992

EXPORTS AND ECONOMIC GROWTH IN CARIBBEAN COUNTRIES

Arnold McIntyre*

The aim of this paper has been to define the role of exports in the development process in small, open Caribbean economies. Feder's (1983) is empirically estimated for a sample of small developing countries. The main purpose is to test the differential marginal factor productivity hypothesis and the "externality" hypothesis about the role of exports in small country growth. It is also argued that the foreign exchange contribution of exports in their most important role in Caribbean-type economies. The results do not provide support for the Feder's externality argument but there is support for the foreign contribution of exports in Caribbean economies.

*Arnold McIntyre is a Country Economist at the Caribbean Development Bank in Barbados. The author would like to thank Professors Gerald K. Helleiner, David Foot and Albert Berry (University of Toronto); Dr Delisle Worrell (Deputy Governor, Central Bank of Barbados) and Dr Andrew Downes (University of the West Indies) for their comments and useful suggestions.

INTRODUCTION

A lot of attention has been focused on the relationship between export performance and economic growth in the development economics literature. Generally, two major approaches have been adopted. First, there have been individual country analyses of the implications of export-promotion versus import-substitution strategies for economic growth (See Bhagwati (1978) and Krueger (1978) for useful summaries). Second, there is a body of empirical research that examines the extent to which differences in export performance may explain inter-country growth differentials – Balassa (1985); Ram (1985); Feder (1983); Tyler (1981); Helleiner (1986) and Fosu (1990) to mention a few. These studies employ a production function framework that includes exports as an argument in the function. Generally, the empirical evidence suggests that exports have a positive impact on economic growth in developing countries, particularly middle-income and semi-industrialised countries. There have been no studies in the literature that focus on small developing countries including the Caribbean countries.[1]

The Caribbean literature on exports and economic growth has generally been cast in the mould of the centre periphery model of the 'dependency school' which initially evolved in Latin America (see Best and Levitt (1969)). In addition, "staple" theory (See Watkins (1968); Girvan (1972); Beckford (1972)) has been applied in the context of the major mineral exports i.e. bauxite and oil. Essentially, these studies analyse the developmental impact of foreign owned multinational corporation (MNC) enclave industries on the domestic economy in Caribbean countries. However, there is no empirical tradition (as mentioned above) for analyzing the relationship between exports and growth. Therefore, given the absence of research on small developing countries in general, and the Caribbean in particular, it is useful to examine empirically the relationship between exports and growth for a cross-section of small developing countries including the Caribbean. In Section 1 Feder's model of exports and growth is presented and it is applied to small developing countries. In Section 1(a) data and results are presented for Feder's model. In Section 2 an alternative model analysing the role of exports in output expansion in Caribbean countries is presented. In contrast to Feder's model the importance of the foreign exchange earnings generated by exports is highlighted.

SECTION 1

FEDER'S MODEL APPLIED TO SMALL DEVELOPING COUNTRIES

Some empirical studies across countries have shown that developing countries with a strong export growth record have higher rates of economic growth. Tyler (1981) and others have shown that export performance together with other variables is associated with inter country variance in growth rates. Why is this so? What is special about exports? A variety of explanations have been advanced relating to the beneficial aspects of exports, such as their contribution to greater capacity utilization, technological improvements, better management due to international competition, economies of scale and others. Feder (1983) argues that a major implication of these discussions is that there are substantial differences between marginal factor productivities in export-oriented and non export-oriented activities such that the former have higher levels of factor productivity. There are two key propositions to be derived from Feder's model: first, differential marginal factor productivities between the export and non-export sector; second, dynamic growth effects i.e. "externalities" from the export sector.

An important issue is whether the correlation between export growth and GDP growth is primarily due to joint causation (e.g. you find a new exportable resource so both exports and GDP rise), or to effects of GDP growth on export growth? Feder's model treats exports as an exogenous variable and is criticised for not considering the issue of simultaneity bias. There is a body of literature on export supply functions that treat exports as an endogenous variable. Therefore, it is argued that exports are a stochastic regressor and to avoid biased and inconsistent estimates instrumental variables (Two Stage Least Squares - TSLS) should be employed as the preferred estimating technique. Adams, Behrman & Boldin (1989) recognise the issue of simultaneity bias and present both TSLS and (Ordinary Least Squares - OLS estimates. In the present analysis data for the 1965-80 period was used as instruments in estimating the model via TSLS for the 1980-89 period.[2]

Feder's model is an improvement on earlier analyses in that it tries to get at the question of externalities. By so doing it formalises a lot of anecdotal arguments that have been advanced in support of exports. The model suffers from measurement problems since the labour force data are very imprecise and since I/Y (the investment share of GDP) has had to be used as a proxy for the preferred $\dot{K}/K$. Notwithstanding these problems the model is an important improvement on previous analyses and is used here because it provides some analysis of why exports are correlated with growth.

Feder's (1983) model develops an analytical framework in which it is possible to quantitatively assess factor productivity differentials between exports and non-exports using aggregate data. Following the empirical approach of the sources of growth studies, aggregate growth is related to growth in labour and capital via an underlying production function. Export performance is also used as one of the variables explaining growth.

A model is developed in which the economy is divided into the export and non-export sectors. Output in each sector is dependent on factors allocated to that sector but the non-export sector is also dependent on the volume of exports produced. This formulation assumes positive effects of exports on other sectors and these effects are regarded as externalities.

Now, because of data limitations in developing countries sectoral allocations of primary factors are not available, so, Feder (1983) specified a relationship which permitted estimates of marginal productivities in different sectors using national data. For econometric purposes Feder (1983) estimated the following equation for a sample of countries defined as semi-industrialised.

where:

(1) $$\dot{Y}/Y = a_o + \alpha .\ I/Y + \beta(\dot{L}/L) + \lambda[(\dot{X}/X).(X/Y)]$$

$$\alpha > 0; \quad \beta > 0; \quad \lambda > 0$$

Y = Output GDP

Y = Investment

L = Labour Force

X = Export

and, $\dot{}$ means rate of growth

Generally, the results provide strong support for the differential marginal factor productivities hypothesis. However, equation (1) does not allow us to identify the specific inter-sectoral externality effect. For this purpose, Feder (1983) reformulates the model and estimates the following equation:

$$\dot{Y}/Y = \alpha_0 + \alpha.\ I/Y + \beta(\dot{L}/L) + \lambda_1[\dot{X}/X.X/Y] + \lambda_2\dot{X}/X \quad (2)$$

$$\alpha > 0; \quad \beta > 0; \quad \lambda_1 > 0 \quad \lambda_2 > 0.$$

where:

$\dot{X}/X$ = Export Growth Rate

1(a) Data and Results

Data for output growth, labour force growth and export growth are taken from the World Development Report (1991). The investment share of GDP is also taken from the World Development Report (1991) and the World Bank's data for 1965 and 1989 have simply been averaged to obtain a figure for the periods 1965-89 similarly, it is averaged for 1965 and 1980 , and 1980 and 1989 to obtain figures for 1965-80 and 1980-89. For countries in the sample with data available for the whole period average investment ratios are computed for the periods 1965-80; 1980-89 and 1965-89. These permit the carrying out of some sensitivity analysis. The results do not differ significantly as a consequence of these exercises. Export shares of GDP were also obtained from the World Development Report (1991). The periodisation used in the empirical work is conditioned by the ready availability of data. Therefore, the model is estimated for the periods 1965-89, 1965-80 and 1980-89 which are available from the World Development Report (1991). In addition, the model was developed to analyse growth rates over a period of time as opposed to an annual growth rate, that is, time series data.

An obvious question is how was the sample of small countries chosen; that is, what was the decision rule for inclusion as "small"? Jalan (1982) develops a country size index which allows him to classify 59 countries as an illustrative list of small countries. Generally, this sample was used but only included those countries with populations less than 7 million by 1986 and for which data are available. In addition, Israel, Singapore and Hong Kong were included from the sample as their level of overall development and industrial development in particular sets them apart from other small developing countries.

Econometric results are presented for a cross-section of 22 small developing countries (see the list of countries and the data set in Appendix 1) for the time period 1965-89; 25 small developing countries for the sub-period 1965-80 and 24 small developing countries for the sub-period 1980-89. The equation is also estimated for 16 and 14 small middle-income developing countries[3] drawn from the list of 22, 25 and 24 small developing countries for the time periods 1965-89, 1965-80 and 1980-89 respectively. The estimation technique is ordinary least squares. Tests for heteroscedasticity were carried out but its presence is not detected.

Table 1 contains the regression results for 22, 25 and 24 small developing countries for the three time periods, 1965-89, 1965-80 and 1980-89 respectively. The export variables do not perform particularly well and the "externality" variable ($\dot{X}/X$) is not statistically significant at 5% or better.[4] The change in the export share of GDP is statistically significant in the 1965-89 period and the 1965-80 sub-period. The labour force growth variable performs poorly and is not significant in any of the periods. The investment share of GDP is significant in the 1965-89 period and the 1980-89 sub-period. A dummy variable is included for CARICOM countries and it is statistically significant. In short, Feder's "externality" argument is not empirically supported in the present sample of small developing countries. The evidence does suggest that in the sample CARICOM countries are different from the other small developing countries

The results in Table 2 are for the periods 1965-89, 1965-80 and 1980-89 but only for a cross-section of 14, 16 and 14 small middle-income developing countries respectively.[5] The results for the small middle-income developing countries are not significantly better than those for the full sample of small developing countries except for the 1980-89 sub-period. Once again the performance of the export variables is not good and only the change in the export share of GDP is statistically significant in 1965-89 and 1980-89. The performance of the labour force growth variable and the investment share of GDP is weak. The dummy variable for CARICOM countries is not statistically significant suggesting that it was only significant in the full sample as CARICOM countries are middle income countries. The equation for the full sample was reestimated with a dummy for middle income countries and it was statistically significant at 10% or better.

The test (Park-Glejer) for heteroscedasticity does not detect its presence when the Feder model is estimated for the full sample of small developing countries in the period under consideration. An important consideration is whether the model applies to different sub-periods and there is no structural break across the two sub-periods 1965-80 and 1980-89. To examine this issue the 'Chow Test' (1960) involving the equality of coefficients of different regressions is carried out.

The test-statistic is the following:

$$F(K,\ N+M-2K) = \frac{(RSS_R - RSS_R)/\kappa}{RSS_{\mu R}/(N+M-2\kappa)}$$

Where:

N = No of Observations in Period 1

M = No of Observations in Period 2

RSS_R = Residual Sum of Squares (unrestricted)

$RSS_{\mu R}$ = Residual sum of Squares (unrestricted)

κ = No of Restrictions

Since the value of the F-statistic is 6.59 which is greater than the critical value of the F-distribution at the 5% level, we reject the null hypothesis. Therefore it is incorrect to assume equal coefficients.

TABLE 1

Regression Results for Feder Model Applied to 22 Small Developing Countries
Dependent Variable: Output (GDP) Growth (t-Statistics in Parentheses)

Right-Hand-Side Variables	1965-89 (n=22)	1965-80 (n=25)	1980-89 (n=24)
INTERCEPT	0.28 (0.16)	5.12 (3.95) ***	0.43 (0.22)
I/Y	0.19 (2.47) **	-0.03 (-0.42)	0.14 (1.68) **
$\dot{L}/L$	0.02 (0.03)	0.15 (0.40)	-0.44 (-0.92)
$[\dot{X}/X.X/Y]$	0.04 (1.40) *	0.13 (2.65) ***	0.03 (1.00)
$\dot{X}/X$	-0.14 (-1.01)	-0.16 (-1.77)	0.09 (0.85)
D[1]	-4.36 (-3.26) ***	-1.71 (-1.06)	-5.19 (-3.15) ***
R^2	0.57	0.31	0.63
$\bar{R}^2$	0.44	0.13	0.53

NOTES: [1]A dummy variable is introduced for CARICOM countries. All tests are one-tailed tests (except for the dummy variable).[6] *** means significant at 1% confidence level. ** means significant at 5% confidence level. * means significant at 10% confidence level.

TABLE 2

Regression Results for Feder Model Applied to Small Middle-Income Developing Countries
Dependent Variable: Output (GDP) Growth (t-Statistics in Parentheses)

Right-Hand-Side Variables	1965-89 (n=14)	1965-80 (n=16)	1980-89 (n=[illegible]4)
INTERCEPT	6.98 (2.40) **	8.37 (3.34) ***	1.59 (1.65) **
I/Y	-0.21 (-2.12)	-0.12 (-1.16)	-0.[illegible] (-1.86)
$\dot{L}/L$	-0.16 (-0.25)	-0.66 (-1.12)	0.83 (1.74) **
$[\dot{X}/X.X/Y]$	0.11 (2.78) ***	0.02 (0.27)	0.16 (2.96) ***
$\dot{X}/X$	-0.01 (-0.06)	0.06 (0.40)	0.09 (0.86)
D1	0.81 (0.71)	0.48 (0.27)	1.18 (0.65)
R^2	0.67	0.22	0.92
$\bar{R}^2$	0.46	-0.17	0.88

NOTES:

All t-tests are one-tailed tests (except for the coefficient on the dummy variable).

In summary, the Feder model performs best in the 1980-89 period for both samples of countries based on the explanatory power of the regression, that is, the R^2. For the sample of small developing countries only the change in the export share of GDP variable is significant and this is also true for the sample of small middle income developing countries only. In the 1980-89 sub-period for the small middle-income developing countries the R^2 is significantly higher than in any other instance.

The results do not provide strong evidence about the importance of differential marginal factor productivities and "externality" effects in small developing countries. In fact, there is no evidence of the importance of "externalities" of the export sector on the rest of the economy in small developing countries.

The above analysis does not explicitly recognise the function of exports in developing countries as providing the main source of foreign exchange for the much needed imports of intermediate and capital goods.[7] It is important to note that while the Feder model does not try to identify the extent to which export performance matters because imports matter, the fact that imports matter will still show up in Feder's results, mixed in with other reasons why exports may matter. The earlier "two-gap" model literature did recognise the importance of foreign exchange earnings but suggested that the foreign exchange contribution of exports is important only if the economy suffers from an import "shortage". At present in many developing countries import rationing is widely used as part of economic policy. In this context a large part of the contribution of exports to GDP growth is due to their role in increasing the supply of foreign exchange and, thus, of imports (See Esfahani (1991)).

SECTION 2

OUTPUT AND FOREIGN EXCHANGE FLOWS

Small developing countries are heavily dependent on a wide range of imports of goods and services. In the productive sectors output is heavily dependent on the imports of intermediate and capital goods. Therefore, output expansion necessitates increased quantities of imported intermediate and capital goods and this necessitates increased foreign exchange inflows. In short, a necessary condition for output expansion, both in the short and long-term, is increased foreign exchange flows. Note, however, that the argument based on the foreign exchange contribution of exports does not depend upon the presence of short-term import "shortages". Exports make a vital longer-term contribution to output expansion by providing a supply of foreign exchange to enhance import capacity. This is in contrast to the longer-term reallocative and externality effects of exports highlighted by Feder.

A simple production function is hypothesised in which imports (including consumer goods) enter as an argument together with the primary factors labour and capital. The unavailability of data for the period 1968-88 makes it impossible to use only intermediate and capital goods imports in the production function analysis. Even the data on total import volume are questionable and, more importantly, the data do not include imported services which are important if imports are to be included in a production function. Import volume is posited to be a simple function of the real availability of foreign exchange (RF) and in equation (6) the real foreign exchange variable (RF) enters the production function as an argument. The Cobb-Douglas functional form is not initially assumed to be appropriate to CARICOM economies. A more flexible functional form - the Transcendental Logarithmic Production Function (Translog) (Christensen, Jorgenson and Lau (1973)) is used to test whether the parametric restrictions of a Cobb-Douglas form are valid for CARICOM economies. The results indicate that a Cobb-Douglas form can be used for CARICOM economies (see Appendix 2). The following model is presented.

(3) $$Y = AK^{\alpha_1}L^{\alpha_2}M^{\alpha_3}e^{\varepsilon} \quad (Cobb\text{-}Douglas).$$

(4) $$M = B\ RF^{\beta_1}e^{u}$$

where:

Y	=	Real Output (GDP)
K	=	Capital Stock
L	=	Labour Force
M	=	Real Imports
RF	=	Real Gross Foreign Exchange Inflows

Import capacity is measured as a country's annual real foreign exchange inflows, that is the sum total of all the foreign exchange inflows into a country in a given year. The variable is defined as the country's gross nominal foreign exchange inflows (GFA) (the sum of gross exports of goods and services plus gross exogenous capital flows) deflated by the country's import price index (PM) to arrive at real GF

(RF). The World Tables (World Bank 1990a) defines the capacity to import as the value of exports of goods and nonfactor services deflated by the import price index omitting long-term capital inflows which differentiates it from the above measure. It could also be suggested that one needs to deduct inevitable or compulsory payments on the foreign debt from RF but in our case the data is not available for the period 1968-88.

Substituting (2) into (1):

(5) $$Y = AK^{\alpha_1}L^{\alpha_2}\,(BRF^{\beta_1})^{\alpha_3}e^{(\varepsilon+u)}$$

Alternatively,

(6) $$Y = AB^{\alpha_3}K^{\alpha_1}L^{\alpha_2}RF^{\beta_1\alpha_3}e^{(\varepsilon+u)}$$

Therefore,

(7) $$LnY = Ln(AB) + \alpha_1 LnK + \alpha_2 LnL + (\alpha_3\beta_1)LnRF + v$$
$$\alpha_1 > 0; \quad \alpha_2 > 0; \quad (\alpha_3\beta_1) > 0 \quad \textit{where:} \quad V = \varepsilon + u.$$

Initially, the production function analysis is done to test whether the restriction of homogeneity is valid and therefore a Cobb-Douglas structure is appropriate to CARICOM economies.

In the case of the translog there exist cost and production functions that are dual to each other. The aggregate production technology can be empirically investigated using either a production or a cost function. Generally, it is suggested that the cost function be used to estimate the production parameters as it is easier to implement (see Binswanger (1974)). In Appèndix 2 a translog cost function is presented and share equations are derived. A likelihood ratio (LR) test of the restricted versus unrestricted model is done to test whether the parametric restrictions on the share equations are valid. The estimation is done using Barbadian data for the period 1968-88 and the results of the LR test do not reject the null hypothesis of the restricted model. Therefore, a Cobb-Douglas functional form is appropriate for production technology in Barbados and the same is assumed for Jamaica and Trinidad & Tobago[8] (see Appendix 2 for the detailed work).

2(a) Data and Results

The data used in the estimation of the model are annual and are obtained from local and international sources. The components of the RF variable are obtained from the IMF's <u>Balance of Payments Statistics</u>. The import price index and the domestic price index are obtained from the World Bank's <u>World Tables</u> (1989-90 Edition) and the IMF's <u>International Financial Statistics</u> respectively. The Annual labour force data were obtained from the Statistics Departments in the individual countries. The capital stock data are derived from investment flows and are similar to those used in the Feder analysis. The quality of the labour force data is questionable based on discussions I held with officials at the various Statistics Departments and this is particularly true for the 1970's.

Equation (7) is estimated for Barbados, Jamaica and Trinidad & Tobago for the period 1968-88. The periodisation is conditioned by the availability of labour force data for the individual countries. In Table 3 the individual country results are presented.

The individual country results in Table 3 indicate that the foreign exchange variable is significant in all three countries. The primary factors have the wrong sign in Jamaica and Barbados. The quality of the labour force data is questionable and one must always interpret the results cautiously. The capital stock is derived from investment flows, therefore, the crude nature of the variable might be affecting its performance. In short, the primary factors - labour and capital - have measurement problems that are affecting their performance. They have the correct sign in Trinidad and Tobago but only capital is statistically significant. The $\bar{R}^2$ ranges from 0.58 in Trinidad and Tobago to 0.94 in Jamaica which indicates a good performance for the Model. In short, the individual country results support the argument that foreign exchange flows have a positive impact on output over time.

Generally, the model of output and foreign exchange flows performs better than the Feder model. There are important differences between the two models that must be noted. Feder's model attempts to analyse growth over a long period across countries, whereas, the model of output and foreign exchange flows is a time series model that analyses annual changes in output. Thus the Feder type analysis, where each observation refers to a fairly long period, allows one to pick up the positive effects of high investment rates, whose effects may come with something of a lag. In the analysis using annual data these effects are not likely to show up.

TABLE 3

Individual Country Results for some CARICOM Countries (1968-88)
Dependent Variable: Log Real GDP (t-Statistics in Parentheses)

Equation	Constant	LnK	lnl	ln RGFA	R^2	$\bar{R}^2$	D.W.	Rho[1]	F-Statistic	n
(1) Barbados	7.06 (5.03) ***	-0.08 (-0.89)	-0.25 (-0.84)	0.20 (4.03) ***	0.95	0.93	1.64	0.48 (2.32) **	63.44	20
(2) Jamaica	35.34 (3.31) ***	-3.55 (-2.38)	-0.87 (-3.26) *	0.41 (1.33) *	0.96	0.94	1.48	0.61 (3.36) ***	77.94	20
(3) Trinidad and Tobago	0.14 (0.02)	0.39 (2.90) ***	0.13 (0.15)	0.58 (3.78) ***	0.58	0.50	1.18		7.45	21

NOTES:

All t-tests are one-tailed tests.

[1]Rho is the AR(1) coefficient. Serial correlation is corrected for via the Cochrane-Orcutt proce

In conclusion the model does provide an alternative explanation about the role of exports in Caribbean–type economies to the Feder model which stresses the importance of reallocation and "externalities". There is evidence to suggest that in Caribbean economies foreign exchange flows do have a significant influence on domestic output. In this context any source of foreign exchange inflow (including exports) by enhancing import capacity is stimulating economic growth and development. This would seem to be the most important contribution of exports in. Caribbean economies.

ENDNOTES

1. Caribbean countries refers specifically to the members of the Caribbean Community (CARICOM): Jamaica, Barbados, Trinidad and Tobago, Guyana, Belize, Bahamas, Grenada, St. Vincent, St. Lucia, Dominica, Antigua, St. Kitts/Nevis, and Montserrat.

2. The results are not good and are not presented in the main text. The R^2 and adjusted R^2 is negative and none of the independent variables are statistically significant at 10% or better.

3. Middle-income economies are those with a GNP per capita of more than US$580 but less than US$6,000 in 1989. Feder (1983) suggests that the correlation between exports and growth is strongest for semi-industrialised economies. Empirical evidence (Adams, Behrman & Boldini (1989)) has found that the Feder model performs better for middle income developing countries.

4. The weak performance of the export growth variable is consistent with the results of a recent study on exports and growth in Latin America and the Caribbean (Park (1991)). Park (1991) finds no correlation between exports and growth in Latin American and Caribbean countries in the periods 1960-70 and 1970-81.

5. The following results in Table 4 are presented for the low-income countries despite the small number of degrees of freedom.

6. This means that coefficients with the wrong sing are not statistically significant.

7. Esfahani (1991) recognises this as one of the key weaknesses of previous studies looking at the correlation between exports and growth in LDC's. Esfahani (1991) argues that the correlation between exports and growth is mainly due to the contribution of exports to the reduction of import "shortages", which restrict the growth of output in many semi-industrialised countries.

8. The absence of data prevented estimation of a translog function for Jamaica and Trinidad & Tobago.

TABLE 4

Regression Results for Feder Model Applied to Small Low-Income Developing Countries
Dependent Variable: Output (GDP) Growth (t-Statistics in Parentheses)

Right-Hand-Side Variables	1965-89 (n=8)	1965-80 (n=9)	1980-89 (n-10)
INTERCEPT	-2.20 (-0.72)	0.67 (0.27)	0.97 (0.20)
I/Y	0.20 (1.67) **	0.14 1.34 *	0.19 (1.08)
$\dot{L}/L$	0.34 0.36)	0.54 (0.55)	-0.82 (-0.68)
$[\dot{X}/X.X/Y]$	-0.12 (-0.97)	0.13 (2.26) **	-0.04 (-0.40)
$\dot{X}/X$	0.22 (0.79)	-0.11 (-1.02)	0.17 (0.50)
R^2	0.64	0.65	0.58
$\bar{R}^2$	0.17	0.30	0.25

APPENDIX 1

THE LIST OF SMALL COUNTRIES AND THE DATASET (1965-89; 1965-80; 1980-89)

1965-89

COUNTRY	$\dot{Y}/Y$	$\dot{L}/L$	$[\dot{X}/X.X/Y]$	I/Y (percent)	$\dot{X}/X$
Bolivia*	2.3	2.6	4	22	1.3
Central American Republic	2.3	2.2	-8	20	-2.3
Costa Rica*	4.9	2.6	12	22	5.4
Dominica Republic*	5.8	2.5	16	18	0.7
El Salvador*	2.8	2.2	-14	15	-0.1
Guatemala*	3.7	2.8	0	13	-1.8
Haiti	1.6	1.8	-1	10	0.6
Honduras*	3.9	3.3	-5	14	2.7
Jamaica*	1.3	1.3	14	28	-1.1
Kuwait*	1.2	6.1	-8	17	11.6
Malawi	4.4	3.1	0	16	4.2
Mali	4.1	2.3	4	22	8.0
Mauritania	1.8	3.9	8	14	3.8
Niger	-0.5	2.9	8	10	6.2
Papua New Guinea*	3.3	2.4	23	22	11.0
Paraguay*	5.1	3.0	19	18	6.7
Senegal*	2.5	2.9	3	13	2.6
Sierra Leone	1.9	2.2	-17	11	-2.4
Mauritius*	5.0	2.4	31	23	6.1
Somalia	3.3	2.8	-9	16	
Trinidad & Tobago*	0.8	1.4	-18	22	-5.3
Tunisia*	5.5	2.3	26	25	8.1

N.B. Asterisks indicate Middle Income Countries.

1965-80

COUNTRY	$\dot{Y}/Y$	$\dot{L}/L$[1]	$[\dot{X}/X . X/Y]$	I/Y	$\dot{X}/X$
Bolivia*	4.4	2.5	-10	22	2.7
Central American Republic	2.8	1.9	-9	21	-1.3
Costa Rica*	6.3	2.7	-2	20	7.0
Dominica Republic*	8.0	2.7	-2	10	0.3
El Salvador*	4.7	2.8	-4	15	1.0
Guatemala*	5.9	2.8	2	13	4.8
Haiti	2.9	1.7	10	7	5.5
Honduras*	5.0	3.2	5	15	3.1
Jamaica*	1.4	1.3	3	27	-0.4
Kuwait*	1.6	7.1	08	16	18.5
Liberia	3.3	3.0	3	17	4.4
Libya	4.2	4.3	10	29	3.3
Malawi	5.5	2.9	4	14	5.1
Mali	4.2	2.1	1	18	9.5
Mauritania	2.1	2.4	-14	14	4.0
Nicaragua*	2.5	3.1	-4	21	2.8
Papua New Guinea*	4.1	2.4	23	22	14.1
Paraguay*	7.0	2.8	-6	15	6.5
Senegal*	2.1	2.9	-8	12	2.6
Sierra Leone	2.7	2.0	-11	12	-2.4
Mauritius*	5.2	1.6	2	17	3.1
Somalia	3.5	2.6	3	11	4.4
Trinidad & Tobago*	5.0	1.2	0	21	-5.5
Tunisia*	6.5	2.1	6	28	10.8

N.B. Asterisks indicate middle income countries.

NOTE: [1]Calculated for 1965-80.

1980-89

COUNTRY	$\dot{Y}/Y$	$\dot{L}/L$	$[\dot{X}/X.X/Y]$	I/Y	$\dot{X}/X$
Burkina Faso	5.0	2.6	-4	19	0.8
Bolivia*	-0.9	2.7	-6	13	-0.8
Central American Republic	1.4	2.7	1	9	-3.7
Costa Rica*	2.8	2.4	14	24	3.1
Dominica Republic*	2.4	2.3	18	26	1.2
El Salvador*	0.6	1.4	-18	16	-1.6
Guatemala*	0.4	2.9	-2	14	-11.7
Haiti	-0.5	1.9	-11	12	-6.9
Honduras*	2.3	3.5	-10	13	2.1
Jamaica*	1.2	1.3	11	29	-2.1
Kuwait*	0.7	4.4	-4	19	1.2
Malawi	2.7	3.4	-4	19	2.9
Mali	3.8	2.5	3	27	5.6
Mauritania	1.4	2.4	22	15	3.4
Niger	-1.6	3.4	-6	10	-3.8
Papua New Guinea*	2.1	2.5	0	23	6.4
Paraguay*	2.2	3.2	25	21	7.0
Senegal*	3.1	3.0	11	15	2.5
Sierra Leone	0.6	2.4	-6	11	-2.5
Mauritius*	5.9	1.0	29	29	10.5
Somalia	3.0	3.0	-12	21	-4.6
Togo	1.4	3.5	3	21	3.1
Trinidad & Tobago*	-5.5	1.7	-18	19	-5.1
Tunisia*	3.4	2.5	20	23	4.1

N.B. Asterisks indicate Middle Income Countries.

SOURCE: World Bank (1990a)

APPENDIX 2

PRODUCTION FUNCTIONS

Generally, the translog cost function has the following form:

(1)
$$lnC(w,y) = \left[a_0 + \sum_{i=1}^{n} a_i lnw_i + \tfrac{1}{2}\sum_{i=1}^{N}\sum_{j=1}^{n} b_{ij} lnw_i lnw_j\right] + lny$$

$$\text{where: } \sum_{i=1}^{n} a_i = 1, \quad b_{ij} = b_{ji}, \quad \sum_{j=1}^{n} b_{ij} = 0 \qquad \text{for } i = 1,\ldots,n$$

(note: w = factor prices; y = output).

If $a_i > 0$ for all i, $\Sigma a_i = 1$ and $b_{ij} = 0$ for all i and j the translog function collapses to a Cobb-Douglas Cost function.

From equation (1) the following factor share equations can be derived

$$S_i(w,y) = a_i + \sum_{j=1}^{n} b_{ij} lnw_j .$$

Of course there is the restriction that

$$\sum_{i=1}^{n} S_i(w,y) = 1 .$$

We can observe S_i so the equation for the factor shares can be used to estimate the parameters of the cost – and hence production – function. If there is homogeneity (Cobb-Douglas form) $b_{ij} = 0$ and equation (2) Collapses to;

(3) $$S_i(w,y) = a_i$$

This implies that the factor shares are equal to a constant. In empirical work a time trend variable is added to equation (3) as a simple de-trending procedure. In practice equation's (2) and (3) are estimated using a systems estimator (e.g. Seemingly Unrelated Regressions Estimator) and a LR test is done to test the validity of the restrictions to determine whether a Cobb-Douglas form is accepted.

We have the following general production function:

(4) $$Q = f(K,L,M)$$

where:

Q = gross output

K = capital input

L = labour input

M = real imports

It might be suggested that intermediate imports should be included but reliable data is only available for imports and import prices.

Given the above technology we have the following cost function:

(5) $$lnC = \alpha_0 + lnQ + \alpha_K lnP_K + \alpha lnP_L + \alpha_M lnP_M + \tfrac{1}{2}\beta_{LL}(lnP_L)^2 + \beta_{LK}(lnP_K)(lnP_L) + \beta_{LM}(lnP_L)(lnP_M) + \tfrac{1}{2}\beta_{MM}(lnP_M)^2 + \beta_{MK}(lnP_K)(lnP_M) + \tfrac{1}{2}\beta_{KK}(lnP_M)^2 .$$

Differentiating equation (5) with respect to the logs of the prices gives the cost share equations.

(6) $$S_L = \frac{\partial lnC}{\partial lnP_L} = \alpha_L + \beta_{LK} lnP_K + \beta_{LL} lnP_L + \beta_{LM} lnP_M .$$

(7) $$S_K = \frac{\partial lnC}{\partial lnP_K} = \alpha_K + \beta_{KL} lnP_L + \beta_{KK} lnP_K + \beta_{KM} lnP_M$$

(8) $$S_M = \frac{\partial \ln_C}{\partial lnP_M} = \alpha_M + \beta_{LM} lnP_L + \beta_{MK} lnP_K + \beta_{MM} lnP_M .$$

Since the shares must sum to unity

$$\alpha_K + \alpha_L + \alpha_M = 1.$$

and the ß's sum to zero in each column (row). Therefore, from equation (6) we have:

(9) $$\beta_{LM} = -\beta_{LK} - \beta_{LL}$$

By substitution in equation (6)

(10) $$S_L = \alpha_L + \beta_{LK} lnP_K - \beta_{LK} lnP_M + \beta_{LL} lnP_L - \beta_{LL} lnP_M$$

Thus,

(11) $$S_L = \alpha_L + \beta_{LK}(lnP_K - lnP_M) + \beta_{LL}(lnP_L - lnP_M).$$

(12) $$S_L = \alpha_L + \beta_{LK}(lnP_K / lnP_M) + \beta_{LL}(lnP_L / lnP_M).$$

Similarly, we can derive:

(13) $$S_K = \alpha_K + \beta_{KK}(lnP_K/lnP_M) + \beta_{KL}(lnP_L/lnP_M).$$

Therefore, we have a system of 2 independent equations – equations (12) and (13).

Equations (12) and (13) are estimated for Barbados for the period 1968-88. The purpose here is to test the restriction of homogeneity to determine whether a Cobb-Douglas structure is appropriate.

A critical issue is the estimation technique to be employed. Notwithstanding the fact that ordinary least squares (OLS) estimates will give you unbiased and consistent parameter estimates, it will not be the most efficient. To improve the efficiency of the parameter estimates one should take into account explicitly the correlation of the error terms across equations. Therefore Zellner's (1972) Seemingly Unrelated Regressions (SUR) system approach which accounts for possible correlation between equations was used.

From the results of the SUR estimation we can get the log-likelihood function to carry out the likelihood ratio (LR) test. The LR test uses both the restricted and unrestricted estimators and is based on the following statistic:

$$\lambda_{LR} = 2[L(\hat{\gamma}) - L(\gamma_r)] \xrightarrow{d} \chi^2_{(J)}$$

where:

$L(\gamma)$ is the unrestricted estimators log-likelihood function.

$L(\gamma_r)$ is the restricted estimators log-likelihood function.

The system of share equations i.e. equations (12) and (13) are estimated for both the restricted and unrestricted model by SUR. Note, that equations (12) and (13) are the unrestricted model. The restricted model that is estimated is the following:

(14) $$S_L = \alpha_L + bt$$

where: t = time trend

(15) $$S_K = \alpha_K + ct.$$

With a test statistic of 4.01 we accept the null hypothesis of the restricted model at a 95% level of confidence ($\xi^2_{0.95} = 8.672$).

BIBLIOGRAPHY

Adams, F.G., Behrman, J.R. and Boldin, (1989), "Productivity, Competitiveness and Export Growth in Developing Countries", mimeo, University of Pennsylvania, Economics Department.

Balassa, B., (1985), "Exports, Policy Choices, and Economic Growth in Developing Countries after the 1973 Oil Shock", Journal of Development Economics Vol. 18, No. 1, pp. 23-25.

Best, L. and Levitt, K., (1968), "Export Propelled Growth and Industrialization". Mimeo. Montreal: Centre for Developing Area Studies, McGill University.

Beckford, G.L. (1972), Persistent Poverty: Underdevelopment in Plantation Economies of the Third World (Clarendon: Oxford University Press).

Bhagwati, J., (1978), Anatomy and Consequences of Trade Regime's (Cambridge, Mass: National Bureau of Economic Research).

Binswanger, H.P., (1974), "A Cost Function Approach to the Measurement of Elasticities of Factor Demand and Elasticities of Substitution", American Journal of Agricultural Economics, 56, pp. 377-386.

Boamah, D. & Craigwell, R., (1990), "Import Demand in Barbados: A Production Theory Approach" Mimeo, Research Department, Central Bank of Barbados.

Chow, G.C., (1960), "Tests of Equality Between Sets of Coefficients in Two Linear Regressions". Econometrica, Vol. 28, pp. 591-605.

Christensen, L., R., Jorgenson, D.W., Lau, L.J., (1973), "Transcendental Logarithmic Production Frontiers", Review of Economics and Statistics, Vol. 55, pp. 28-45.

Esfahani, H.S., (1991), "Exports, Imports and Economic Growth in Semi-Industrialised Countries" Journal of Development Economics. Vol. 35, #1, January 1991, pp. 93-11.

Feder, G., (1983), "On Exports and Economic Growth", Journal of Development Economics, February/April, pp. 59-73.

Fosu, (1990), "Exports and Economic Growth: The African Case", World Development, Vol. 18, No. 6, pp. 831-835.

Girvan, N., (1972), Foreign Capital and Economic Underdevelopment in Jamaica, Institute of Social and Economic Research, University of the West Indies, Mona, Jamaica.

Jalan, B., (1982), "Classification of Economies by Size" in Jalan (ed.), Problems and Policies in Small Economies, London: Crown Helm, Ltd.

Park, J.H., (1991), "Exports and Economic Growth in Developing Countries: The Case of Latin America", Mimeo, Kennesaw State College.

Ram, R., (1985), "Exports and Economic Growth: Some Additional Evidence", Economic Development and Cultural Change, Vol. 33, No. 2, pp. 415-425.

Ram, R., (1987), "Exports and Economic Growth in Developing Countries: Evidence from Time-Series and Cross-Sectional Data", Economic Development and Cultural Change, Vol. 36, pp. 51-72.

Tyler, W.G., (1981), "Growth and Export Expansion in Developing Countries", Journal of Development Economics, Vol. 9 (August) pp. 121-130..

Watkins, M.H., (1963), "A Staple Theory of Economic Growth", Canadian Journal of Economic and Political Science, Vol. XXIX.

World Bank (1991), World Development Report, Washington D.C.: World Bank Publications.

World Bank (1990a), World Tables (1989-90 edition), Washington D.C.: World Bank Publications.

Zellner, A., (1962), "An Efficient Method of Estimating Seemingly Unrelated Regressions and Tests for Aggregation Bias", Journal of American Statistical Association, 57, pp. 585-612.