Lecturas de Economía
ISSN: 0120-2596
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Lecturas de Economía, núm. 55, julio-diciembre, 2001, pp. 143-160
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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

Introduction

Food security in developing and least-developed nations has been a major concern during the second half of the twentieth century. In the 1960's, the green revolution attempted to address this issue through on-site agricultural development, based on intensive use of improved seeds and fertilizers. Specific domestic constraints bottlenecked the efforts of the green revolution, which did not fully reach its objective. Today, the question still remains of how to achieve food security in nations with insufficient production to satisfy the needs of their growing population. The green revolution experience reveals the limited success of production policies in addressing the food security matter in less developed countries. Trade policies appear to offer an alternative way of helping poor nations achieve food security. In fact, middle and low-income countries import a major portion of the food they need from other countries with production surpluses. A reduction by policy means (say an export subsidy) of the export price of an exporting country can help secure food in some poor importing countries through an increase in the quantity of food imported. At the same time, this export price reduction may favor market expansion and market share gain for the exporting country. The effects of a single country introducing subsidies depends on the cross elasticities of demand for the same good from other countries as well as from cross elasticities for related goods.

Starchy food is the key dietary component providing food security of 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 1).

Table 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, Triniad-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 (ROW), which includes all Caribbean supplier countries other than the U. S. and the Caribbean itself. Import quantities 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. All the wheat consumed in this region is imported. Data on the Caribbean show that, the quantity share of imports in the total quantity of rice consumed was as high as 62 percent in 1993; in 1990, this share was 86 percent for corn, and in 1986, it was 86 percent for fresh potatoes (USDA and FAO). 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.

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

The question is how one can expect price changes by any means (policies or market adjustment mechanism) in either the U. S. or in the ROW to affect food security in the Caribbean through the import demand for starchy foods. There is a linkage between imports of starchy foods and food availability in the Caribbean. Consequently, changes in the Caribbean import demands of starchy foods due to changes in the foreign supplier prices will impact food availability through imports. Indeed, in the absence of any technological progress to bring about an increase in Caribbean domestic production, higher imports correspond to improved Caribbean food availability. Furthermore, if the Caribbean imports more from any of the two sources (U. S. or ROW), the market share of this source in the Caribbean will increase, assuming source competition in the Caribbean market. Caribbean suppliers of starchy foods may be concerned about their market share in this region. Market sharing can only be an issue if competition exists for a given source-differentiated starchy food in the Caribbean. We do not know whether a starchy food from two different origins (U. S. and ROW) 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 ROW on the Caribbean imports of starchy foods from the two sources.

As far as Caribbean food availability through imports is concerned, as well as knowing whether or not source- competition or source-complementarity exists for a starchy food from two different origins, there is a need for determining the responsiveness of the Caribbean starchy food import demand to price changes in the U. S. and the ROW. Given its relatively small share of the total U. S. and total ROW 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 ROW prices are exogenous for the Caribbean.

The general objective of this paper is to estimate the Caribbean import demand elasticities for these staples imported from the U. S. and from the ROW, using a Restricted-Source-Differentiated Almost Ideal Demand System (RSDAIDS).

I. 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 (RSDAIDS). 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). In the AIDS or the RSDAIDS, the demand of a commodity is measured by the budget share of that commodity.

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

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

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 (for j not equal to i), β_{ih} is the real expenditure coefficient, E is group expenditures, and P is the Stone price index.[1]

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

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1 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.

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

$$\sum_k \gamma_{ihik} + \sum_{j \neq i} \gamma_{ihj} = 0; \text{ (homogeneity)} \tag{3}$$

$$\gamma_{ihik} = \gamma_{ikih} \text{ (symmetry)} \tag{4}$$

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

$$\varepsilon_{ihih} = -1 + \frac{\gamma_{ihih}}{w_{ih}} - \beta_{ih} : \text{own price elasticity,} \tag{5}$$

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

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

$$\eta_i = 1 + \frac{\beta_{ih}}{w_{ih}} : \text{expenditure elasticity,} \tag{8}$$

hicksian elasticities are computed using the following formulas:

$$\delta_{ihih} = -1 + \frac{\gamma_{ihih}}{w_{ih}} + w_{ih} : \text{own price elasticity} \tag{9}$$

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

$$\varepsilon_{ihj} = \frac{\gamma_{ihj}}{w_{ih}} + w_j : \text{cross-price elasticity with a different good.} \tag{11}$$

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.

II. 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:

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

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

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

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

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

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

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

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

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. 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).

The use of the Stone 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.

Misspecification (including normality), separability, product aggregation (or source differentiation), and endogeneity tests are conducted. With respect to the misspecification test, first, the Shapiro-Wilk test statistics is used to assert normality. Second, the 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, nonlinearity, and temporal dependence. The joint conditional variance test investigates the presence of dynamic and static heteroskedasticity.

With regard to the separability test, two prominent studies on this matter 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. 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). Both methods of testing for separability are used in this study. The Moschini, Moro, and Greene's separability test is performed 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:

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

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).

In relation to the product aggregation (or source differentiation) test, 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 are tested. For the purpose of this test, the following restrictions are imposed on the RSDAIDS model:

$$\begin{aligned} \alpha_{ih} &= \alpha_i \quad \nabla h \in i \\ \gamma_{ihjk} &= \gamma_{ij} \quad \nabla h, k \in i, j \\ \beta_{ih} &= \beta_i \quad \nabla h \in i. \end{aligned} \qquad (22)$$

With respect to the endogeneity test, the Wu-Hausman test as described by Blundell (1987) is conducted. The null hypothesis is that the real expenditure variable is exogenous.

III. Data

United States and ROW 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 ROW. 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 ROW 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[2] which is available in the same source in units of domestic currency per U. S. dollar.

2 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.

The Caribbean estimated per capita import demand elasticities 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 over the fifteen-year time period of the data used in this study. Based on data from the U. S. Department of Agriculture (USDA) and from the Food and Agricultural Organization of the United Nations (FAO), food aid in terms of wheat and flour 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 fifteen-year data period. For corn, the aid was given only during three years.

IV. Results

At the 0.05 level, the misspecification test fails to reject the separate null hypotheses of normality of the error terms, of no structural change, no nonlinearity, no temporal dependence, no dynamic heteroskedasticity, and no static heteroskedasticity.

The results of the tests for separability based on Hayes, Wahl, and Williams' suggestion are presented in Table 1 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 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 below is not rejected at the 0.05 level of significance.

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.

Table 2. Results of block separability, product aggregation, and endogeneity test for the RSDAIDS model

Type of Test	*Test Results*
Block Separability	H_0: Wheat is separable from all other starchy foods F = 19.43**, df:6 for numerator and 59 for denominator H_0: Rice is separable from all other starchy foods. F = 6.05**, df: 6 for numerator and 59 for denominator H_0: Corn is separable from all other starchy foods. F = 9.79**, df: 6 for numerator and 59 for denominator H_0: All of the above F = 11.60**, df: 18 for numerator and 59 for denominator
Source Differentiation	H_0: Wheat can be aggregated. F = 714.19**, df: 5 for numerator and 68 for denominator H_0: Rice can be aggregated. F = 172.94**, df: 5 for numerator and 68 for denominator H_0: Corn can be aggregated. F = 156.75**, df: 5 for numerator and 68 for denominator H_0: Potatoes can be aggregated. F = 78635.1**, df: 5 for numerator and 68 for denominator H_0: All of the above F = 19919.7**, df: 20 for numerator and 68 for denominator
Auxiliary Regression of Real Expenditures to Test for Endogeneity	$\ln(E/P) = -2.71^{**} - 1.17^{*}LP_{wheat} + 1.41LP_{rice} + 2.22^{*}LP_{corn}$ (1.03) (0.51) (2.01) (1.06) $-16.17^{*}LP_{potatoes} - 0.76Lag_{Real\ Exp} - 0.0007LogGDP$ (8.15) (0.72) (0.003)

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

Marshallian and Hicksian elasticity estimates are computed based on the estimated budget share equations. These elasticity estimates and their standard errors are in Table 3. In general, the own-price Marshallian coefficients of Caribbean per capita demand (expressed in terms of budget share) for both U. S. and ROW 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 3 indicates that Caribbean Marshallian per capita demand for U. S wheat in terms of budget share is unitary elastic to U. S. wheat price, and Caribbean per capita demand for U. S. rice in terms of budget share is own-price inelastic. Furthermore, Caribbean Marshallian per capita demands in terms of budget shares for the ROW wheat, rice, and corn are own-price inelastic.

Based on the significance and on the magnitude of the elasticities, reduction in the price of the U. S. wheat would be more effective than reduction in the price of U. S. rice in addressing food security through imports in the Caribbean, or equivalently; in increasing U. S. exports to the Caribbean. From the ROW perspective alone, changes in the wheat price would have the same impact on Caribbean Marshallian per capita budget share demand for the ROW wheat as would changes in the rice price on Caribbean Marshallian per capita budget share demand for the ROW rice. A 1 percent change in the price of wheat and rice in the ROW would lead to less than 1 percent change in the Caribbean per capita budget share demands for these two staples, given that these budget share demands are own-price inelastic.

The source-differentiated Marshallian cross-price elasticities between wheat from the U. S. and from the ROW (as well as between rice from the U. S. and from the ROW) 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 ROW 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 ROW equations are also negative but not significant. The same is true in the U. S. potatoes equation.

Table 3. Marshallian and hicksian elasticities for starchy food (unmilled wheat and flour, rice, corn, and fresh potatoes) per capita import demand in terms of budget share in the Caribbean (1982-1996).

		Marshallian Elasticities		*Hicksian Elasticities*	
Product	*Variable*	*U. S. Equation*	*ROW Equation*	*U. S. Equation*	*ROW Equation*
Wheat (unmilled and flour)	$LogPWHT_{US}$	-1.01 **	-0.40**	-0.88**	-0.11
		(0.23)	(0.12)	(0.19)	(0.09)
	$LogPWHT_{ROW}$	-0.63 **	-0.65 **	-0.30	0.09
		(0.22)	(0.15)	(0.22)	(0.15)
	$LogP_{RICE}$	-0.80	4.16 **	-0.69	4.40**
		(2.23)	(1.42)	(2.20)	(1.40)
	$LogP_{CORN}$	0.34	-0.57	0.56	-0.08
		(1.11)	(0.73)	(1.08)	(0.70)
	$LogP_{POTATOES}$	1.29	-4.34**	1.31	-4.29**
		(2.15)	(1.43)	(2.15)	(1.44)
	Log (EXP/P)	0.81	1.80**		
		(0.46)	(0.32)		
Rice	$LogP_{RICEUS}$	-0.87 **	-0.85**	-0.83**	-0.88**
		(0.29)	(0.14)	(0.28)	(0.13)
	$LogP_{RICEROW}$	-1.54 **	- 0.65 **	-1.47**	-0.71**
		(0.23)	(0.28)	(0.22)	(0.27)
	$LogP_{WHEAT}$	-2.81 **	2.43**	-2.34**	2.01
		(0.78)	(1.12)	(0.85)	(1.17)
	$LogP_{CORN}$	0.58	2.52	0.80	2.32
		(1.92)	(2.03)	(1.86)	(1.95)
	$LogP_{POTATOES}$	3.81 **	-2.72	3.83**	-2.74
		(1.43)	(1.59)	(1.44)	(1.59)

Table 3. Continued

		Marshallian Elasticities		*Hicksian Elasticities*	
		U. S.	*ROW*	*U. S.*	*ROW*
Product	*Variable*	*Equation*	*Equation*	*Equation*	*Equation*
Corn	*Log(Exp/P)*	0.82	- 0.73		
		(0.56)	(0.78)		
	$LogPCORN_{US}$	0.12	0.17	0.21	0.26
		(0.22)	(0.26)	(0.19)	(0.15)
	$LogPCORN_{ROW}$	0.09	-1.08 **	0.13	-1.04**
		(0.08)	(0.33)	(0.08)	(0.31)
	LogPWHEAT	-1.34 **	0.27	-1.06**	0.54
		(0.39)	(1.57)	(0.43)	(1.53)
	$LogP_{RICE}$	-8.31**	0.01	-8.32**	-0.002
		(1.28)	(4.07)	(1.25)	(3.97)
	$LogP_{POTATOES}$	9.02 **	0.23	9.03**	0.24
		(1.20)	(3.88)	(1.20)	(3.88)
	Log(Exp/P)	0.49	0.47		
		(0.29)	(1.10)		
Potatoes	$LogP_{POTATOES\ US}$	0.61	0.61		
			(0.41)	(0.41)	
		$LogP_{POTATOESROW}$	-0.40	-0.36	
			(0.57)	(0.58)	
		LogPWHEAT	2.80	3.85**	
			(1.42)	(1.57)	
	$LogP_{RICE}$	-3.67	-3.42		
		(2.05)	(2.08)		
	LogPCORN	-1.19	-0.68		
		(3.40)	(3.28)		
	Log(Exp/P)	1.84			
		(0.99)			

Note: 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.

The source-differentiated Marshallian cross-price elasticities between wheat from the U. S. and from the ROW (as well as between rice from the U. S. and from the ROW) 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 ROW 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 ROW equations are also negative but not significant. The same is true in the U. S. potatoes equation.

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 ROW, 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 were lower in the U.S. than in the ROW. However, for wheat and potatoes, they were lower in the ROW 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 ROW 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 of starchy foods can affect food security through Caribbean per capita import demands in terms of budget shares and how the Caribbean views a starchy food coming from two different sources (the U. S. and the ROW).

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 the shares of the Caribbean per capita imports spending for these two commodities. The same is true for reducing ROW prices of wheat and rice. Moreover, Caribbean per capita demand in terms of budget share is own-price unitary elastic for U. S wheat and own-price inelastic for U. S. rice, and ROW 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. Equivalently; the markets for wheat from the two origins (U. S. and ROW), and for rice from the same two origins seem to be separate in the Caribbean. This may be due to quality differences between U. S. wheat and ROW wheat, and between U. S. rice and ROW rice.

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