Import Substitution for Livestock Feed in the Caribbean Community

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This paper evaluates the economic feasibility of substituting domestically produced corn and soya for imports in the Caribbean Community. A linear programming model is used to minimize the costs of meeting feed demands under free trade and two self-sufficiency scenarios. Special emphasis is given to the availability of land suitable for feed production, domestic production costs relative to import costs, and the implications for employment and the balance of payments. The model also identifies optimal quotas or tariffs to achieve self-sufficiency.

Key words: customs unions, import substitution, international trade policy, less developed countries, linear programming, livestock feed.

Import substitution is defined as the replacement of imported goods by the same or similar goods produced domestically (Ahmad). It attracted attention initially as a means of promoting industrial development in less developed countries (LDCs). There is now more emphasis on agriculture (Sisler and Blandford), primarily because of the tripling of LDC imports of grain during the 1970s (International Bank for Reconstruction and Development).

Another important trade policy development is the formation of customs unions and free-trade areas to promote trade among LDCs (Baldwin and Kay). Advocates of these arrangements point to traditional benefits of specialization and to the expectation that more "equitable" trading relationships will emerge between nations at similar levels of economic development.

The Caribbean Community (CARICOM), a customs union of twelve Caribbean countries, is a prime example of the coalescence of these two themes in LDC trade policy.[1] Food consumption, particularly meat and other livestock products, has been growing rapidly in CARICOM. As a result, imports of animal feed (corn and soya meal) to support the livestock industry more than quadrupled in value between 1970 and 1978. Such growth has been viewed with concern in CARICOM, both because of its foreign exchange implications and because the Community desires to promote intraregional trade and integration. In response, experimental projects to evaluate the technical feasibility of producing corn and soya, have been established in Belize, Guyana, Jamaica, and Trinidad and Tobago.

This paper evaluates the economic feasibility of substituting domestically produced corn and soya for imports in CARICOM, given the availability of suitable land. The implications for employment, balance of payments, and quotas or tariffs necessary to achieve self-sufficiency are emphasized.

Background

The current balance of payments situation, composition of exports, and the dominance of sugar in agricultural production make import substitution of corn and soya particularly attractive to CARICOM. Because both population and income are concentrated in Barbados, Guyana, Jamaica, and Trinidad and Tobago (the more developed CARICOM countries, MDCCs), the situation in these countries is particularly critical.

For two of the MDCCs, Barbados and

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[1] CARICOM is the successor to the Caribbean Free Trade Association (CARIFTA), formed in 1968. Member countries are Anguilla, Antigua, Barbados, Belize, Dominica, Grenada, Guyana, Jamaica, Montserrat, Nevis, St. Kitts, St. Lucia, St. Vincent, and Trinidad and Tobago. Eight of these countries are small and/or have low per capita incomes relative to Barbados, Guyana, Jamaica, and Trinidad and Tobago.

Jamaica, import substitution could reduce persistent merchandise trade deficits, which on an annual basis averaged $88 million and $73 million, respectively, during 1970–78. (All prices, costs, and revenues in this paper are in U.S. dollars.) The balance of payments imperative is not so great in Guyana and Trinidad and Tobago. Guyana had a surplus averaging $6 million annually over the period; the surplus in Trinidad and Tobago has been substantial (nearly $200 million per year) because of petroleum exports. However, in all four countries, export earnings are derived primarily from an unstable sugar market or from nonrenewable finite resources (bauxite/alumina or petroleum). Hence, import substitution is attractive to all four MDCCs.

To examine the potential for import substitution of livestock feed, one must understand the current role of sugar. In 1973, the total investment in sugar estates and factories in CARICOM was over $200 million. Sugar cane occupied approximately 500,000 acres of arable land, and both directly and indirectly provided employment for approximately 500,000 persons, or 11% of the population (Girwar). Sugar occupies the largest amount of arable land devoted to any single crop. However, in recent years the high level of trade protection has been important to the survival of the industry. Caribbean exporters benefited from preferential sugar pricing on their exports to Britain under the Commonwealth Sugar Agreement. Since Britain entered the European Community (EC) in 1973, CARICOM has continued to receive preferential treatment, through the Lomé Convention. Because the EC is now a surplus sugar producer, CARICOM's preferences are unlikely to persist indefinitely. McGregor cites two instances in which recent sugar price increases under Lomé have failed to keep pace with increasing production costs in CARICOM. The other important market for Caribbean sugar, the United States, is being threatened by high fructose corn sweeteners and increased competition from other sugar surplus countries.

Although authorities are divided over whether to continue in sugar or replace it with other products, all agree that in order for the sugar industry to survive, drastic structural transformation will be required (Girwar). This opens the way for import substitution of feed grains, to utilize land resources which have been dominated by sugar.

There are two ways in which such import substitution could occur—through either the expansion of currently produced domestic feedstuffs or the development of a corn/soya industry. The potential for increased grass-fed livestock production is strictly limited because of the lack of suitable land. Although root crops, especially cassava, are of great importance as an energy source in livestock feed in Europe, CARICOM's human demand for cassava far exceeds domestic production (Osuji). Copra production is declining, and it is primarily used for oil, little being available for protein meal production.

The greatest potential appears to lie in cane feed, a mixture of chopped cane stalks, leaves, and prescribed supplements. Its cost compares favorably with other commercial feeds (Lambie & Co.). Cane feed's major disadvantage is that it must be served fresh and prepared carefully. It requires the integration of livestock and sugar cane production.

Primary emphasis in the region has been on the development of corn/soya production. Because the livestock industry is already accustomed to using these inputs, direct import substitution implies minimal adjustment in current feeding practices. Corn/soya concentrates are storable and do not have to be fed where they are produced. This flexibility can contribute to both economic and political objectives. A final advantage is the potential for the joint production of soya oil, a valuable product in a region deficient in vegetable oils.

Analytical Framework

An evaluation of import substitution for corn and soya must consider the costs of production, processing, and transportation of feed grains, implications for land and labor use, and the effect upon CARICOM's foreign exchange position. A linear programming model, to determine the optimum allocation of resources and distribution of products within CARICOM, provides the basis for this evaluation. Combined production, import, and transportation costs are minimized under three import substitution scenarios: (*a*) free trade, (*b*) regional self-sufficiency in feed, and (*c*) regional self-sufficiency in vegetable oil. For each, the model generates an optimal allocation of land among corn, soya, and sugar production and the optimal distribution of products within the region.

Mathematically, the model is formulated as follows:

$$(1)\quad \text{Minimize } Z_0 = \sum_{i=1}^{I}\sum_{g=1}^{G}\alpha_{ig}Y_{ig} + \sum_{i=1}^{I}\sum_{j=1}^{J}\sum_{g=1}^{G}c_{ijg}X_{ijg},$$

subject to

$$(2)\quad \sum_{g=1}^{G} Y_{ig} \leq S_i (i = 1, \ldots, I);$$

$$(3)\quad -a_{ig}Y_{ig} + \sum_{j=1}^{J} X_{ijg} \leq 0 (i = 1, \ldots, I; g = 1, \ldots, G);$$

$$(4)\quad \sum_{i=1}^{I} X_{ijg} \geq D_{jg} (j = 1, \ldots, J; g = 1, \ldots, G);$$

$$X_{ijg} \geq 0;\ Y_{ig} \geq 0 \text{ (for all } i, j, g);$$

where Y_{ig} is acres of commodity g produced at origin i; a_{ig}, output per acre of commodity g at origin i; X_{ijg}, units (tons or gals.) of commodity g transported from origin i to destination j; α_{ig}, the cost/acre of producing commodity g at origin i; c_{ijg}, the transport cost/unit of commodity g from origin i to destination j; S_i, the supply of land at origin i; and D_{jg}, the demand for commodity g at destination j.

Import substitution could have several impacts on the agricultural sector. In the long run, prices and quantities would be affected by changes in trade policy. Nevertheless, costs of production and distribution could be minimized within the constraints imposed by such policy. The cost minimization implicit in the programming model reflects only part of the adjustment likely to take place in the long run. For this analysis, it was necessary to assume that prices (including exchange rates) remain constant, that minimum levels of final demand must be met, and that these levels can be determined exogenously.[2] Given the "small country" characteristics of the region, these are not unrealistic assumptions.

The programming model does generate some information on equilibrium prices for fixed levels of demand. Equilibrium prices are embodied within the dual of the programming problem, which can be expressed as

$$(5)\quad \text{Minimize } Z^* = \sum_{i=1}^{I} S_iL_i - \sum_{j=1}^{J}\sum_{g=1}^{G} D_{jg}Q_{jg},$$

subject to

$$(6)\quad L_i - a_{ig}P_{ig} \geq -\alpha_{ig} (i = 1, \ldots, I; g = 1, \ldots, G);$$

$$(7)\quad P_{ig} - Q_{jg} \geq -c_{ijg} (i = 1, \ldots, I; j = 1, \ldots, J; g = 1, \ldots, G);$$

$$(8)\quad L_i \geq 0;\ P_{ig} \geq 0;\ Q_{jg} \geq 0 \text{ (for all } i, j, g),$$

where L_i is the rent/acre of land; P_{ig}, the value of product g at origin i; Q_{jg}, the value of product g at destination j; and other terms are as defined in equations (1)–(4).

The dual generates implicit values for land and the products at their origins and destinations. The latter are of particular policy interest. As demonstrated by Waverman, minimum preventive tariffs, tariffs that reduce imports from outside the region to zero, can be obtained by comparing the free trade programming solution with a solution in which imports of a particular commodity are prohibited. The difference between the imputed value at a destination, derived from the restricted model, and the imputed price under free trade is equal to the tariff that would reduce imports to zero and achieve complete import substitution.

To specify the model empirically, six subregions were identified. Five are the largest individual countries within CARICOM (the MDCCs plus Belize); the sixth represents CARICOM's international markets (the "rest of the world"). Each of the subregions is both a supply origin and demand destination for one or more agricultural products. In all CARICOM subregions, sugar is a potential production activity. With the exception of Barbados, which is unsuited to feed grain production, double cropping of corn and/or soya is allowed. Soya production costs include costs of processing into oil and meal, implying that processing occurs near the point of production. Feed grain activities in Belize and Guyana include necessary land clearing costs.

The information on input requirements and yields for corn/soya was derived from unpublished experimental farm data (see Charles for details) and from information given in Radley. Costs of production are based on 1975 input prices. For corn production, costs range from \$225 per acre in Belize and Trinidad and Tobago to \$310 per acre in Jamaica. Soybean production costs range from \$200 per acre in

[2] A strict application of project appraisal techniques to import substitution policy would require that the costs of production and distribution reflect the social opportunity costs of resources (Little and Mirrlees). In developing, labor surplus countries, existing wage rates may not reflect the social opportunity cost of labor. Similarly, the exchange rate may not be an equilibrium rate, implying that domestic resources may be over- or under-valued relative to resources internationally. No attempt is made in this study to assess the difference between money and social costs.

Guyana to $320 per acre in Jamaica. These figures are based on relatively capital-intensive technology and reflect slight differences in machinery complements. More important, they reflect differences in input levels due to soils, rotations, and labor costs.

Yields for corn, for example, ranged from 1.1 (long) tons per acre in Belize and Guyana to 1.8 tons per acre in Trinidad.[3] The costs of producing sugar ranged from $450 per acre in the low rainfall areas of Barbados to almost $880 per acre in peasant holdings of Trinidad. Sugar production costs and yields are derived from information provided by governments or growers' organizations. Further data on costs and yields are given by Charles. Tables containing a summary of the data employed in the model, as well as differential costs between capital and labor intensive technologies, are published in Charles, Blandford, and Boisvert.

The programming model also includes activities for importing corn and soya meal and oil from outside CARICOM and trade among countries within CARICOM. Import prices from outside CARICOM to the four MDCCs are actual 1975 CIF prices. Transport costs for corn/soya between the MDCCs for 1975 are estimated from unpublished data obtained from the West Indies Shipping Corporation.

The constraints in this model differ from those in a conventional transportation programming model. The production of each commodity in each country is determined endogenously and is constrained only by the availability of suitable land. (No constraints on the supply of labor are assumed because CARICOM is a labor surplus area.) Land, which could be devoted to corn/soya production, includes land currently in sugar which is suitable for mechanized feed grain production. This amounts to 47,000 acres in Jamaica and 60,000 acres in Trinidad and Tobago. It also includes 20,000 and 7,500 acres of currently uncleared land in Guyana and Belize, respectively, which are suitable for mechanized feed grain production.

The remaining 343,000 acres included in the model is suitable only for sugar. Additional constraints require that the region meets its domestic demand for corn and soya, defined by 1975 imports. These totaled approximately 210,000 tons of corn, 58,000 tons of soya meal, and 4.4 million gallons of vegetable oil. Two demands for sugar are also identified as separate constraints. A domestic sugar demand in 1975 of roughly 200,000 tons has to be satisfied by domestic production as does an export demand of roughly 625,000 tons. The latter represents the region's 1975 commitments under preferential trade agreements. It is assumed that in the short run CARICOM would be unwilling to jeopardize this assured source of foreign exchange even if sugar prices were relatively low. These commitments reflect an institutional constraint on achieving import substitution in the short run.

The model used 1975 data for two main reasons. First, prior to 1973, the demand for livestock feed never exceeded $15 million (1970 dollars) and, after an increase of 36% between 1973 and 1974, the real value of imports has since appeared to stabilize at around the 1975 level of $22 million. Second, and perhaps more important, this particular year was the only one for which complete information on feed production costs was available. The use of a single year's data is limiting, particularly in its reliance on a single set of import prices.

Empirical Results

In 1975 there was no significant production of feed (corn and soya meal) in any of the five CARICOM countries analyzed. Sugar was produced for export, and all feed demands were met by imports. This actual or "base" situation is the point of departure for analyzing the feasibility of import substitution of feed in CARICOM. The solutions to the programming model provide comparative empirical estimates of feed production, costs, and trade under the three import-substitution scenarios.

Production and Distribution

The major production and distribution patterns for the three scenarios are given in table 1. Because it is assumed that each country will meet its own domestic and preferential export demand for sugar under all scenarios, sugar is omitted from the table. Similarly, Belize is omitted because it neither produces nor imports corn/soya under any scenario.

[3] Although it could be misleading to use yields derived from experimental trials, the yields actually used in the programming analysis are considerably below the maximum achieved in the region. For example, soybean trials in Trinidad have produced yields in excess of 2,000 pounds per acre. An expected average yield of 1,500 pounds per acre is assumed in the model. Similar downward adjustments were made for corn. Although experiments have suggested that triple cropping may be feasible, only double cropping was incorporated in the model.

Table 1. Production and Distribution of Agricultural Products under Alternative Scenarios

		Destinations			
Origins	Product[a]	Guyana	Trinidad & Tobago	Jamaica	Barbados
Free trade					
Guyana	Corn				
	Soya meal	6,199			
	Soya oil	110,243			236,656
Trinidad & Tobago	Corn	6,188	76,720		11,592
	Soya meal		18,963		1,865
	Soya oil		1,087,428		74,756
Jamaica	Corn				
	Soya meal				
	Soya oil				
Extraregional (rest of world)	Corn			115,357	
	Soya meal			31,357	
	Soya oil	347,246		2,539,642	
Feed self-sufficiency					
Guyana	Corn	6,188			
	Soya meal	6,199		8,997	1,483
	Soya oil	457,489	7,991	155,859	311,412
Trinidad & Tobago	Corn		76,720	49,543	11,592
	Soya meal		18,963		382
	Soya oil		1,079,437		
Jamaica	Corn			65,815	
	Soya meal			22,360	
	Soya oil			1,246,682	
Extraregional (rest of world)	Corn				
	Soya meal				
	Soya oil			1,137,100	
Oil self-sufficiency					
Guyana[b]	Corn				
	Soya meal	19,000			
	Soya oil	457,489		294,299	311,412
Trinidad & Tobago[c]	Corn	6,188	76,720	9,044	11,592
	Soya meal		26,289	6,554	1,865
	Soya oil		1,087,428	849,251	
Jamaica	Corn				
	Soya meal			24,804	
	Soya oil			1,396,093	
Extraregional (rest of world)	Corn			106,313	
	Soya meal				
	Soya oil				

[a] Corn, soya meal, and sugar are measured in long tons, soya oil in imperial gallons.
[b] After CARICOM's demands are met, 12,801 tons of surplus meal are available in Guyana.
[c] After CARICOM's demands are met, 7,326 tons of surplus meal are available in Trinidad and Tobago.

Perhaps the most significant characteristic of the results is that under free trade, feed production occurs in Guyana and Trinidad and Tobago. Guyana satisfies all of its domestic meal requirements, a quarter of its vegetable oil requirements, and two-thirds of the vegetable oil demand in Barbados. Guyana imports the remaining three-quarters of its soya oil from extraregional sources. Trinidad and Tobago meets all of its domestic demand for corn, meal, and vegetable oil, as well as all of Guyana's demand for corn, Barbados' total demand for corn and meal, and a quarter of its demand for vegetable oil. Jamaica continues to import all of its domestic requirements of feed and vegetable oil from extraregional sources.

Under the feed self-sufficiency scenarios, production of corn also occurs in Guyana. The country is able to meet all of its requirements for feed and vegetable oil and export to Barbados, Jamaica, and Trinidad and Tobago.

The most significant change is that Jamaica begins to produce corn and soya even though their costs are high relative to imports. Intraregional trade increases substantially.

Under regional self-sufficiency for feed, vegetable oil production still falls short of demand by over 1 million gallons. In the final scenario, vegetable oil demand is the major constraint of the model. Regional self-sufficiency in oil is obtained, and feed demand is met at minimum cost by importing just over 106,000 tons of corn into Jamaica. Guyana and Jamaica specialize in soya production, while Trinidad and Tobago produces both corn and soya. Regional self-sufficiency in both vegetable oil and feed is not possible given limited land resources and 1975 levels of demand in feed, oil, and sugar.

Resource Use

Land and labor provide the primary focus for discussion because of the scarcity of the former and the lack of employment for the latter. The total cropland incorporated in the model is approximately 477,000 acres. The acreage devoted to corn and soya ranges from 52,000 acres under free trade to 120,000 acres under feed self-sufficiency. This demonstrates the feasibility of satisfying the bulk of the regional demand for feed and vegetable oils, at 1975 levels, with no more than 25% of the region's sugar land. Because the model minimizes the cost of meeting domestic demands and the contractual export demand for sugar, the solutions indicate that some land producing sugar in 1975 is "idled" under all scenarios. The area of idled land ranges from roughly 78,000 acres under free trade to 10,000 acres under feed self-sufficiency.

The most important resource use consequences are for labor. The feed production costs used in the programming analysis correspond to the most capital-intensive technology available (Charles). Total man days per year employed in corn/soya production with this technology is given in table 2. For Jamaica and Trinidad and Tobago, the numbers in parentheses indicate the employment generated if land devoted to corn/soya had remained in sugar production. By subtracting the number in parentheses from the one above it, the net employment effect of import substitution directly attributable to land diverted from sugar production is obtained. Because land used to produce feed in Guyana and Belize was not used for sugar in 1975, there is no opportunity cost of employment associated with import substitution. Therefore, in these countries all employment generated by corn/soya is a net addition.

The demand for labor varies with each scenario and with the product mix. Guyana is the only country where net employment increases in all cases. The results for Trinidad and Tobago and Jamaica present a contrast. Under capital-intensive assumptions, feed production reduces employment in Trinidad and Tobago, but in Jamaica, employment declines only under feed self-sufficiency.

Any reduction in agricultural employment because of import substitution may present problems for these developing nations. For this reason, three additional programming specifications were considered in which the use of labor-intensive feed grain technology was assumed in Trinidad and Tobago and Jamaica. Under this assumption, production costs for feed increase by at least 38%. The major programming results under these assumptions are given in Charles, Blandford, and Boisvert. Although there are several changes in production patterns, the most important can be inferred from the employment summary in table 2. Belize now enters the self-sufficiency scenarios as an exporter to other CARICOM countries. Feed production in Trinidad and Tobago is no longer competitive under free trade. Employment effects in Jamaica and Trinidad and Tobago are significant under self-sufficiency. In both cases, Jamaica has a substantial net increase in employment. Trinidad and Tobago experiences a net reduction of 15% under feed self-sufficiency. These results suggest that labor-intensive technology may be attractive to policy makers. However, since government efforts to date have focused on capital-intensive technology, the remainder of the analysis is based on that assumption.

Trade Policy Instruments

The results of the programming model suggest that under free trade, CARICOM will not be self-sufficient in either feed or vegetable oil. In order to achieve self-sufficiency, new trade policies probably would have to be employed. The policies considered are import quotas and tariffs. Although a production subsidy is the theoretically preferred alternative for achieving import substitution because it avoids the

Table 2. Labor Use in the Production of Corn/Soya

Country	Free Trade	Feed Self-Sufficiency	Oil Self-Sufficiency
	(thousands of man days per year)		
Capital-intensive technology			
Guyana	104	292	320
Trinidad	443	499	636
& Tobago	(1,261)[a]	(1,620)	(1,620)
Jamaica		464	378
		(506)	(283)
Labor-intensive technology			
Guyana	292	292	320
Trinidad	0	1,380	1,795
& Tobago		(1,620)[a]	(1,478)
Jamaica	0	1,220	1,273
		(431)	(273)
Belize	0	83	83

[a] Figures in parentheses denote labor use associated with the previous production of sugar on land diverted to corn/soya.

consumption cost of a tariff or quota (e.g., Corden), it is not considered because of its potential cost to CARICOM countries.

To meet self-sufficiency objectives, only two countries, Guyana and Jamaica, would need to employ import quotas. Under both scenarios, imports of soya oil into Guyana and soya meal into Jamaica would have to be prohibited. Under self-sufficiency in feed, imports of soya oil into Jamaica would be restricted to 45% of their free-trade level (1.14 million gallons). Under self-sufficiency in vegetable oil, imports of corn into Jamaica would be restricted to 92% of their free trade level (106,000 tons).

Superficially, quotas appear to be desirable because of their administrative simplicity, and because they would have to be employed by two only countries. Although not technically illegal for agricultural products under the General Agreement on Tariffs and Trade (GATT), quotas are frowned upon by the international community and could invite retaliation (Meerhaeghe). One clear alternative to quotas is an import tariff.

In order to estimate required tariffs, it is necessary to examine the market prices that would obtain for agricultural products under the various scenarios. Market (shadow) prices are derived from the dual programming problem and are presented in table 3. The programming model guarantees that, where imports from outside the region occur, the shadow prices are equivalent to 1975 import prices. In subregions where shadow prices are below import prices, the imputed value of the resources needed for production is lower than the cost of importing the product. In such a subregion, no trade with countries outside CARICOM will occur.

The shadow prices also indicate how a change in import prices from the rest of the world might affect the feasibility of import substitution. The difference between the 1975 import price and a corresponding shadow price indicates the penalty cost of importing from the rest of the world. Thus, under free trade, the import price of corn in Guyana could fall to 70% of its 1975 level before Guyana would import corn from the rest of the world rather than from Trinidad and Tobago (table 1). Based on the penalty costs, world prices of feed and vegetable oil could fall by 14% to 46% before the feasibility of import substitution could be affected under free trade.

Under the self-sufficiency scenarios, there are instances where shadow prices are above import prices. Imports from outside CARICOM do not occur because they are prohibited in the model's specification. Under these circumstances, the specific tariff needed to prevent all imports of a commodity is calculated by subtracting the import prices from imputed market prices in table 3, if the difference is positive. Waverman suggests that the theoretically minimum preventive tariff is the free-trade-imputed price subtracted from the imputed price under self-sufficiency. However, in this analysis, feed production in CARICOM takes place under the free-trade scenario and intraregional trade is allowed.

Table 3. Import Prices and Imputed (Shadow) Market Prices

	Import Prices '75 (Base Case)	Free Trade	Feed Self-Sufficiency	Oil Self-Sufficiency
	($)[a]			
Guyana				
Corn (70%)[b]	268.65	186.76	195.01	143.11
Soya meal (54%)	381.55	205.72	252.50	0[c]
Soya oil	3.90	3.90	3.07	9.29
Trinidad and Tobago				
Corn (77%)	187.29	143.76	169.80	100.11
Soya meal (60%)	278.99	167.87	259.50	0[c]
Soya oil (85%)	4.66	3.95	3.35	9.34
Jamaica				
Corn	160.11	160.11	229.80	160.11
Soya meal	193.28	193.28	316.50	60.00
Soya oil	3.55	3.55	3.55	9.77
Barbados				
Corn (86%)	210.74	186.76	212.80	143.11
Soya meal (78%)	269.76	210.87	302.50	43.00
Soya oil (74%)	5.69	4.23	3.40	9.62

[a] Corn and soya meal prices are per long ton; soya oil price is per imperial gallon.
[b] Percentages in parentheses denote the ratio of the shadow price under free trade and the corresponding import price.
[c] These zero prices result from there being excess meal produced in the countries.

The 1975 import prices in some countries are therefore greater than the imputed prices derived from the free-trade scenario. Thus, some of the tariffs that would have to be imposed to prevent imports are less than the difference between the imputed prices from the free-trade and self-sufficiency scenarios; they are obtained by subtracting 1975 import prices from corresponding self-sufficiency prices.

In the feed self-sufficiency scenario, specific tariffs are required only on corn and meal in importing countries (table 4). None is required on soya oil because of the joint product nature of oil and meal, which ensures substantial oil production even when meal demand is the limiting factor. Similarly, with self-sufficiency in oil, a tariff is required only on oil. In this case, both the joint product nature of meal and oil, and the crop rotation systems for corn and soya preclude the need for corn and meal tariffs.

Two principal observations can be made about these tariffs. First, as the ad valorem equivalents indicate, five of the eight tariffs are in excess of 50%, and they range as high as 175%. Second, a common market requires the adoption of a common external tariff by member countries. The establishment of a common external tariff at the highest level would increase prices in some member countries above those required to achieve regional self-sufficiency. The increased costs may be politically unacceptable to some member countries and could further alter the patterns of production and distribution within the re-

Table 4. Minimum Preventive Tariffs Assuming 1975 Import Prices

		Self-Sufficiency Scenario	
Country	Product	Feed	Oil
		($ per unit)[a]	
Guyana	Soya oil		5.39 (138%)
Trinidad & Tobago	Soya oil		4.68 (100%)
Jamaica	Corn	69.69 (44%)	
	Soya meal	123.22 (64%)	
	Soya oil		6.22 (175%)
Barbados	Corn	2.06 (1%)	
	Soya meal	32.74 (12%)	
	Soya oil		3.93 (69%)

[a] Corn and soya meal are in long tons; soya oil is in imperial gallons. Numbers in parentheses represent the ad valorem equivalent (percentage of the import price) of the specific tariff.

gion. Because import prices differ among countries the potential for importing via a low-cost country and transshipping to a high-cost country could be created. Even with transshipment, equilibrium prices in some countries would be above those under an optimal differential tariff policy. A more complex programming analysis in which both prices and quantities are determined endogenously would be needed to determine the full implications of this policy.

Foreign Exchange

The effect of import substitution on the balance of payments of CARICOM's member countries is important. The figures given in table 5 reflect the opportunity cost of import substitution in terms of foreign exchange. They include the savings resulting from the reduction in feed and vegetable oil imports from outside CARICOM, valued at 1975 world market (import) prices, and each country's earnings or expenditures resulting from trade in feed and vegetable oil with other CARICOM members.

The values for Trinidad and Tobago and Jamaica incorporate losses in foreign exchange from sugar exports directly displaced by feed production. Expenditures on imports are calculated using the relevant destination price in table 3. Earnings from exports are calculated using prices at their origin. Expenditures on transportation, for both intra- and extraregional trade, are treated as a foreign exchange expenditure (loss), even though some may accrue to flag carriers of the countries concerned. It was not possible to include (net out) any import component of agricultural production and processing costs. This will not affect conclusions drawn from the table unless the import content of sugar production is significantly different from that of feed grains.

Table 5. Change in the Foreign Exchange Position Associated with Import Substitution, 1975

Country	Free Trade	Feed Self-Sufficiency	Oil Self-Sufficiency
	($ millions)[a]		
Guyana	+ 4.3	+10.8	+10.8
Trinidad & Tobago	−29.4	−35.9	−37.1
Jamaica	0.0	−57.8	−37.1
Barbados	+ 0.9	+ 0.6	0.0
CARICOM[b]	−24.2	−82.4	−63.4

[a] The values given in the table for Trinidad and Tobago and Jamaica reflect the foreign exchange opportunity cost of using land previously devoted to export sugar production to produce feed.
[b] Detail may not add due to rounding.

Only two countries, Guyana and Barbados, realize a net foreign exchange saving from import substitution. In Guyana's case, this is because its production of feed and vegetable oil does not displace existing sugar production. It gains by saving on imports from extraregional sources, and also (with the exception of the free-trade case) through a positive net trade balance with other CARICOM countries. In two of the three scenarios, Barbados has an overall net gain, since its expenditure on CARICOM-produced feed and oil is lower than the cost of obtaining these from outside the region. In Trinidad and Tobago, and Jamaica, the loss of foreign exchange from displaced sugar production dominates. Since Trinidad and Tobago is an exporter of feed/oil under all scenarios, its losses are less than those of Jamaica, which is primarily an importer.

Under all scenarios, there is a net loss in foreign exchange from the production of feed/vegetable oil in CARICOM. The loss is smallest under free trade ($24.2 million), but is still significant, primarily because in 1975 the world sugar price was 50% above the average for 1970–78 (International Bank for Reconstruction and Development). Under more moderate sugar prices, the foreign exchange losses from displacing sugar production would be mitigated.

Conclusions

In 1975, the year on which this study is based, corn/soya production in CARICOM was in the early stages of development. Imports of animal feed to satisfy demand from the new, rapidly expanding livestock-feeding industry had been growing, promoting considerable regional interest in the possibility of import substitution. A number of pilot production projects had been established to explore the technical feasibility, reduce the uncertainties of a new agricultural activity, and lower institutional barriers to change. The programming analysis performed in this study is designed to assist in the evaluation of import substitution.

Based on a model designed to minimize the costs of meeting 1975 feed demands, 45% of CARICOM's imports of corn and soya meal and over 30% of its imports of soya oil could be displaced by domestic production under free trade. Jamaica is the only country which continues to import all its corn/soya requirements from outside CARICOM. Land resources within the Community are not adequate to achieve self-sufficiency in both feed and oil. However, self-sufficiency in one or the other is possible.

Self-sufficiency has significant implications for resource use and foreign exchange. For example, feed grain production generates increased employment in Guyana, since undeveloped land is brought into production. When land which was used for sugar in 1975 is diverted into capital intensive corn/soya production in Trinidad and Tobago, employment is reduced. Even if labor-intensive methods were adopted, there would still be a reduction in agricultural employment under feed self-sufficiency.

The foreign exchange implications of import substitution differ significantly among countries. Guyana saves foreign exchange in meeting its soya needs and exhibits a net foreign exchange surplus in its corn/soya trade with other CARICOM countries. In contrast, because corn/soya production in Jamaica displaces sugar for export, Jamaica's overall foreign exchange position deteriorates significantly at 1975 prices.

The trade restrictions needed to achieve self-sufficiency add further complications. Superficially, it appears that quotas, required only in Guyana and Jamaica, provide the simplest means to control imports. However, quotas are not viewed favorably in the international community. Prohibitive tariffs provide a theoretical alternative, but the rates required would generally be over 50% and would differ between member countries. Since CARICOM has been attempting to harmonize its policies and adopt a common external tariff, setting common rates at the highest level may unnecessarily increase the costs of feed in some member countries and could disrupt trade patterns within the Community.

In conclusion, this analysis is a preliminary assessment of the feasibility of import substitution. It is based on the best cost and input information available, and on import prices and feed demands consistent with this information. To forecast the long-term feasibility of import substitution in CARICOM, additional analysis would certainly be required.

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