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A DIFFUSION MODEL OF THE PROCESS OF IMPLEMENTING THE CARIBBEAN BASIN ECONOMIC RECOVERY ACT

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I. INTRODUCTION

THE Caribbean Basin Economic Recovery Act (CBERA) was signed into law on August 5, 1983. This bill outlines provisions of the Reagan administration's Caribbean Basin Initiative, a broad program of trade incentives and economic assistance measures designed to enhance political stability and economic growth in the Caribbean Basin region by fostering trade and investment.[1] Customs-duty-free access to the U.S. market for a wide range of products from designated beneficiary countries for twelve years is the CBERA's central feature. Tariff preferences create static price advantages intended to stimulate exports from beneficiaries and encourage investment in export-oriented production. Over time, beneficiaries are expected to respond to price incentives by restructuring their export baskets to take maximum advantage of duty-free treatment. It is assumed that the effective utilization of trade incentives will be reflected over time in a rising share of preferential exports in total exports to the United States for designated beneficiaries.

Several studies have investigated the relationship between tariff preference margins under the CBERA and induced trade flows. Trade expansion estimates outlined in Sawyer and Sprinkle (1984, 1990), Rousslang and Lindsey (1984), Pelzman and Schoepfle (1988), and Feinberg and Newfarmer (1984) suggest that CBERA tariff preferences should provide small gains to beneficiary countries. In the present study it is assumed that the process of implementing a tariff preference scheme mirrors a dynamic diffusion process whereby successful beneficiaries increase their share of preferential exports in total exports over time. A two-stage approach is used to investigate the process of utilizing trade provisions, and to identify factors which influence the dynamic adjustment process for individual beneficiaries. First, logistic growth functions of the share of preferential exports in

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[1] Background information on the CBERA is presented in Clark (1989a, 1989b), Schoepfle and Perez-Lopez (1985), and Samolis (1984).

total exports over time are estimated for each beneficiary to provide a measure of the rate of adoption and upper limit on participation in the tariff preference scheme. The second step involves relating estimated parameters (slope coefficients and ceiling values) of logistic growth functions to country-specific characteristics in order to identify factors responsible for intercountry differences in the observed (estimated) utilization rates of tariff preferences under the CBERA.[2]

This approach avoids two shortcomings included in previous studies of the CBERA. Since reliable estimates of export supply price elasticities are not available, in these studies it is typically assumed that export supply curves are perfectly elastic, or a range of plausible elasticity values is used to estimate the effects of tariff preferences. The assumption of infinitely elastic export supply curves is not realistic for small developing countries with limited production capabilities where changes in exports account for a large share of total output. When trade expansion effects are estimated by combining information on base-period U.S. imports, changes in tariff rates, U.S. import demand elasticities, and beneficiary export supply elasticities, it is implicitly assumed that all beneficiaries are able to make effective use of tariff preferences offered. In the present paper there are no assumptions concerning export supply elasticities, and the extent to which exports of beneficiaries could realistically expand in response to tariff preferences is indicated. Unlike in previous studies, an effort is made here to identify the factors responsible for intercountry differences in CBERA participation.

II. LOGISTIC FUNCTIONS

The logistic function is commonly used to describe the growth path over time of any variable for which: (a) an upper limit exists, and (b) observed changes in the variable in each time period are dependent upon both the cumulative value attained in the preceding period, and the remaining distance to the upper limit value.[3] These characteristics are likely to be exhibited by the dependent variable in the present study, i.e., the share of preferential exports in total exports for beneficiary i at time t, denoted as SX_{it}. First, $SX_{it} \leq 1$, by definition. Each beneficiary will have an upper limit on the share of preferential exports in total exports. This upper limit, denoted as K_i (≤ 1) is influenced by product coverage and rules of the CBERA, and will vary from country to country depending on the respective factor endowments.

Second, the response of exporters to price incentives can be conceived as a sequential decision-making process whereby exporters learn how to claim CBERA

[2] This methodology has been used by Griliches (1957) and Mansfield (1961) to model the diffusion of new innovations, by Mansfield and Hensley (1960) to describe the spread of contagious diseases, and by Clark, Kaserman, and Anantanasuwong (1993) to describe the process of industrialization in economic development.

[3] Lekvall and Wahlbin (1973) discuss the logistic function and its underlying dynamic process.

eligibility, familiarize themselves with provisions of the scheme, expand production capabilities, and develop new distribution channels to sell more eligible products in the United States. This process of learning-by-doing leads to the expectation that dSX_{it}/dt will be positively influenced by $SX_{i,t-1}$. That is, prior success in utilizing tariff preferences will enhance growth in the share of preferential exports in total exports in time t. Furthermore, dSX_{it}/dt should be positively influenced by $(K_i - SX_{i,t-1})$, the remaining distance to the upper limit value in the preceding period. Growth in the share of preferential exports in total exports is also expected to slow as SX_{it} approaches its ceiling value. This is evident from the fact that as SX_{it} increases in value, $(K_i - SX_{it})$ will decline. These opposing effects contribute to an S-shaped growth path described by the logistic growth function.

A variety of factors will dampen growth in SX_{it} as its ceiling value is approached. Most trade expansion gains from the one-time elimination of duties occur within the first few years of the scheme's operation. Subsequent gains are expected to result from export-oriented investment. Beneficiaries encounter difficulties in attracting foreign investment over time. These difficulties stem from political turmoil, insufficient investment incentives, restrictions on foreign exchange and profit repatriations, inadequate transportation infrastructure, and periodic recessions in the United States. Shortages of materials and productive factors also create bottlenecks, which are exacerbated by a minimum local content rule specifying that the cost of materials and processing must comprise at least 35 per cent of customs value of eligible products. CBERA beneficiaries are starting to voice concern over nontariff barriers used by the United States which limit the effective utilization of the tariff preference scheme (see Clark and Zarrilli 1994).

The logistic specification is expressed as

$$\ln \frac{SX_{it}}{K_i - SX_{it}} = \alpha_i + \beta_i t + \mu_i, \tag{1}$$

where α_i is a constant of integration which positions the logistic curve on the time axis, β_i is a slope coefficient which reflects the growth rate of preferential exports relative to total exports for each beneficiary i, and μ_i is a random disturbance term.

The logistic formulation assumes that there is some maximum attainable share of preferential exports in total exports for each beneficiary. The ceiling is not likely to remain unchanged over extremely long periods of time. As beneficiaries achieve success in attracting significant investment funds, undertaking major structural changes in export sectors, and altering their resource base, K_i will change. However, the change in K_i will be slow in relation to observed changes in SX_i. Thus, for purposes of modeling the dynamic process whereby beneficiaries increase their utilization of CBERA trade provisions, K_i is assumed to be fixed for each beneficiary. Attention will be focused on the rate at which individual beneficiaries approach the maximum attainable SX_i, or β_i, and the upper limit or utilization at a

given point in time, K_i, but not changes in K_i over time.

Equation (1) is estimated for beneficiaries as a group and separately for each beneficiary over the 1984–90 period using ordinary least squares.[4] Each equation is fitted by conducting what is, in effect, a maximum likelihood estimate of the value of K_i for each beneficiary. The maximum observed value of SX_{it} with an increment of 1 per cent is taken as the initial value of K_i in each case. Values for K_i are then increased by one percentage point, and equations are reestimated until maximum R^2's are attained. The value of K_i that results in the maximum R^2 is then employed as the estimate of that parameter.[5]

Estimates of slope coefficients for twenty-one beneficiaries are presented in Table I. Results pertaining to beneficiaries as a group appear in the top of the table. The slope coefficient of the logistic function is positive and highly significant in the total CBERA equation. This finding, and the relatively high R^2, support the view that the process of adopting provisions of a tariff preference scheme mirrors a dynamic diffusion process whereby beneficiaries increase their share of preferential exports in total exports over time. The estimated ceiling share, K_i, is close to 15 per cent. Unfortunately, the highest observed value for SX_i, attained in 1989, was 13.6 per cent. A comparison of these values suggests that the scope for greater utilization of CBERA trade provisions will be limited until new provisions go into effect in 1992.[6] This conclusion is consistent with those of previous studies which have indicated that trade expansion effects are negligible.

Slope coefficients for thirteen individual beneficiaries are positive and statistically significant, reflecting varying degrees of success in utilizing provisions of the CBERA. None of the statistically significant slope coefficients are negative. Two of the three leading sources, Costa Rica and Guatemala, show highly significant slope coefficients, unlike the remaining leader, the Dominican Republic. Eight beneficiaries show statistically insignificant slope coefficients, implying that the rates of growth of preferential exports relative to total exports do not differ significantly from zero. These findings are important because they identify beneficiaries who were unsuccessful in attempts to adopt trade provisions of the CBERA.[7] Estimates of the ceiling share, K_i, range up to 78 per cent, in the case of St. Vincent and

[4] Aruba and Guyana were not included in the analysis. Aruba was designated as a beneficiary in 1986, and preferential exports were zero in 1986, 1988, and 1989, while Guyana was designated as a beneficiary in 1988. Bahamas, designated as a beneficiary in 1985, was included in the analysis. Data are contained in USITC (1989, 1990, 1991).

[5] This approach is statistically equivalent to the method described in Griliches (1957).

[6] The list of eligible products was expanded to include athletic equipment, bandages, certain carpets, certain meats, conveyor belts, head bands, jute yarns, mattresses, plastic and rubber fabrics, plastic sheet, and wrist watches. See USITC (1991).

[7] Countries where β_i did not differ significantly from zero generally attained the highest observed preferential export share shortly after being designated as beneficiaries, and exhibited an extremely small decline in this share over subsequent years.

TABLE I

LOGISTIC FUNCTIONS

Designated Beneficiary	α	Adoption Rate		Ceiling (K)	R^2
		β	t–value		
Total CBERA	–52.261	0.621[a]	8.659	0.147	0.94
Central America:					
Belize	–45.736	0.536[b]	3.324	0.442	0.68
Costa Rica	–19.130	0.230[a]	6.654	0.257	0.90
El Salvador	–53.113	0.615[a]	6.239	0.129	0.89
Guatemala	–47.609	0.559[a]	5.322	0.205	0.85
Honduras	15.222	–0.156	–0.922	0.158	0.15
Panama	4.492	–0.043	–0.182	0.076	0.01
Eastern Caribbean:					
Antigua	–54.862	0.615[a]	4.450	0.268	0.80
Barbados	–77.411	0.890[a]	7.510	0.512	0.92
Dominica	–43.936	0.505	1.692	0.164	0.36
Grenada	–101.102	1.136[a]	4.185	0.391	0.78
Montserrat	–77.459	0.888	1.000	0.054	0.33
St. Kitts and Nevis	–38.511	0.449[a]	4.329	0.724	0.79
St. Lucia	33.048	–0.365	–1.825	0.196	0.40
St. Vincent and Grenadines	–63.176	0.718[c]	2.000	0.786	0.44
Central Caribbean:					
British Virgin Islands	–79.659	0.898[c]	2.364	0.134	0.53
Haiti	–27.509	0.320[b]	2.837	0.278	0.62
Dominican Republic	32.723	–0.358	–1.578	0.226	0.33
Jamaica	10.024	–0.115	–1.312	0.251	0.26
Oil–refining countries:					
Bahamas	14.560	–0.179	–0.243	0.258	0.01
Netherlands Antilles	–38.824	0.436[a]	4.641	0.016	0.81
Trinidad and Tobago	–37.951	0.425[b]	3.060	0.100	0.65

[a] Significant at 0.01 level.
[b] Significant at 0.05 level.
[c] Significant at 0.10 level.

the Grenadines. Some of the highest observed K_i values are recorded for Eastern Caribbean countries, which also include St. Kitts-Nevis and Barbados. Oil-refining countries, such as the Netherlands Antilles and Trinidad and Tobago, exhibit some of the lowest ceiling values.

III. DETERMINANTS OF CBERA PARTICIPATION

The second stage of the analysis focuses on country-specific variables that may account for intercountry differences in adoption rates and ceiling participation levels under the CBERA scheme. A ceiling level (K) refers to a long-run equilibrium

percentage of total exports that will enjoy CBERA duty-free entry, while the adoption rate (β) refers to the rate of adjustment to the long-run equilibrium ceiling K. Static price advantages from one-time duty reductions stimulate exports of CBERA-eligible products, and a rising share of preferential exports in total exports to the United States for a beneficiary can be anticipated over time. The adjustment rate β, or rate of approach to ceiling K, will be higher, the easier it is to adjust the supply of CBERA-eligible products from a beneficiary. Factors expected to affect the rate of adoption include trade orientation, availability of productive factors and infrastructure, past growth performance, CBERA provisions, and availability of other duty-free programs. The ceiling level K is influenced by the scope (product coverage) of the program, as well as by many of the same variables that influence β. This investigation is severely limited by the lack of available data on structural characteristics of small developing countries in the Caribbean Basin region, and by the relatively small number of country observations involved.

Since factors responsible for intercountry differences in the adoption rate and ceiling level are not independent of each other, the value of β depends, in part, on the ceiling value of K. As such, comparability of parameters between countries might be improved by adjusting the β values for differences in K. This objective can be achieved by also including $\beta' = \beta \times K$ as a dependent variable, which translates the β values from the percentage of ceiling units into actual percentage units. Factors responsible for β, β', and K are discussed below. Variables included in the analysis were strongly influenced by data availability.

Trade orientation of a beneficiary prior to implementation of the CBERA is considered to be an important determinant of CBERA participation.[8] High levels of exports relative to gross national product (GNP) reflect the ability of a beneficiary to expand the supply of traditional products, and also indicate a familiarity with marketing and distribution channels abroad. High levels of imports relative to GNP suggest low levels of protection, the absence of other market distortions, availability of hard currencies for the importation of key inputs, machinery and food, and the absence of exchange controls. CBERA participation is expected to be positively influenced by levels of exports and imports relative to GNP.

It is anticipated that the availability of capital, labor, and infrastructure will exert a strong influence on CBERA participation. The ability to mobilize resources is measured by two variables, the share of gross fixed capital formation in gross domestic product (GDP) averaged over the 1980–83 period, and population density, expressing population divided by area in square kilometers. Infrastructure availability is proxied by kilometers of roads and kilometers of rail lines, both expressed

[8] The relationship between export performance and trade orientation is discussed in Dollar (1992) and articles cited therein.

relative to square kilometers of area. CBERA participation should be positively associated with the ability to mobilize resources, and availability of infrastructure.

Past growth performance is considered to influence the ability of a beneficiary to take advantage of tariff preferences. Government policies that encourage growth, such as provision of infrastructure, promotion of market efficiency and free trade, and maintenance of stable macroeconomic policies, will encourage CBERA participation. Growth variables included in the analysis are the average annual real GDP growth rates over the 1980–83 period, and the average annual GDP per capita growth rate over the same period. Positive relationships are expected between CBERA participation and both growth rate variables.

Two features of CBERA provisions are likely to exert influences on participation parameters. Potential tariff revenue savings, as reflected in the average tariff rate prior to the CBERA, are likely to encourage CBERA participation. Only CBERA-eligible products enjoy preferential tariff treatment. Beneficiaries exporting large amounts of products not eligible for duty-free entry are expected to show low CBERA participation measures. Product exclusions are provided by the most-favored nation (MFN) dutiable value of imports in 1984. CBERA participation parameters are expected to be positively associated with the average tariff duty rate adopted in 1983, and negatively associated with the MFN dutiable value of imports recorded in 1984.

Finally, the availability of other duty-free programs is likely to influence CBERA participation. Most products eligible for CBERA duty-free treatment were already eligible for tariff preferences under the U.S. Generalized System of Preference (GSP) scheme.[9] Considerable concern has been voiced over the redundancy of GSP and CBERA product coverage (see USITC 1990, chap. 1). CBERA participation is expected to be negatively related to U.S. GSP imports.

IV. RESULTS

Correlation coefficients between measures of CBERA participation and their determinants are presented in Table II. Many key factors are found to be correlated with measures of CBERA participation.[10] Results confirm the importance of trade orientation in determining CBERA adoption rates and ceiling participation values. Ratios of agricultural exports, agricultural imports, and manufactured imports relative to GNP, are all positively correlated with CBERA participation measures. The correlation coefficients between manufactured exports relative to GNP and

[9] See Clark (1991) for background information on the U.S. GSP scheme.

[10] Variables are constructed from data contained in Kurian (1992), Schoepfle and Perez-Lopez (1985), UN (1987), USITC (1989, 1990, 1991), and the World Bank (1989). Intercorrelation among the independent variables makes it difficult to estimate their separate contributions using regression analysis.

TABLE II

CORRELATION COEFFICIENTS

Variable	Adoption Rate (β)	$\beta' = \beta \times K$	Ceiling (K)
Trade orientation (averaged over 1980–83):			
Exports of agricultural products / GNP	0.19	0.49[b]	0.62[a]
Exports of manufactured products / GNP	0.02	0.01	0.15
Imports of agricultural products / GNP	0.40[c]	0.65[a]	0.61[a]
Imports of manufactured products / GNP	0.26	0.52[b]	0.53[b]
Availability of factors and infrastructure:			
Gross fixed capital formation / GDP, avg. over 1980–83	0.39[c]	0.40[c]	0.28
Population density (population per sq. km area)*	0.54[b]	0.59[a]	0.36[d]
Km roads per sq. km area*	0.59[a]	0.66[a]	0.41[c]
Km rail lines per sq. km area*	0.15	0.16	0.32[e]
Past growth performance (1980–83):			
Average annual real GDP growth	–0.11	0.25	0.38[c]
Average annual GDP per capita growth	0.21	0.38[c]	0.32[d]
CBERA provisions:			
Average tariff duty rate, 1983	0.05	0.27	0.36[d]
MFN dutiable import values, 1984 (U.S.$ 1,000)	–0.12	–0.29[d]	–0.35[c]
Other duty-free programs:			
U.S. GSP imports, 1984 (U.S.$ 1,000)	–0.46[b]	–0.34[d]	0.11

* British Virgin Islands, Montserrat, and Netherlands Antilles are excluded due to data unavailability.

[a] Significant at 0.01 level.
[b] Significant at 0.05 level.
[c] Significant at 0.10 level.
[d] Significant at 0.15 level.
[e] Significant at 0.20 level.

CBERA participation rates do not differ significantly from zero. Two explanations can be advanced for the lack of association between these variables. First, many manufactured products in line with the comparative advantage of beneficiaries are not eligible for duty-free treatment, including textiles and apparel, certain leather products, and footwear. Second, many manufactured products were already eligible for duty-free GSP status. Most leading items receiving preferential CBERA access to the U.S. market are agricultural products, including sugar, beef and veal, pineapples, orange juice, cigarette leaf, and rum.

Availability of capital, labor, and infrastructure is found to exert an important influence on CBERA adoption rates and ceiling participation values. Most of these variables are positively correlated with CBERA participation measures. Inadequate infrastructure and a limited labor supply in certain beneficiary countries are considered to constitute major barriers to the expansion of manufacturing sectors

and realization of potential benefits associated with the CBERA (see USITC 1990, chap. 1).

Growth performance prior to the enactment of the CBERA is found to exert an influence on the ability of beneficiaries to respond to tariff preferences. Average annual real GDP growth is positively correlated with the ceiling participation value, while average annual GDP per capita growth is positively correlated with both the adjusted slope and ceiling value for CBERA participation. These correlations emphasize the importance of government policies that encourage economic growth as prerequisites to taking advantage of CBERA provisions.

Variables related to CBERA provisions are found to be correlated with some measures of CBERA participation. The average tariff duty rate prior to the enactment of the CBERA, a measure of potential revenue savings and magnitude of price incentives, is positively correlated with the ceiling participation value. The lack of correlation between the average tariff and CBERA adoption rate measures is consistent with the widely held view that the high visibility the region achieved among investors due to CBERA publicity and promotional activities provided greater gains to beneficiaries than actual tariff concessions (see USITC 1989, chap. 3). MFN dutiable import levels after enactment of the CBERA are negatively correlated with both the adjusted slope coefficients and ceiling participation values, emphasizing the importance of product exclusions in limiting CBERA benefits.

Results suggest that the availability of the alternative duty-free program exerted an adverse impact on CBERA participation. The GSP variable is negatively correlated with CBERA adoption rate measures.

V. CONCLUSIONS

In this study logistic growth functions of the share of preferential exports in total exports over time for CBERA beneficiaries were analyzed to provide estimates of the adoption rates and upper limit on participation under the tariff preference scheme. Thirteen beneficiaries out of twenty-one were successful in adopting trade provisions of the CBERA. Estimated parameters of logistic functions were related to country-specific characteristics using simple correlation analysis to identify the factors responsible for intercountry differences in the observed rates and levels of CBERA participation. Although data on structural characteristics of beneficiary countries are extremely limited, evidence is provided to suggest that trade orientation, availability of productive factors and infrastructure, prior economic growth, and tariff revenue savings, exert positive influences on CBERA participation, while negative influences are exerted by product exclusions and availability of the GSP scheme. Results also support the hypothesis that the process of adopting provisions of a tariff preference scheme mirrors a dynamic diffusion process whereby beneficiaries increase their share of preferential exports in total exports over time.

Results pertaining to the logistic function for beneficiaries as a group are a cause for concern as the estimated ceiling share (15 per cent) is very close to the actual ceiling value attained in 1989 (13.6 per cent). This finding suggests that greater utilization of CBERA trade provisions will be limited until new provisions, which go into effect in 1992, extend product coverage to include certain products previously excluded from CBERA eligibility.

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