheat and potatoes, they were lower in the Rest-of-the-World than in the U. S. during the same time period. Furthermore, the U.

S. share of the total volume of starchy foods imported by the Caribbean was in general lower than the Rest-of-the-World share, except for corn.

Foreign suppliers' prices are not under the control of the Caribbean, which does not have any bargaining power, given its size in the overall international market. Consequently, the prices faced by the Caribbean in the foreign markets may exogeneously change at any time by policy means from the exporters' side or by changes in international market conditions. The questions are about how these likely price changes can affect food security through imported quantities in the Caribbean and possibly foreign suppliers' gain in market shares, and how the Caribbean views a starchy food coming from two different sources.

This study uses the Restricted Source Differentiated Almost Ideal Demand System (RSDAIDS) developed by Yang and Koo to model the Caribbean per capita import demand for the four starchy foods (unmilled wheat and flour, rice, corn and fresh potatoes) and to estimate Caribbean import demand elasticities for U. S. and Rest-of-the-World starchy foods. Appropriate econometric tests justify the use of this model with homogeneity and symmetry restrictions imposed. The results of the study suggest that reducing U. S. prices of wheat and rice is likely to improve food security in the Caribbean through an increase in imports of these two commodities with or without cross-market repercussion effects. The same is true for reducing Rest-of-the-World prices of wheat and rice. Moreover, Caribbean per capita demand is own-price unitary elastic for U. S wheat and own-price inelastic for U. S. rice, and Rest-of-the-World wheat and rice. Among the four starchy staples, wheat or rice does not seem to be in price-based source competition in the Caribbean. Instead, there exists a complementarity relationship across source for each of the two products. In other words, the Caribbean distinguishes between the wheat or rice coming from the U. S. and the wheat or rice coming from the Rest-of-the-World. The import demand elasticities resulting from the study are not expected to be affected by the relatively small amount of food aid (in terms of wheat and flour, rice, and corn) received by a very few countries in the Caribbean only some years within the time period of the data. Furthermore, due to the fact that starchy foods are staples, trade liberalization policies through trade agreements in the Caribbean are not very likely to have a major impact on the elasticity estimates in the long run. More trade liberalization in the future is likely to generate income growth that would not necessarily be spent in importing more starchy foods, unless the Caribbean population keeps increasing. Because of the interaction of various internal and external counteracting factors, trade liberalization policies are not expected to considerably inflate our elasticity estimates in the future. However, non-availability of complete and precise data on the Caribbean trade policies throughout the time period of the study prevents investigating the impact of the Caribbean trade liberalization policies on the source differentiated import demands of starchy foods.

Limitations of the Study

Available complete series data on all the variables in this study could be built up to only fifteen years (1982-1996). The aggregate nature of the study does not allow any development about specific country in the Caribbean or in the Rest-of-the-World group. Data limitations prevent expanding the model toward investigating possible effects of

Caribbean trade policies or agreements on the Caribbean import demands of starchy foods.

Suggestion for Further Research

The real nature of the complementarity relationship across source for wheat and rice is not known. Further research requiring country-specific data (which are not always accessible) is needed to determine whether or not quality difference and/ or trade agreements between the Caribbean and some specific foreign suppliers in the Rest-of-the-World group are likely causes of the observed complementarity relationship. If the required data are made available, such a research may also investigate the possibility of using a model that would fit the inclusion of trade policies or agreements, quality differences, trade creation and diversion (if any) originated from the existence of the Caribbean Common Market (CARICOM)[16].

[16] In the appendix are attached some information about CARICOM and a list of the Caribbean Countries including the CARICOM countries which is in table A4.

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Appendix

Table 2.A1. Wheat and Flour: U. S. Aid Quantity, Caribbean Total Quantity Consumed, and Share of U. S. Aid in Caribbean Total Consumption

Year	U. S. Aid (MT)	Caribbean Total Quantity Consumed (MT)	Share of U. S. Aid in Caribbean Total Consumption (MT)
1982	2,840	2,033,240	0.14
1983	2,973	2,327,950	0.13
1984	21,400	2,279,500	0.90
1985	93,187	2,318,700	4.02
1986	66,052	2,374,700	2.78
1987	143,519	2,479,800	5.79
1988	181,985	2,351,300	7.74
1989	6,500	2,265,000	0.29
1990	n.a.	2,115,800	n.a.
1991	n.a.	2,321,700	n.a.
1992	93,190	2,220,500	4.20
1993	49,328	1,931,500	2.55
1994	35,300	1,902,600	1.86
1995	24,710	1,669,100	1.48
1996	23,950	4,679,100	0.51

Sources : column 2: USDA (1982-1989), FAO (1992-1996). Column 3 is the same as total imports in previous table 2.2 in the text.

Table 2.A2. Rice: U. S. Aid Quantity, Caribbean Total Quantity Consumed, and Share of U. S. Aid in Caribbean Total Consumption

Year	U. S. Aid (MT)	Caribbean Total Quantity Consumed (MT)	Share of U. S. Aid in Caribbean Total Consumption (MT)
1992	36,102	1,342,620	2.69
1993	68,074	1,467,600	4.64
1994	47,500	1,477,200	3.22
1995	50,360	1,571,620	3.20
1996	44,590	1,497,020	2.98

Source: FAO (column 2) .Column 3 is part of total availability in previous table 2. 5 in the text.

Table 2.A3. Corn: U. S. Aid Quantity, Caribbean Total Quantity Consumed, and Share of U. S. Aid in Caribbean Total Consumption

Year	U. S. Aid (MT)	Caribbean Total Quantity Consumed (MT)	Share of U. S. Aid in Caribbean Total Consumption (MT)
1992	143,055	1,284,600	11.14
1993	192,700	1,475,200	13.06
1994	16,400	1,253,700	1.31

Source: FAO (column 2). Column 3 is part of total availability in previous table 2.8 in the text.

Some Information on CARICOM

For the last twenty-five or thirty years, some of the Caribbean countries have tended to emerge as a group. On July 4, 1973 four countries Barbados, Guyana, Jamaica, and Trinidad-Tobago signed a treaty establishing a Caribbean Community and Common Market (CARICOM). Six less developed countries of the former Caribbean Free Trade Association (CARIFTA), Belize, Dominica, Grenada, St Lucia, St Vincent and the Grenadines, and Montserrat signed the CARICOM Treaty in April 1974. In July 1974, Antigua and the Associated State of St Kitts-Nevis- Anguilla acceded to membership. In July 1983, the Bahamas signed the treaty as a member of the Caribbean Community but not as a member of the Common Market. In July 1995, Suriname acceded to membership of the Caribbean community and Common Market. Haiti became a provisional member of the CARICOM in July 1997.The Caribbean community has three areas of activity: 1) economic integration 2) cooperation in non-economic areas, and operation of certain common services, 3) coordination of foreign policies of independent member states. Table A4 presents two basic indicators for these countries, such as their population and their gross domestic product (GDP) per capita.

Table 2.A4. Some Indicators of the Caribbean Countries

Caribbean Countries	Population (thousands)	GDP per capita 1995 (U.S. $)
1. CARICOM –Independent countries		
Antigua and Barbuda	64	6,640
Bahamas	279	12,258

Table 2.A4 (continued)

Caribbean Countries	Population (thousands)	GDP per capita 1995 (U.S. $)
CARICOM –Independent Countries (continued)		
Barbados	264	7,120
Belize	217	2,696
Dominica	74	2,754
Grenada	780	809
Haiti	7,180	285
Jamaica	2,500	1,762
St Lucia	145	3,083
St Kitts and Nevis	42	4,642
St-Vincent and Grenadines	110	2,032
Surinam	409	1,066
Trinidad and Tobago	1,262	4,101
CARICOM	13,424	1,511
2. Non-Grouped Countries		
Cuba	10,964	1,113
Dominican Republic	7,250	1,663
3. Netherland Territories		
Aruba	82	16,810
Netherland Antilles	207	7,871

Table 2.A4 (continued)

Caribbean Countries	Population (thousands)	GDP per capita 1995 (U.S. $)
4. British Territories		
Anguilla (1)	10	5,932
Montserrat (1)	10	5,155
British Virgin Islands	18	18,487
Cayman Islands	32	28,125
Turks and Caicos Islands	15	7,021
5. French Departments		
French Guina * (1)	141	9,908
Guadeloupe	447	7,585
Martinique*	360	10,895
6. U.S. Territories		
Puerto-Rico	3,700	11,450
U.S. Virgin Islands	102	13,163

(1) : these countries are non-independent countries but members of the CARICOM
* : data from 1992
Source: Association of the Caribbean States
http://www.acs-aec.org/Bdatos/cuadro1.htr