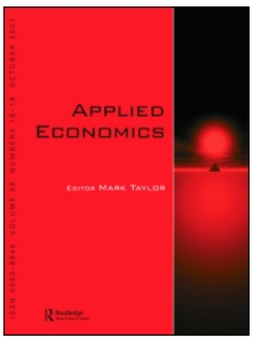

Applied Economics

ISSN: 0003-6846 (Print) 1466-4283 (Online) Journal homepage: https://www.tandfonline.com/loi/raec20

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To cite this article: Subhash C. Sharma & Dharmendra Dhakal (1994) Causal analyses between exports and economic growth in developing countries, Applied Economics, 26:12, 1145-1157, DOI: 10.1080/00036849400000112

To link to this article: https://doi.org/10.1080/00036849400000112

Applied Economics, 1994, **26**, 1145–1157

Causal analyses between exports and economic growth in developing countries

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This study investigates the prima facie causal relationship between the exports and output growth in 30 developing countries over the period from 1960 to 1988 in a multivariate framework. The information set considered for the output and exports models are Ω=(domestic output, exports, labour and capital), and Ω=(exports, domestic output, exchange rate and foreign output) respectively. This study identities a feedback prima facie causal relationship between exports and output growth in five countries, export growth prima facie causes output growth in another six countries; output growth prima facie causes export growth in a further eight countries; and no causal relationship was observed between export growth and output growth in the remaining 11 countries. We also found that in 15 countries the foreign exchange rate prima facie caused export growth, and that in 12 countries world output caused export growth.

I. INTRODUCTION

A popular subject of debate among development economists is the role of exports in economic growth. Several authors, e.g. Michalopoulos and Jay (1973), Michaely (1977), Balassa (1978, 1985), Tyler (1981), Feder (1983) and Kavoussi (1984) among others, have empirically investigated the relationship between growth of exports and aggregate output. The two common approaches taken in past research are, first, the bivariate correlation analysis between export growth and the growth of output, and, second, the production-function-based regression models. Most of these studies have used cross-country data and thus assumed that the regression coefficient are constant across countries. With some qualifications, the regression analyses are consistent in their findings that the growth of exports is significantly correlated with the growth of output.

Most of the above-mentioned studies have implicitly assumed that export growth causes output growth without formally testing the direction of causality. However in recent years, economists have argued for the formal testing of causal relationship (in the Granger sense) between export growth and output growth as an important factor in development planning. Jung and Marshall (1985) tested for Granger causality between export and output growth using time-series data on 37 developing countries. Their results supported unidirectional causality from export growth to output growth in only four countries. Chow (1987) investigated the causal relationship between export of manufactured goods and manufactured output in eight newly industrialized countries. Using Sim's test, Chow found bidirectional causality between export growth and industrial output in most of these countries. Recently Bahmani-Oskooee *et al.* (1991) also re-examined the causal relationship between export growth and economic growth in 20 LDCs. They found positive causality from export growth to output growth in five countries and negative causality in three countries. On the other hand, Bahmani-Oskooee observed positive causality from economic growth to export growth in four countries and negative causality in one country. All of these studies considered only bivariate models and thus the findings may be biased by the omission of relevant variables. In particular, omitting labour growth and the growth of capital while testing the causality from export growth to output growth, may yield spurious correlations. Excluding the export price and foreign income while testing causality from output growth to export growth may have given spurious correlations.

Recently, Kunst and Marin (1989), Grabowski *et al.* (1990) and Sharma *et al.* (1991) have investigated the causal

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relationships between export growth and output growth in a multivariate framework in different countries. In the case of Austria, by using the information set Ω=(exports, the terms of trade, productivity, and world output), Kunst and Marin (1989) did not find support for the proposition that exports have a causal influence on productivity, but concluded that the reverse causal relationship was significant at the 10% level.

By analysing the development experimence of Japan, Grabowski *et al.* (1990) found that in the pre-war period, exports caused output growth only indirectly through agricultural productivity, while in the post-war period exports directly caused output growth. They did not investigate the reverse causation from output to exports. By using the information set Ω=(growth of output, export, labour and capital) Sharma *et al.* (1991) investigated the causal relationship between exports and growth in five industrialized countries (German, Italy, Japan, United Kingdom and United States) from 1960 to 1987. They concluded that Germany and Japan experienced export-led growth, while the United States and the United Kingdom experienced a reverse causal relationships between exports and growth. From their study no causal relationship between exports and output was found for Italy.

The above-mentioned research, using a multivariate framework, focused only on selected developed countries. To date there has been no investigation of the causal relationship between output growth and export expansion in a multivariate framework for less developed countries. The present study fills this vacuum to a certain extent. In this study, the causal relationships between export growth and output growth are investigated in 30 developing countries in a multivariate framework by using annual data from 1960 to 1988. The selection of countries is mainly dictated by availability of data. There is a variation in the time period for some countries caused by unavailability of the data. In addition to exports, the conventional sources of growth, namely labour, and capital, are also included in the information set of the growth model. Using a macroeconomic argument for export growth, foreign income, the exchange rate and output growth as well as exports are included in the information set of the export model. This multivariate framework of causal investigation has the following advantages over bivariate models studied by previous researchers. First, we hope that the results of this study will be more realizable than those of the earlier studies since the information set used here in testing causality is larger than that used in previous studies. Second, in addition to testing for the causal relationship between export growth and output growth, other causal determinants of exports and economic growth are also tested.

The paper is organized as follows. Section II discusses the causal hypotheses tested and their theoretical justification. Section III discusses the econometric methodology used. In Section IV the empirical findings of this study are presented and discussed. And finally some concluding remarks are noted.

II. CAUSAL HYPOTHESES

In this study, three primary causal hypotheses and a number of secondary causal hypothesis are tested. The primary hypotheses to be tested are: (1) Does export growth prima facie cause output growth? (2) Does output growth prima facie cause export growth? (3) Is there a bidirectional prima facie causal relationship between export growth and output growth? The secondary hypotheses to be tested are as follows. (1) Does labour prima facie cause output? (2) Does capital prima facie cause output? (3) Does labour prima facie cause exports indirectly through output? (4) Does capital prima facie cause exports indirectly through output? (v) Does world output prima facie cause exports? (6) Does exchange rate prima facie causes exports? (7) Does world output prima facie causes domestic output indirectly through exports? OR (8) does the exchange rate prima facie causes domestic output indirectly through exports? The theoretical justification for these hypotheses is discussed below.

The most common approach taken in empirical investigations of the export growth relationship is based on the neoclassical aggregate production function. Assuming Hicks-neutral technological change, aggregate growth can be written as the sum of the total factor productivity (TFP) growth and the weighted sum of the growth rate of factor inputs. The weights are the elasticities of output with respect to each input, and under competitive conditions will equal their respective factor shares. From the growth-theory literature point of view, exports expansion is the key factor in promoting productivity growth for developing countries. Various explanations have been put forward to relate export and TFP growth rates together in developing countries. First, Balassa (1978, 1985) pointed out that in general, the production of export goods is concentrated in those economic sectors of the economy which are already most efficient. Thus export expansion helps concentrate investment in these sectors, which in turn increases the overall total productivity of the economy. Second, a large export sector also allows a country to gain from economies of scale and positive externalites (Tyler, 1981). Third, foreign competition increases the pressure on industries exporting goods to keep costs relatively low and to promote technological changes which in turn improve productivity (Michaely, 1977; Kavoussi, 1984). Fourth, the growth of exports has a stimulating effect on total productivity of the economy as a whole through its positive impact on higher rates of capital (Kavoussi, 1984). Fifth, an argument can be based on the two-gap models (popularized by Chenery and Strout, 1966), which states that, if the foreign exchange constraint is binding then the growth of exports reduces the

foreign exchange constraint, thereby facilitating imports of capital goods and faster growth (Voivodas, 1973; Williamson, 1978; Fajana, 1979). Finally, Feder (1983) measures the contribution of exports to economic growth through resource allocations. Clearly, these arguments leads us to hypothesize that a causal relationship exists from export growth to growth of output.

In contrast to the export-led growth model, it can also be argued that causality runs from productivity to exports. This is possible if the growth of domestic demand lags behind growth of output. From a technology theory of trade point of view this is possible if a group of industries achieve technological innovation; production of their goods will then increase faster than domestic demand, and thus the producers are likely to sell their goods in the foreign market. Another possible explanation for the growth of domestic demand lagging behind growth of output is discussed by Jung and Marshall (1985). They argue that factors other than export growth are responsible for the growth of output, presumably primary-input growth, or factor-productivity growth.

The third possible hypothesis is that a bidirectional causal relationship exists between output growth and export growth. Kunst and Marin (1989) justify this bidirectional causality from the point of view of intra-industry trade theory, which incorporates imperfect competition and economies of scale. According to these theories, productivity increases made possible by the realization of economies of scale give rise to exports (Helpman and Krugman, 1985). If the resulting market structure is one in which there are few industries, the existence of economies of scale will enable further cost reductions. Hence, a potential feedback effect between exports and productivity growth is possible.

A brief theoretical justification of secondary hypotheses are as follows. In the output model, labour and capital are included as the most likely variables to explain growth apart from exports. According to neoclassical growth theory, growth of these factors would be expected to cause output growth. In the export model, the exchange rate and world output are included in addition to domestic output. Exports in developing countries depend on the world demand for exported goods, and world demand depends on the price of goods and the income of buyers. Thus, it is hypothesized that world income and the exchange rate, as well as domestic output growth, cause export growth in developing countries. Note that change in world income is expected to cause export growth because higher level of world income generates more demand for exported goods. Furthermore, it is also hypothesized that world income and the exchange rate indirectly cause the output growth of developing countries through demand for their exported goods. During recessionary times in the industrial countries the demand for imported goods decreases, which leads to a decrease in exports from developing countries which in turn decreases the total output of exporting countries, and vice versa.

III. ECONOMETRIC METHODOLOGY

The Granger causality tests are based on the assumption that the time series are stationary. In this analysis, the unit root tests developed by Phillips and Perron (1988) and Perron (1988) are used to test for a unit root. The advantage of Perron tests over Dickey and Fuller (1981) and augmented Dickey–Fuller tests is that the Perron tests are robust to a wide variety of serial correlation and time dependent heteroscedasticity.

Consider, the following model for Y, the output of a country

$$Y_t = \mu + \beta(t - n/2) + \alpha Y_{t-1} + \varepsilon_t, \quad t = 1, 2, \ldots, n \qquad (1)$$

To test for a unit root in Equation 1, the null hypothesis $H_0^1: \beta = 0$, $\alpha = 1$ is tested by using the test statistics $Z(\Phi_3)$, and $H_0^2: \alpha = 1$, is tested by using the test statistics $Z(\alpha)$ and $Z(t_\alpha)$. The test statistics $Z(\Phi_3)$, $Z(\alpha)$ and $Z(t_\alpha)$ are given in Perron (1988, pp. 308–9).

The specification of the output equation and the test for Granger causality in this equation is discussed next. The export equation is specified by repeating the same procedure. Let the output (Y), capital (K), labour (L) and export (EX) be stationary time series, then the output equation is specified as

$$Y_t = \gamma_0 + \gamma_1(B)Y_t + \gamma_2(B)K_t + \gamma_3(B)L_t + \gamma_4(B)EX_t + u_t, \qquad (2)$$

where $\gamma_i(B)$, $i = 1, 2, 3, 4$ is the polynomial in the back shift operator B, i.e. $\gamma_i(B) = \sum_{j=1}^{mi} \gamma_{ij} B^j$, and mi is the degree of the polynomial. Here we assume that u_t satisfies all the assumptions of the standard linear regression model. Granger (1980) modified his earlier definition of causality introduced in Granger (1969) in terms of 'prime facie cause in mean'. If the least squares criterion is used, prima facie cause in mean is equivalent to causality in terms of predictability (Granger, 1969). According to Granger, a variable EX causes another variable Y with respect to a given information set that includes EX and Y, if current Y can be better predicted by using past values of EX than by not doing so. Granger (1980, Theorem 2) states that, EX is a prima facie cause in mean of Y if $\gamma_4(B)$ is not equal to 0. Furthermore, if EX is a prima facie cause of Y, and Y is a prima facie cause of EX then there is a feedback relationship between Y and EX. Furthermore, following Hsiao (1982), if for example capital causes output and output causes exports, then capital is said to indirectly cause exports. In view of the new terminology in this paper, indirect causality means the indirect prima facie cause (in mean).

To estimate model 2, first the lag lengths, mi, for each variable need to be specified. In this study, Hsiao's (1979, 1981) sequential procedure is used which is based on the Granger definition of causality and Akaike (1969, 1970) minimum final prediction error (FPE) criterion. Hsiao (1981, p. 88) notes that 'the FPE criterion balances the risk

due to the bias when a lower order is selected and the risk due to the increases of variance when a higher order is selected'. Hsiao (1981, p. 89) further does that 'choosing the order of the lags by minimum FPE is equivalent to applying an approximate F-test with varying significance levels'. In the causal analyses, the FPE criterion of lag selection has been used by Grabowski *et al.* (1990), Cheung *et al.* (1991a, 1991b) Sharma *et al.* (1991), and among others.

The steps in specifying the lag length are as follows. Regress Y on its own lags, i.e.

$$Y_t=\gamma_0+\gamma_1(B)Y_t+u_t. \tag{3}$$

The maximum lag length say, m of $\gamma_1(B)$ is arbitrarily chosen. In this study, m is fixed at 6. Let $SSE(l)$ be the sum of squares due to errors in Equation 2, then the value of l which minimizes

$$FPE(l)=\frac{(n+l+1)}{(n-l-1)}\frac{SSE(l)}{n} \tag{4}$$

is considered the appropriate lag length to Y. Let this value of l be $m1$. Next the optimum lag length in the bivariate relationships are determined for each of the remaining variables, i.e. consider

$$Y_t=\gamma_0+\sum_{j=1}^{m1}\gamma_{1j}Y_{t-j}+\sum_{k=1}^{m}\gamma_{2k}W_{t-k}+u_t, \tag{5}$$

where $W=EX$, K or L. For a given W the value of l which minimizes

$$FPE(m1,l)=\frac{(n+m1+l+1)}{(n-m1-l-1)}\frac{SSE(m1,l)}{n}, \tag{6}$$

is the appropriate lag length for that variable.

Note that the causality results are sensitive to the order in which the variables are added to Equation 5. In this study, the specific gravity criterion of Caines *et al.* (1981) is used to determine the order in which the variables are added at each stage. The specific gravity of W with respect to Y in Equation 5 is defined as the reciprocal of the $FPE(m1, l)$. Among the three variables, the one with the highest specific gravity (i.e. the smallest FPE) is considered to be the most important to Y and is added to Y equation in 3. Let this variable be EX with lag length $m2$.

After specifying the bivariate model, the third and fourth variables are added by repeating the above procedure, i.e. the lag lengths are determined corresponding to the minimum FPE and the order of the variables is determined based on the specific gravity criterion. Note that the FPE corresponding to three variables is given by

$$FPE(m1,m2,l)=\frac{(n+m1+m2+l+1)}{(n-m1-m2-l-1)}\frac{SSE(m1,m2,l)}{n} \tag{7}$$

The variable which gives the smallest FPE in (7) is added as the third variable. The fourth variable is added similarly.

If $\gamma_{i,1}\gamma_{i,2}\gamma_{i,3},\cdots\gamma_{i,mi}$ are jointly significant, i.e. if H_0: $\gamma_{i,1}=\gamma_{i,2}=\gamma_{i,3},\cdots\gamma_{i,mi}=0$ is rejected then the ith variable ($i=EX, K, L$) prima facie causes the output. Finally, H_0 is tested by using an F-test based on restricted and unrestricted sum of squares due to errors.[1]

IV. THE CAUSAL RELATIONS

Following the specification and estimation procedure discussed in the previous section, causality tests are carried out for 30 countries. The selection of the countries is mainly based on data availability. The data are collected from the International Financial Statistics yearbook and tapes.

The causal variables considered in the output equation are real total output (Y), the size of the labour force (L), capital (K) and real export (EX). For the real total output, the gross domestic product (GDP) at 1985 prices is used; for the total labour force the total population is used as a proxy variable,[2] capital is measured as a gross fixed capital formation divided by the GDP deflator, and real exports are measured as exports divided by GDP deflator. The GDP deflator is obtained by dividing the GDP at current prices by the GDP at 1985 prices and multiplying by 100. The causal variables considered in the export equation are real total output (Y), the exchange rate (ER) and an index of world output (WY).

As indicated earlier, testing for causality requires stationary series. First, a log transformation is used for each time series. Then after the log transformation, each time series is tested for a unit root by using the $Z(\Phi_3)$, $Z(\alpha)$ and $Z(t_\alpha)$ test statistics discussed earlier. The values of $Z(\Phi_3)$, $Z(\alpha)$ and $Z(t_\alpha)$ are reported in Table 1, and the final transformations needed to make the series stationary are summarized in Table 2. The null hypothesis of a unit root is accepted or rejected if at least two out of three test statistics either accept or reject the null hypothesis up to 10% level of significance. The hypothesis of unit root was rejected in only two time series. The hypothesis of a unit root was tested again, after taking the first difference of the log series, and this time it was rejected in 116 series. In the rest of the 27 series the

[1] Note that the causality results are sensitive to the exact causality test used (e.g. Sims test or the F-test used here), to the lag length specification and the structure of the error term. To that extent the results of this study should be viewed with some degree of caution.

[2] Given the unavailability of the labour-force data, total population is used as a proxy for the total labour force. This is an unsatisfactory approach for a LDC, where there is likely to be substantial disguised unemployment and changes in human capital etc. Moreover, there is likely to be a severe measurement problem with the total labour force, since it is only weakly correlated with an appropriate measure of labour input.

Table 1. *Unit root test statistics*

Country/ time period	Series	Log of the series Test statistics			Log 1st difference of the series (Log 2nd difference of the series) Test statistics		
		$Z(\Phi_3)$	$Z(\alpha)$	$Z(t_\alpha)$	$Z(\Phi_3)$	$Z(\alpha)$	$Z(t_\alpha)$
Colombia	*ER*	2.68	0.61	9.18	12.82	−29.01	−5.06
1960–88	*EX*	2.98	−9.90	4.35	9.55	−19.75	−4.30
	K	2.53	−9.48	4.40	9.72	−21.71	−4.40
	L	3.92	−1.33	20.28	20.82	−29.85	−6.45
	Y	1.28	−2.34	9.89	4.84	−14.14	3.23
					(32.75)	(−31.61)	(−8.09)
Costa Rica	*ER*	2.41	−2.15	10.83	21.22	−23.55	−6.51
1960–88	*EX*	3.20	−9.64	4.45	63.34	−30.90	−11.25
	K	1.93	−1.73	10.63	14.99	−25.95	−5.46
	L	3.92	−10.58	4.55	19.52	−26.74	−6.25
	Y	1.45	−1.62	11.46	8.99	−16.97	−4.15
Dominican Republic	*ER*	2.46	0.75	8.20	13.61	−29.57	−5.22
1960–88	*EX*	3.02	−9.80	4.32	17.75	−31.50	−5.96
	K	4.56	−14.94	2.80	38.11	−31.71	8.68
	L	2.54	−9.28	4.54	17.41	−24.75	−5.82
	Y	1.03	−3.28	6.97	16.45	−30.26	−5.69
Ecuador	*ER*	14.73	6.51	16.75	3.97	−10.48	−2.42
1960–88	*EX*	1.91	−7.19	5.63	7.09	−17.99	−3.76
	K	1.22	−5.30	6.65	9.82	−24.62	−4.43
	L	2.32	−0.50	11.86	3.48	−11.78	−2.63
					(29.96)	(−36.92)	(−7.73)
	Y	1.14	−5.15	6.60	7.03	−20.04	−3.75
Egypt	*ER*	2.45	−8.90	4.72	10.86	−19.43	−4.64
1960–88	*EX*	3.69	−8.11	5.81	11.03	−18.94	−4.69
	K	1.48	−4.64	7.73	7.84	−21.09	−3.86
	L	1.34	−5.44	6.71	8.14	−32.13	−3.93
	Y	5.52	−2.37	14.90	3.77	−11.62	−2.74
					(17.48)	−(19.27)	−5.91
El Salvador	*ER*	0.96	−1.21	5.83	3.91	−11.49	−2.72
1960–84					(42.12)	(−21.33)	(−9.17)
	EX	3.84	1.12	9.95	8.75	−21.66	−4.17
	K	1.04	−2.42	6.80	6.80	−15.12	−3.65
	L	42.39	2.35	29.80	18.59	−25.69	−5.92
	Y	5.42	−0.12	12.30	3.28	−10.31	−2.56
					(16.03)	(−21.72)	(−8.59)
Greece	*ER*	9.97	−0.85	20.71	6.62	−17.69	−3.63
1960–88	*EX*	1.72	0.88	7.08	8.88	−22.56	−4.08
	K	4.98	−1.20	14.39	10.62	−17.10	−4.60
	L	1.40	−5.52	6.80	3.76	−13.16	−2.73
					(28.01)	(−24.73)	(−7.48)
	Y	16.05	−0.35	24.86	16.14	−25.62	−5.63
Guatemala	*ER*	1.58	−3.90	5.64	8.45	−18.35	−4.11
1960–88	*EX*	12.21	2.32	21.18	14.88	−25.54	−5.42
	K	1.63	−3.68	8.87	7.56	−20.40	−3.99
	L	1.67	−5.94	6.35	11.37	−20.67	−4.77
	Y	3.42	−0.27	14.29	4.50	−14.11	−3.00
					(14.82)	(−29.92)	(−7.10)
Guyana	*ER*	2.08	−1.92	6.08	15.83	−32.05	−5.62
1960–88	*EX*	2.90	−9.00	4.82	15.17	−22.15	−5.48
	K	3.16	−11.56	3.55	9.06	−15.18	−4.12
	L	5.11	−9.87	5.18	23.86	−21.80	−6.87
	Y	1.99	−2.17	9.80	17.92	−22.18	−5.98

Table 1. (*Continued*)

Country/ time period	Series	Log of the series Test statistics			Log 1st difference of the series (Log 2nd difference of the series) Test statistics		
		$Z(\Phi_3)$	$Z(\alpha)$	$Z(t_z)$	$Z(\Phi_3)$	$Z(\alpha)$	$Z(t_z)$
Honduras	*ER*	2.08	−8.11	4.87	4.95	−13.74	−3.10
1960–88					(15.55)	(−24.46)	(−5.40)
	EX	3.07	−2.43	10.48	6.39	−15.19	−3.57
	K	2.32	−0.92	10.47	14.66	−18.54	−5.38
	L	2.54	−8.79	4.92	6.09	−11.99	−3.47
	Y	1.76	−4.73	7.41	5.57	−13.70	−3.34
					(24.08)	(−22.86)	(−6.94)
India	*ER*	1.94	−8.01	4.59	11.71	−23.13	−4.84
1960–88	*EX*	2.63	−8.58	5.01	11.35	−25.19	−4.75
	K	1.70	−6.49	5.57	10.63	−16.18	−4.50
	L	3.44	−6.88	5.01	12.77	−25.94	−5.05
	Y	2.08	−4.93	5.72	32.52	−25.17	−8.03
Iran	*ER*	2.06	−7.66	5.39	8.37	−18.07	−4.08
1960–88	*EX*	4.19	0.17	15.01	15.44	−23.70	−5.55
	K	1.97	−0.78	11.43	6.07	−11.94	−3.45
	L	2.42	−2.21	11.05	9.80	−22.81	−4.43
		2.72	−1.16	11.54	4.38	−11.47	−2.89
	Y				(21.10)	(−23.22)	(−6.49)
Jamaica	*ER*	3.70	−2.70	12.16	9.72	−12.85	−4.32
1960–88	*EX*	3.19	−9.56	4.57	21.14	−17.68	−6.50
	K	1.53	−6.18	6.17	10.00	−24.28	−4.48
	L	1.86	−8.26	4.38	6.17	−16.62	−3.51
	Y	2.92	2.81	11.97	6.75	−18.53	−3.67
Kenya	*ER*	9.34	1.27	12.15	6.93	−14.37	−3.62
1964–87	*EX*	1.71	−7.83	3.21	11.89	−21.66	−4.78
	K	3.21	−3.83	8.77	6.99	−13.54	−3.73
	L	6.03	−1.68	9.91	11.77	−18.75	−4.55
	Y	1.48	−6.36	4.47	8.33	−15.02	−4.05
South Korea	*ER*	15.54	−22.52	0.54	43.04	−22.78	−9.13
1963–88	*EX*	9.83	−4.59	11.12	6.48	−12.33	−3.48
	K	2.66	−4.23	8.21	9.73	−18.79	−4.37
	L	54.02	−1.12	31.75	11.66	−22.18	−4.82
	Y	1.52	−5.18	6.49	9.82	−19.68	−4.14
Mexico	*ER*	15.19	2.41	4.18	10.99	−20.51	−4.61
1960–85	*EX*	1.71	−2.83	−1.25	6.62	−17.81	−3.59
	K	1.71	−3.53	−1.06	7.80	−12.34	−3.95
	L	35.07	3.18	3.32	6.92	−1.46	−0.87
					(13.22)	(−18.99)	(−5.13)
	Y	3.48	1.89	0.66	4.83	−10.37	−3.04
					(17.80)	(−16.88)	(−5.96)
Morocco	*ER*	2.79	−1.75	12.42	3.97	−14.19	−2.79
1960–88					(25.82)	(−32.65)	(−7.18)
	EX	2.90	−6.65	6.40	11.03	−17.03	−4.62
	K	1.38	−5.62	6.05	7.28	−16.38	−3.74
	L	1.96	−7.83	5.07	10.03	−18.80	−4.48
	Y	2.15	−7.39	5.62	17.46	−28.48	−5.79
Nigeria	*ER*	3.62	2.34	10.11	5.92	−15.66	−3.43
1960–88	*EX*	1.77	−6.70	5.91	17.01	−29.52	−5.83
	K	1.82	−2.76	10.02	5.85	−13.62	−3.92
					(29.36)	(−20.27)	(−7.66)
	L	6.14	−4.62	12.68	10.16	−23.46	−4.50
	Y	1.17	−3.73	7.95	5.66	−14.61	−3.36
					(28.83)	(−23.75)	(−7.59)

Table 1. (*Continued*)

Country/ time period	Series	Log of the series Test statistics			Log 1st difference of the series (Log 2nd difference of the series) Test statistics		
		$Z(\Phi_3)$	$Z(\alpha)$	$Z(t_\alpha)$	$Z(\Phi_3)$	$Z(\alpha)$	$Z(t_\alpha)$
Pakistan	*ER*	2.96	−8.34	4.97	11.57	−22.08	−4.80
1960–88	*EX*	2.66	−7.55	5.72	5.99	−13.44	−3.45
	K	1.45	−6.03	6.18	5.90	−13.37	−3.42
	L	1.50	−6.36	5.65	13.54	−24.92	−5.20
	Y	2.68	−0.89	12.43	13.75	−30.07	−5.24
Paraguay	*ER*	3.40	2.04	8.43	4.22	−12.54	−2.90
1962–87					(25.02)	(−30.11)	(−6.92)
	EX	4.07	−13.08	2.59	21.56	−31.33	−6.44
	K	1.28	−5.70	5.17	6.97	−15.88	−3.65
	L	2.31	−2.69	10.56	9.02	−20.39	−4.25
	Y	1.69	−6.86	4.86	3.37	−4.50	−2.49
					(12.73)	(−18.89)	(−4.91)
Peru	*ER*	36.91	1.71	1.96	9.69	−19.74	−4.32
1960–88	*EX*	1.56	−6.81	−1.46	11.40	−22.34	−4.77
	K	2.99	−10.04	−2.44	14.01	−18.81	−5.28
	L	6.81	−5.69	−2.59	12.53	−22.77	−5.00
	Y	4.41	−4.76	−2.14	6.98	−14.98	−3.64
Philippines	*ER*	2.96	−10.83	3.85	12.52	−25.31	−4.98
1960–88	*EX*	3.63	−10.49	4.32	16.85	−24.18	−5.80
	K	1.62	−4.75	7.25	2.37	−9.29	−1.89
					(9.85)	(−20.21)	(−4.44)
	L	22.49	0.02	24.50	28.06	−31.23	−7.46
	Y	1.70	−2.20	4.54	2.50	−9.67	−2.15
					(13.18)	(−23.73)	(−5.13)
Portugal	*ER*	5.58	−1.77	16.70	1.77	−6.75	−1.77
1960–87					(7.69)	(−11.29)	(−3.92)
	EX	2.08	−7.62	5.19	6.15	−12.17	−3.49
	K	1.31	−2.68	8.71	2.12	−7.68	−1.96
					(8.09)	(−14.92)	(−4.01)
	L	3.31	−6.08	7.66	10.10	−17.80	−4.49
	Y	4.42	−1.01	14.36	10.87	−17.89	−4.66
South Africa	*ER*	3.16	−1.67	10.23	8.43	−17.11	−4.10
1960–88	*EX*	1.33	−5.78	5.95	4.40	−10.04	−2.96
					(21.33)	(−15.69)	(−6.51)
	K	6.15	0.70	16.62			
	L	10.91	−1.18	21.91	9.58	−25.12	−4.38
	Y	11.98	−0.58	20.22	13.92	−17.68	−5.27
Sri Lanka	*ER*	3.96	−5.84	8.40	11.41	−22.54	−4.76
1960–88	*EX*	2.06	−5.02	8.13	8.79	−20.24	−4.19
	K	2.06	−7.74	5.30	8.97	−22.41	−4.23
	L	30.95	−2.45	22.79	9.70	−23.85	−4.40
	Y	2.75	−5.97	7.61	10.05	−18.66	−4.45
Thailand	*ER*	2.49	−3.89	4.98	5.02	−14.65	−3.12
1960–87					(28.36)	(−24.44)	(−7.53)
	EX	2.46	−7.07	5.53	14.01	−27.11	−5.27
	K	6.80	−2.64	14.28	11.24	−23.84	−4.72
	L	18.76	0.76	22.66	18.51	−20.24	−6.03
	Y	2.75	−1.28	12.12	10.53	−20.14	−4.57
Tunisia	*ER*	2.19	0.36	11.23	12.05	−28.39	−4.91
1960–88	*EX*	2.50	−8.71	4.93	14.99	−25.25	−5.47
	K	1.70	−4.53	5.85	4.46	−14.16	−2.89
					(24.00)	(−26.03)	(−6.93)
	L	2.38	−1.24	12.47	3.93	−10.96	−2.79
					(15.08)	(−18.80)	(−5.49)
	Y	1.43	−6.08	5.44	12.90	−28.47	−5.08

Table 1. (*Continued*)

Country/ time period	Series	Log of the series Test statistics			Log 1st difference of the series (Log 2nd difference of the series) Test statistics		
		$Z(\Phi_3)$	$Z(\alpha)$	$Z(t_\alpha)$	$Z(\Phi_3)$	$Z(\alpha)$	$Z(t_\alpha)$
Turkey	*ER*	15.37	0.33	23.00	9.57	−21.06	−4.37
1960–88	*EX*	1.15	−4.57	6.83	18.80	−24.14	−6.03
	K	2.56	−9.53	4.32	12.14	−24.53	−4.92
	L	11.70	−0.31	21.62	12.92	−24.06	−5.08
	Y	1.23	−3.79	8.51	10.60	−23.15	−4.56
Uruguay	*ER*	4.88	−13.92	−2.95	16.95	−25.21	−5.80
1960–88	*EX*	6.44	−16.90	−3.56	41.51	−34.55	−9.09
	K	1.75	−7.04	−1.87	8.76	−20.38	−4.15
	L	4.37	−11.86	−2.86	12.41	−22.59	−4.96
	Y	1.98	−7.63	−1.99	3.89	−10.78	−2.79
					(13.51)	(−16.11)	(−5.01)
Venezuela	*ER*	1.24	−3.30	6.66	10.02	−23.56	−4.76
1960–88	*EX*	1.38	−3.72	7.76	13.43	−20.91	−5.18
	K	1.26	−4.10	8.02	6.20	−14.87	−3.51
					(19.75)	(−25.07)	(−6.23)
	L	1.08	−4.45	6.11	10.94	−24.50	−4.67
	Y	3.60	−2.52	12.45	3.23	−12.23	−2.52
1960–88	*WP*	4.42	−2.08	15.80	6.19	−14.90	−3.52
1960–85	*WP*	5.64	−0.79	−0.53	6.94	−11.46	−3.71
1960–84	*WP*	7.04	−0.01	16.48	6.72	−10.33	−3.66
1964–87	*WP*	7.47	−3.42	11.96	5.01	−10.79	−3.07
					(18.51)	(−15.47)	(−6.08)
1963–88	*WP*	8.56	−4.25	12.75	4.86	−11.69	−2.96
					(18.51)	(−14.07)	(−5.74)
1962–87	*WP*	10.76	−2.75	16.39	5.24	−12.21	−3.21
					(20.20)	(−15.84)	(−6.29)

Note: The critical values for $n=25$, at 10% and 5% level of significance are equal to 5.91 and 7.24 for $Z(\Phi_3)$; −15.6 and −17.9 for $Z(\alpha)$; and −3.24 and −3.60 for $Z(t_\alpha)$. *ER*: exchange rate; *EX*: exports, *K*: capital; *L*: labour; *Y*: real GDP/GNP; *WP*=world output.

hypothesis of unit root was rejected after the second differencing. Thus in summary, for stationarity 2 series needed no differencing (just the log transformation), 116 series needed first differencing after the log transformation, and the remaining 27 series needed second differencing after the log transformation.

After each series is made stationary, following the specification procedure discussed in the previous section, output and export equations are specified for each country. The order in which the variables are added, and the lag length for each variable is reported in Table 3. Finally, the F-statistics based on the restricted and unrestricted residual sum of squares is used to test for the prima facie causality. These F-statistics are reported in Table 4 and the final direct and indirect prima facie causal relationships are summarized in Table 5.

Following the World Bank classification of grouping countries based on per capita income, the countries are divided into three groups: (1) low-income countries (GNP per capita income of US$545 or less in 1988); (2) lower middle-income countries (GNP per capita income of more than US$545 but less than $2200 in 1988); and (3) upper middle-income countries (GNP per capita income of more than US$2200 but less than US$6000 in 1988). According to this classification, five countries (India, Kenya, Nigeria, Pakistan and Sri Lanka) are in the low-income group; 18 countries (Colombia, Costa Rica, Dominican Republic. Ecuador, Egypt, El Salvador, Guatemala, Guyana, Honduras, Jamaica, Mexico, Morocco, Paraguay, Peru, Philippines, Thailand, Tunisia and Turkey) are in the lower-middle income group; and seven countries (Greece, Iran, South Korea, Portugal, South Africa, Uruguay and Venezuela) are in the upper middle-income group. Since no systematic pattern is observed in the findings according to the above classification of countries, the findings are discussed in a general framework.

Table 2. *Tranformation needed for stationarity*

Countries	*ER*	*EX*	*K*	*L*	*Y*	*WY*
Colombia	FD	FD	FD	FD	SD	FD
Costa Rica	FD	FD	FD	FD	FD	FD
Dominican Republic	FD	FD	FD	FD	FD	FD
Ecuador	SD	FD	FD	SD	FD	FD
Egypt	FD	FD	FD	FD	SD	FD
El Salvador	SD	FD	FD	FD	SD	FD
Greece	FD	FD	FD	SD	FD	FD
Guatemala	FD	FD	FD	FD	SD	FD
Guyana	FD	FD	FD	FD	FD	FD
Honduras	SD	FD	FD	FD	SD	FD
India	FD	FD	FD	FD	FD	FD
Iran	FD	FD	FD	FD	SD	FD
Jamaica	FD	FD	FD	FD	FD	FD
Kenya	FD	FD	FD	FD	FD	FD
South Korea	ND	FD	FD	FD	FD	SD
Mexico	FD	FD	FD	SD	SD	FD
Morocco	SD	FD	FD	FD	FD	FD
Nigeria	FD	FD	FD	FD	SD	FD
Pakistan	FD	FD	FD	FD	FD	FD
Paraguay	SD	FD	FD	FD	SD	SD
Peru	FD	FD	FD	FD	FD	FD
Philippines	FD	FD	SD	FD	SD	FD
Portugal	SD	FD	SD	FD	FD	FD
South Africa	FD	SD	SD	FD	FD	FD
Sri Lanka	FD	FD	FD	FD	FD	FD
Thailand	SD	FD	FD	FD	FD	FD
Tunisia	FD	FD	SD	SD	FD	FD
Turkey	FD	FD	FD	FD	FD	FD
Uruguay	FD	ND	FD	FD	SD	FD
Venezuela	FD	FD	FD	FD	SD	FD

Note: ND = no differencing, only log transformation; FD = first differencing after the log transformation; SD = second differencing after the log transformation. *ER*: exchange rate; *EX*: exports; *K*: capital; *L*: labour; Y: output; *WY*: world output.

Table 3. *Order of the variables in each equation and lag lengths*

		1st		2nd		3rd		4th	
Countries	Equation	Variables	Lag lengths	Variables	Lag lengths	Variables	Lag lengths	Variables	Lag lengths
Colombia	Output	*Y*	4	*EX*	1	*L*	1	*K*	1
	Export	*EX*	1	*Y*	3	*ER*	3	*WY*	4
Costa Rica	Output	*Y*	1	*L*	3	*EX*	3	*K*	2
	Export	*EX*	1	*ER*	2	*WY*	6	*Y*	1
Dominican	Output	*Y*	5	*K*	5	*L*	4	*EX*	1
Republic	Export	*EX*	1	*ER*	5	*Y*	2	*WY*	2
Ecuador	Output	*Y*	1	*K*	2	*EX*	1	*L*	1
	Export	*EX*	1	*Y*	3	*WY*	1	*ER*	6
Egypt	Output	*Y*	2	*L*	6	*EX*	4	*K*	1
	Export	*EX*	1	*ER*	2	*Y*	6	*WY*	5
El Salvador	Output	*Y*	2	*K*	1	*EX*	1	*L*	1
	Export	*EX*	4	*Y*	5	*WY*	1	*ER*	1
Greece	Output	*Y*	1	*EX*	1	*K*	1	*L*	1
	Export	*EX*	1	*Y*	1	*ER*	6	*WY*	6
Guatemala	Output	*Y*	1	*EX*	1	*L*	1	*K*	1
	Export	*EX*	3	*WY*	4	*ER*	1	*Y*	1

Table 3. (*Continued*)

Countries	Equation	1st		2nd		3rd		4th	
		Variables	Lag lengths	Variables	Lag lengths	Variables	Lag lengths	Variables	Lag lengths
Guyana	Output	*Y*	1	*EX*	1	*K*	1	*L*	1
	Export	*EX*	4	*ER*	3	*Y*	3	*WY*	3
Honduras	Output	*Y*	4	*K*	4	*EX*	1	*L*	1
	Export	*EX*	1	*Y*	1	*WY*	1	*ER*	1
India	Output	*Y*	1	*L*	1	*EX*	2	*K*	6
	Export	*EX*	1	*Y*	3	*WY*	1	*ER*	1
Iran	Output	*Y*	1	*L*	5	*K*	5	*EX*	6
	Export	*EX*	1	*Y*	6	*WY*	3	*ER*	6
Jamaica	Output	*Y*	1	*EX*	1	*L*	1	*K*	3
	Export	*EX*	2	*WY*	1	*ER*	1	*Y*	6
Kenya	Output	*Y*	1	*K*	1	*EX*	1	*L*	1
	Export	*EX*	1	*WY*	3	*Y*	4	*ER*	2
South Korea	Output	*Y*	1	*EX*	1	*L*	1	*K*	1
	Export	*EX*	1	*ER*	1	*Y*	1	*WY*	2
Mexico	Output	*Y*	2	*K*	1	*EX*	4	*L*	4
	Export	*EX*	1	*WY*	2	*ER*	2	*Y*	1
Morocco	Output	*Y*	6	*L*	1	*K*	1	*EX*	5
	Export	*EX*	1	*Y*	2	*WY*	1	*ER*	2
Nigeria	Output	*Y*	1	*EX*	2	*L*	3	*K*	2
	Export	*EX*	1	*ER*	1	*WY*	1	*Y*	1
Pakistan	Output	*Y*	1	*K*	5	*EX*	3	*L*	1
	Export	*EX*	1	*ER*	1	*Y*	1	*WY*	1
Paraguay	Output	*Y*	2	*EX*	3	*K*	1	*L*	1
	Export	*EX*	4	*WY*	4	*ER*	4	*Y*	1
Peru	Output	*Y*	1	*K*	3	*EX*	4	*L*	1
	Export	*EX*	1	*Y*	3	*WY*	1	*ER*	1
Philippines	Output	*Y*	1	*EX*	4	*K*	5	*L*	1
	Export	*EX*	2	*WY*	1	*Y*	1	*ER*	2
Portugal	Output	*Y*	1	*K*	1	*EX*	1	*L*	1
	Export	*EX*	3	*ER*	1	*Y*	5	*WY*	5
South Africa	Output	*Y*	1	*EX*	6	*L*	6	*K*	6
	Export	*EX*	6	*WY*	1	*ER*	1	*Y*	1
Sri Lanka	Output	*Y*	3	*K*	6	*L*	1	*EX*	1
	Export	*EX*	1	*ER*	1	*WY*	1	*Y*	1
Thailand	Output	*Y*	1	*K*	5	*L*	4	*EX*	5
	Export	*EX*	1	*ER*	3	*Y*	5	*WY*	1
Tunisia	Output	*Y*	1	*L*	1	*K*	1	*EX*	1
	Export	*EX*	1	*WY*	1	*Y*	2	*ER*	1
Turkey	Output	*Y*	1	*L*	6	*K*	2	*EX*	2
	Export	*EX*	1	*ER*	2	*WY*	4	*Y*	2
Uruguay	Output	*Y*	4	*L*	1	*EX*	1	*K*	1
	Export	*EX*	1	*ER*	1	*WY*	2	*Y*	1
Venezuela	Output	*Y*	1	*K*	2	*EX*	1	*L*	1
	Export	*EX*	1	*WY*	3	*ER*	1	*Y*	1

Note: *Y*: output; *K*: capital; *L*: labour; *EX*: exports; *ER*: exchanged rate; *WY*: world output.

Table 4. *Test statistics for testing causality*

	Output equation			Exports equation		
Countries	Exports	Capital	Labour	Output	Exchange rate	World output
Colombia	2.95[d]	0.17	1.73	3.88[b]	4.11[b]	0.47
Costa Rica	3.99[b]	1.13	1.33	0.24	4.85[b]	2.72[c]
Dominican Republic	0.36	2.89[c]	1.13	4.03[b]	4.63[b]	1.96
Ecuador	1.10	1.53	0.24	2.21	1.47	1.04
Egypt	2.15	0.64	2.94[d]	5.74[b]	4.77[c]	4.31[c]
El Salvador	0.21	0.69	0.17	4.31[c]	0.47	1.82
Greece	2.83[d]	0.75	0.38	0.43	3.21[c]	1.53
Guatemala	1.70	0.60	0.22	1.17	2.91[d]	3.34[b]
Guyana	0.61	0.03	0.21	2.77[d]	8.80[b]	1.33
Honduras	0.46	1.33	0.18	0.32	0.32	0.17
India	3.74[c]	1.44	0.69	1.91	0.14	0.44
Iran	2.75	8.29[c]	4.95[d]	5.18[c]	2.03	5.29[c]
Jamaica	3.47[c]	2.52[c]	3.81[c]	2.43[c]	9.42[b]	1.64
Kenya	1.30	3.28	0.42	2.60	2.28	1.24
South Korea	1.41	0.66	1.37	1.61	2.56	0.81
Mexico	4.59[b]	12.53[a]	2.21	0.01	3.66[c]	4.76[b]
Morocco	1.22	3.84[c]	0.69	3.36[c]	1.42	2.25
Nigeria	2.58[d]	1.31	1.52	0.06	6.66[b]	5.30[b]
Pakistan	1.40	6.95[b]	0.45	0.19	2.12	0.01
Paraguay	1.54	0.09	0.07	2.49	3.13[d]	6.56[c]
Peru	6.68[a]	21.91[a]	4.20[b]	5.10[b]	2.34	3.93[c]
Philippines	2.65[d]	1.52	0.11	3.96[c]	1.62	6.15[b]
Portugal	4.81[b]	3.73[c]	0.01	6.64[b]	14.88[a]	4.52[b]
South Africa	100.28[c]	50.83[d]	103.83[c]	0.01	4.55[c]	10.10
Sri Lanka	0.86	2.53[c]	1.97	0.06	36.03[a]	0.28
Thailand	1.94	5.55[c]	4.23[c]	2.86[c]	6.18[b]	0.47
Tunisia	0.18	0.31	1.55	2.70[c]	0.23	6.46[b]
Turkey	0.92	2.04	3.29[b]	0.15	5.29[b]	2.03
Uruguay	0.07	0.03	3.30[c]	0.03	9.63[a]	2.63[d]
Venezuela	0.86	2.32	0.54	0.08	0.42	3.10[c]

Note: [a, b, c, d] show that these statistics are significant at the 1%, 5%, 10% and 11% level of significance respectively.

Among our primary hypothesis of interest that export growth prima facie causes output growth is supported in 11 countries (Colombia, Costa Rica, Greece, India, Jamaica, Mexico, Nigeria, Peru, Philippines, Portugal and South Africa) out of the 30 countries considered here. The reverse hypothesis that output growth prima facie causes export growth is also supported in 13 countries (Columbia, Dominican Republic, El Salvador, Egypt, Guyana, Iran, Jamaica, Morocco, Peru, Philippines, Portugal, Thailand and Tunisia). A feedback relationship, i.e. that output growth causes export growth and vice versa is supported in five countries (Colombia, Jamaica, Peru, Philippines and Portugal). Thus, this analysis suggests that Colombia, Jamaica, Peru, Philippines and Portugal followed the path of export-led growth, while at the same time suggesting that domestic market conditions had a significant impact on the growth process, with exports playing a reactive role. On the other hand, Costa Rica, Greece, India, Mexico, Nigeria and South Africa showed export-led growth only; and in the Dominican Republic, Egypt, El Salvador, Guyana, Iran, Morocco, Thailand and Tunisia the growth of domestic demand lags behind the growth of output and factors of production. Productivity growth is responsible for the growth of exports.

The findings for our secondary hypotheses are as follows. In six countries (Egypt, Iran, Jamaica, Peru, South Africa and Thailand) labour growth prima facie causes output growth and in 12 countries (Dominican Republic, Iran, Jamaica, Kenya, Mexico, Morocco, Pakistan, Peru, Portugal, South Africa, Sri Lanka and Thailand) capital formation prima facie causes output growth. Furthermore, it is observed that in 15 countries (Colombia, Costa Rica, Dominican Republic, Egypt, Greece, Guatemala, Guyana, Jamaica, Mexico, Nigeria, Paraguay, Portugal, South Africa, Sri Lanka and Thailand) exchange rate prima facie causes export growth, and in 12 countries (Costa Rica, Egypt, Gautemala, Iran, Mexico, Nigeria, Paraguay, Peru, Philippines, Portugal, South Africa and Tunisia) world output prima facie causes export growth.

It is important to note that in half of the countries considered here foreign-exchange rate policy seems to be widely used as an export expansion policy. Moreover, in 12 countries world output growth causes export growth. This indicates that the foreign economy influences the domestic

Table 5. *The causal relationships*

Countries	Direct causality	Indirect causality
Colombia	$EX \Rightarrow Y$; $Y \Rightarrow EX$; $ER \Rightarrow EX$	$ER \rightarrow Y$
Costa Rica	$EX \Rightarrow Y$; $ER \Rightarrow EX$; $WY \Rightarrow EX$	$ER \rightarrow Y$; $WY \rightarrow Y$
Dominican Republic	$K \Rightarrow Y$; $Y \Rightarrow EX$; $ER \Rightarrow EX$	$K \rightarrow EX$
Ecuador	No relationship	
Egypt	$L \Rightarrow Y$; $Y \Rightarrow EX$; $ER \Rightarrow EX$; $WY \Rightarrow EX$	$L \rightarrow EX$
El Salvador	$Y \Rightarrow EX$	
Greece	$EX \Rightarrow Y$; $ER \Rightarrow EX$	$ER \rightarrow Y$
Guatemala	$ER \Rightarrow EX$; $WY \Rightarrow EX$	
Guyana	$Y \Rightarrow EX$; $ER \Rightarrow EX$	
Honduras	No relationship	
India	$EX \Rightarrow Y$	
Iran	$K \Rightarrow Y$; $L \Rightarrow Y$; $Y \Rightarrow EX$; $WY \Rightarrow EX$	$K \rightarrow EX$; $L \rightarrow EX$
Jamaica	$EX \Rightarrow Y$; $K \Rightarrow Y$, $L \Rightarrow Y$; $Y \Rightarrow EX$; $ER \Rightarrow EX$	$ER \rightarrow Y$; $K \rightarrow EX$; $L \rightarrow EX$
Kenya	$K \Rightarrow Y$	
South Korea	No relationship	
Mexico	$EX \Rightarrow Y$; $K \Rightarrow Y$; $ER \Rightarrow EX$; $WY \Rightarrow EX$	$ER \rightarrow Y$; $WY \rightarrow Y$
Morocco	$K \Rightarrow Y$; $Y \Rightarrow EX$	$K \rightarrow EX$
Nigeria	$EX \Rightarrow Y$; $ER \Rightarrow EX$; $WY \Rightarrow EX$	$ER \rightarrow Y$; $WY \rightarrow Y$
Pakistan	$K \Rightarrow Y$	
Paraguay	$ER \Rightarrow EX$; $WY \Rightarrow EX$	
Peru	$EX \Rightarrow Y$; $K \Rightarrow Y$; $L \Rightarrow Y$; $Y \Rightarrow EX$; $WY \Rightarrow EX$	$WY \rightarrow Y$; $K \rightarrow EX$; $L \rightarrow EX$
Philippines	$EX \Rightarrow Y$; $Y \Rightarrow EX$; $WY \Rightarrow EX$	$WY \rightarrow Y$
Portugal	$EX \Rightarrow Y$; $K \Rightarrow Y$; $Y \Rightarrow EX$; $ER \Rightarrow EX$; $WY \Rightarrow EX$	$ER \rightarrow Y$; $WY \rightarrow Y$; $K \rightarrow EX$
South Africa	$EX \Rightarrow Y$; $K \Rightarrow Y$; $L \Rightarrow Y$; $ER \Rightarrow EX$, $WY \Rightarrow EX$	$WY \rightarrow Y$; $ER \rightarrow Y$
Sri Lanka	$K \Rightarrow Y$; $ER \Rightarrow EX$	
Thailand	$K \Rightarrow Y$; $L \Rightarrow Y$; $Y \Rightarrow EX$; $ER \Rightarrow EX$	$K \rightarrow EX$; $L \rightarrow EX$
Tunisia	$Y \Rightarrow EX$; $WY \Rightarrow EX$	
Turkey	$L \Rightarrow Y$; $ER \Rightarrow EX$	
Uruguay	$L \Rightarrow Y$; $ER \Rightarrow EX$; $WY \Rightarrow EX$	
Venezuela	$WY \Rightarrow EX$	

Note: $a \Rightarrow b$: means a causes b; $a \rightarrow b$: means a causes b indirectly through some other variable.

economy substantially as the domestic economy reaches a certain level of economic development. Furthermore, in six countries labour growth causes output growth, and in 12 countries capital formation causes output growth. These findings support the neoclassical growth theory and its past presumptions. The fact that in at least 16 countries neither capital nor labour growth are found to cause output growth is difficult to reconcile with neoclassical growth theory. One possible, though unlikely, explanation is that the causal influence of movements of factor inputs on output movements is purely contemporaneous in these countries. The Granger causality test fails to detect the effect on output of contemporaneous innovations in capital, labour and export growth.

Among the indirect prima facie causal hypotheses, our results reveal that in eight countries (Colombia, Costa Rica, Greece, Jamaica, Mexico, Nigeria, Portugal and South Africa) the exchange rate prima facie caused output growth indirectly through export growth; and in seven countries (Costa Rica, Mexico, Nigeria, Peru, Philippines, Portugal and South Africa) world output prima facie caused output growth indirectly through export growth. Furthermore, we notice that capital formation prima facie causes export growth indirectly through output growth in seven countries (Dominican Republic, Iran, Jamaica, Morocco, Peru, Portugal and Thailand), and in four countries (Egypt, Iran, Jamaica, Peru and Thailand) labour growth indirectly causes export growth through output growth.

V. SUMMARY AND CONCLUSIONS

In this study, the causal relationships between the export growth and output growth in 30 low- and middle-income developing countries over the period from 1960 to 1988 are investigated in a multivariate framework, Out of the 30 countries, a feedback prima facie causal relationship between export growth and output growth is found in five; export growth prima facie causes output growth in six other countries; output growth prima facie causes export growth in another eight countries; and no causal relationship was observed between output growth and export growth in the remaining countries. There is no systematic pattern in the results of low-income, middle-income and upper middle-income countries. One interesting result of this analysis is that no causal relationship is observed between export growth and output growth for the case of South Korea. South Korea is widely believed to be an export oriented growth country.

In addition, it is observed that in 15 countries the foreign exchange rate prima facie caused export growth and in 12 countries world output caused export growth. Thus, the findings indicate that the most viable export expansion policy should be control of the foreign exchange rate, and that worldwide economic activities are transmitted to low- and middle-income countries through the export growth of developing countries.

There is an overwhelming evidence from this study to support the export-led growth hypothesis. However, there is not a systematic prediction that exports cause growth. It is possible that growth of output and exports are both caused by underlying economic policies.[3]

Secondly, given the second differencing of some of the series, it is not possible to make statements regarding the direction of causal relationships. Recently Bahamni-Oskooee *et al.* (1991) observed that Dominican Republic, Indonesia, Korea, Taiwan and Thailand followed a path of export-led growth. In our analysis Indonesia and Taiwan are not included and we did not observe export-led growth in the case of Dominican republic, Korea and Thailand.

ACKNOWLEDGEMENTS

The authors would like to thank Harry G. Miller, Paul Pecorino, Michael P. Shields and Richard Grabowski for helpful comments. The authors would also like to thank an anonymous referee whose comments have been instrumental in footnotes 1–3.

REFERENCES

Akaike, H. (1969) Fitting autoregression for prediction, *Annals of the Institute of Statistical Mathematics*, **21**, 203–17.

Akaike, H. (1970) Statistical predictor identification, *Annals of the Institute of Statistical Mathematics*, **22**, 243–7.

Bahamni-Oskooee, Mohsen, Mohtadi, H. and Shabsigh, G. (1991) Exports, growth and causality in LDCs: a reexamination, *Journal of Development Economics*, **36**, 405–15.

Balassa, B. (1978) Exports and economic growth: further evidence, *Journal of Development Economics*, **5**, 181–9.

Balassa, B. (1985) Exports, policy choices, and economic growth in developing countries after the 1973 oil shock, *Journal of Development Economics*, **18**, 23–35.

Caines, P. E., Keng, C. W. and Sethi, S. P. (1981) Causality analysis and multivariate autoregressive modeling with an application to supermarket sales analysis, *Journal of Economic Dynamics and Control*, **3**, 267–98.

Chenery, H. and Strout, A. (1966) Foreign assistance and economic development, *American Economic Review*, **56**, 679–733.

Cheung, Daniel W. W., Sharma, S. C. and Trescott, P. B. (1991a) The interest rate management and sterilization hypotheses for the UK: under fixed exchange rate, *Applied Economics*, **23**, 821–38.

Cheung, Daniel W. W., Sharma, S. C. and Trescott, P. B. (1991b) Monetary interdependence between the United States and United Kingdom under alternative exchange rate regimes, *Applied Financial Economics*, **1**, 175–84.

Chow, P. C. Y. (1987) Causality between export growth and industrial development, *Journal of Development Economics*, **26**, 55–63.

Dickey, D. A. and Fuller, W. A. (1981) Likelihood ratio statistics for autoregressive time series with a unit root, *Econometrica*, **49**, 1057–72.

Fajana, O. (1979) Trade and growth: the Nigerian experience, *World Development*, **7**, 73–8.

Feder, G. (1983) On exports and economic growth, *Journal of Development Economics*, **12**, 59–73.

Grabowski, Richard, Sharma S. C. and Dhakal, D. (1990) Exports and Japanese economic development, *Economics Letters*, **32**, 127–32.

Granger, C. W. J. (1969) Investigating causal relations by econometric models and gross spectral methods, *Econometrica*, **37**, 424–38.

Granger, C. W. J. (1980) Testing for causality: a personal viewpoint, *Journal of Economic Dynamics and Control*, **2**, 329–52.

Helpman, E. and Krugman, P. R. (1985) Market structure and foreign trade, MIT Press, Cambridge, MA.

Hsiao, C. (1979) Autoregressive modeling of Canadian money and income data, *Journal of American Statistical Association*, **74**, 553–60.

Hsiao, C. (1981) Autoregressive modeling and money income causality detection, *Journal of Monetary Economics*, **7**, 85–106.

Hsiao, C. (1982) Autoregressive modeling and causal ordering of economic variables, *Journal of Economic Dynamics and Control*, **4**, 243–59.

Jung, Woo S. and Marshall, Peyton J. (1985) Exports, growth and causality in developing countries, *Journal of Development Economics*, **18**, 1–12.

Kavoussi, Rostam M. (1984) Export expansion and economic growth: further empirical evidence, *Journal of Development Economics*, **14**, 241–50.

Kunst, Robert M. and Marin, Dalia (1989) On exports and productivity: a causal analysis, *Review of Economics and Statistics*, **71**, 699–703.

Michaely, Michael (1977) Exports and growth: an empirical investigation, *Journal of Development Economics*, **4**, 49–53.

Michalopoulos, C. and Jay, K. (1973) Growth of exports and income in the developing world: A neoclassical view, *AID Discussion Paper No. 28*, Washington, DC.

Perron, Pierre (1988) Trends and random walks in macroeconomic time series: further evidence from a new approach, *Journal of Economics Dynamics and Control*, **12**, 297–332.

Phillips, P. C. B. and Perron, P. (1988) Testing for a unit root in time series regression, *Biometrica*, **75**, 335–46.

Sharma, Subhash C., Norris, M. and Cheung, Daniel W. W. (1991) Exports and economic growth in industrialized countries, *Applied Economics*, **23**, 697–708.

Tyler, W. G. (1981) Growth and export expansion in developing countries: some empirical evidence, *Journal of Development Economics*, **9**, 121–30.

Voivodas, C. (1973) Exports, foreign capital inflow and economic growth, *Journal of International Economics*, **3**, 337–49.

Williamson, R. (1978) The role of exports and foreign capital in Latin American economic growth, *Southern Economic Journal*, **45**, 410–20.

[3] Due to certain limitations of causality tests, and the unavailability of accurate data for some variables the results of this study (or similar such studies) should be viewed with some reservations.