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Export-led growth in Bangladesh: a time series analysis

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This article examines time series evidence to investigate the link between exports and economic growth in Bangladesh. Using quarterly data for a period from 1976 to 2003 the article finds that industrial production and exports are cointegrated. The results of an error correction model (ECM) suggest that there is a long-run unidirectional causality from exports to growth in Bangladesh.

I. Introduction

In over three decades, Bangladesh has witnessed substantial growth in its export of goods and services.[1] Over this period economic growth has accelerated with GDP initially recording an average growth rate of below 3% in the early 1970s and rising to 5% during the 1990s.[2] The trade and industry policies have changed from being highly import substituting and government controlled to become more liberalized and deregulated. In the 1970s, Bangladesh was a strongly inward-oriented economy ranking among the top in price distortions caused by high tariff barriers.[3] By the 1980s, the dismal growth performance of the early 1970s and a general enthusiasm about export-led growth – reinforced by the disillusionment experienced by most developing countries over their import-substituting development experiments of the 1950s on the one hand and by the success of the Asian Tigers with export-oriented development strategies on the other – made a case for a policy shift in Bangladesh, as in many other developing countries.[4]

Progressive trade liberalization and domestic deregulation were the foci of trade and industrial policies since the 1980s; policies that recognized the need for: (i) greater efficiency and international competitiveness; (ii) faster growth of export-oriented industries; (iii) reduction of regulation and control along with tariff rationalization; (iv) a liberalized market-based competitive structure; (v) and disinvestment of public sector enterprises. To promote exports, several measures were undertaken. For example, in the 1980s the government established the first export processing zone in Chittagong. It was followed by other measures such as tax breaks for export-oriented enterprises and income tax rebates. Later on, two more export processing zones were established in Dhaka and Khulna. In recent years, Bangladesh has experienced not only a substantial increase in the volume of exports but also important changes in the composition of those exports; moving away from traditional items such as jute and jute products and towards new manufactured products such as ready-made garments.

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[1] The total value of exports increased from US$468.8 million (2000 constant USD) in 1976 to 6951 million in 2002 according to International Monetary Fund (IMF).
[2] See Ahmed and Sattar (2004) for a detailed account.
[3] According to Dodaro (1991), Bangladesh recorded the second highest value of the price distortion index – only after Ghana – from within a group of 41 countries.
[4] See Love (1995) for a discussion.

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There has been a substantial empirical literature on the effects of exports on growth. Among the early studies, Michaely (1977), Balassa (1978), Chow (1987), Darrat (1987) have provided evidence in support of export-led growth hypothesis for various developing countries. In recent times, Abual-Foul (2004) and Awokuse (2004) have established unidirectional causality between exports to output for Jordan and Canada, respectively. New developments in time series analysis have facilitated more sophisticated examination of the time series evidence on causal links between exports and growth. To the best of our knowledge, no study has ever done a time series analysis of the export–output relationship for Bangladesh. Using time series techniques, the current research shows that there is evidence of a long-run equilibrium relationship between exports and output in Bangladesh.

The rest of the article is organized as follows. Section II discusses data, methodology and empirical results. Section III summarizes and concludes.

II. Data, Methodology and Empirical Results

The data set comprised quarterly data on industrial production index,[5] exports of goods and services and exports of goods only for a period from 1976:1 to 2003:3, from the *International Financial Statistics* published by the International Monetary Funds. For all three data series the base year is 2000 and the export values are given in US constant dollars. Let y and x denote the logarithms of industrial production index and exports, respectively. Note that 'exports of goods and services' and 'exports of goods only'[6] will be used as two alternative measures of exports.

Unit root test

Augmented Dickey–Fuller (ADF) tests were carried out to find out the order of integration for each of the three series. First, tests in levels and then in first differences were carried out. Each series started with the most flexible specification of the test equation that includes an intercept and a trend:

$$\Delta z_{i,t} = \alpha_{i,o} + \alpha_{i,1} t + \gamma z_{i,t-1} + \sum_{j=1}^{p} \beta_{i,j} \Delta z_{i,t-j} + \varepsilon_{i,t} \tag{1}$$

where z_i is the variable of interest where $i = 1, 2$ indexes the variable (i.e. $z_1 = y$ and $z_2 = x$), $\alpha_{i,0}$ represents the intercept term, t is the time trend, Δz_is are the augmented terms, p is the appropriate lag length of the augmented terms and ε_i is the white noise error term. The ADF test is essentially the test of significance of the coefficient γ in the above equation. In order to select the lag length p, we start with a maximum lag of 8 and pare it down to the appropriate lag by examining the Akaike Information Criterion (AIC).[7] If one does not find the intercept and the trend – both or one of them – to be statistically significant at the 10% significance level, one drops the insignificant term(s) and re-estimates the test statistics. The results are reported in Table 1. The number of lags of the augmented terms and other specifications of the test equation are included in the table. As we can see, all three series are integrated of order one, i.e. I (1).

Engle–Granger cointegration test

Given that both y and x are I (1) one can use the Engle–Granger cointegration test procedure to examine if industrial production and exports are cointegrated. This procedure involves testing the residuals for stationarity (using the Dickey–Fuller [DF] test method), obtained from an OLS regression of industrial production on contemporaneous values of exports:

$$y_t = \beta_0 + \beta_1 x_t + e_t \tag{2}$$

Note that Equation 2 represents a long-run equilibrium relationship between industrial production and exports. The estimated equations for two alternative measures of exports and DF test statistics for the residuals are reported in Panel A and Panel B respectively of Table 2. Two versions of the DF test were conducted: one with no lag and the other with

[5] Since GDP data are not available at quarterly frequency industrial production index were used.
[6] Since one is using industrial production index it seems more appropriate to use 'exports of goods only' but 'exports of services' may indirectly affect industrial production. Both series, however, display similar patterns over the sample period.
[7] There is no general rule as to how one chooses the maximum lag length to start with. Enders (1995: 227) suggests that one should 'start with a relatively long lag length'. Some researchers use the following rule of thumb: start with a maximum lag length equal to the cube root of the number of observation which is 4.8 ($\cong \sqrt[3]{111}$) in this case. One also uses other information criteria such as Schwarz criterion (SC) or Hannan–Quinn criterion (HQC). Most times these criteria choose the same lag length. Even for cases with different lag lengths selected by different criteria the ADF test results are qualitatively similar.

Table 1. Augmented Dickey–Fuller test results

	Industrial production (y)	Exports of goods and services (x)	Exports of goods only (x)
Panel A: In levels			
Is an intercept term included in the test equation?	Yes	Yes	Yes
Is a time trend included in the test equation?	Yes	Yes	Yes
Lag length of the augmented terms	4	4	5
ADF test statistics	−1.98	−1.94	−2.05
MacKinnon's p-value	0.60	0.62	0.57
Panel B: In differences			
Is an intercept term included in the test equation?	Yes	Yes	Yes
Is a time trend included in the test equation?	No	No	No
Lag length of the augmented terms	3	3	2
ADF test statistics	−5.93	−5.98	−10.65
MacKinnon's p-value	0.00	0.00	0.00

5 lags (*that is*, augmented terms were included). These tests however give contradictory results: while the test with no lag indicates that the residuals are stationary, the test with 5 lags (selected using AIC) indicates that they are not.[8] Note that since the residuals are generated from a regression equation the standard DF table cannot be used. The critical values provided by Engle and Granger (1987) were used and included in Table 2. The estimated cointegrating equation indicates that there is a significant positive long-run relationship between exports (no matter whichever measure used) and industrial production in Bangladesh.

Table 2. Engle–Granger cointegration test results

Panel A: Exports of goods and services		
Estimated long-run equilibrium relationship: (cointegrating equation)		
$y_t = \underset{(15.68)}{1.34} + \underset{(31.66)}{0.43}x_t + e_t$		
Dickey–Fuller Test on $\{\hat{e}_t\}$		
	Lag = 0	Lag = 5
Test statistic	−5.96	−1.93
5% critical value	−3.37	−3.17
Panel B: Exports of goods only		
Estimated long-run equilibrium relationship: (cointegrating equation)		
$y_t = \underset{(19.60)}{1.48} + \underset{(33.99)}{0.42}x_t + e_t$		
Dickey–Fuller test on $\{\hat{e}_t\}$		
	Lag = 0	Lag = 5
Test statistic	−6.77	−1.99
5% critical value	−3.37	−3.17

Note: The t-statistics for estimated coefficients in the cointegrating equations are shown in parentheses below the equations. The 5% critical values are from Engle and Granger (1987) as reported in Enders (1995: 383).

Error-correction model and Granger causality

The existence of a cointegrating relationship suggests that one should estimate an error-correction model (ECM) of industrial production and exports, as represented by the following equation:

$$\Delta z_{i,t} = \delta_{i,o} + \delta_{i,1}\hat{e}_{t-1} + \sum_{i=1}^{2}\sum_{j=1}^{p}\lambda_{i,j}\Delta z_{i,t-j} + \xi_{i,t} \quad (3)$$

Enders (1995) describes this equation as a near VAR. The term $\hat{e}_{t-1}$s are obtained from the estimated cointegrating equations presented in Table 2, and the coefficient $\delta_{i,1}$ represents the speed of adjustment after the growth rate of industrial production (or the growth rate of exports) deviates from the long-run equilibrium in period $t-1$. In other words, it represents the long-run causal effect in relation to the long-run equilibrium relationship of the cointegrated processes. The coefficients of the lagged values, $\lambda_{2,j}$, in the first of the two equations represent short-run effects of exports on industrial production and $\lambda_{1,j}$s in the second equation represent short-run effects of industrial production on exports. A test of joint significance of these lagged terms constitutes a short-run Granger causality test.

[8] Because of the low power of ADF tests, some studies (e.g. Freeman, 2001) suggest that one should experiment with the lag structure to determine if cointegrating relationship can be found between variables 'close' in time. The stationarity tests of the residuals obtained from experiments with various lags suggest that there is a cointegrating relationship between y and 8th lag of x.

Table 3. Error-correction model and Granger causality test

Dependent variable ⇒	Δy	Δx
Panel A: Exports of goods and services		
Estimated value of $\delta_{i,1}$	−0.12	0.09
t-statistics	−1.88*	0.85
F-statistics		
H_0: $\delta_{i,1}=0$	3.53*	0.73
H_1: $\delta_{i,1}\neq 0$		
F-statistics		
H_0: $\lambda_{i,j}=0$ for all j	0.75	0.80
H_1: $\lambda_{i,j}\neq 0$ for at least one j		
Panel B: Exports of goods only		
Estimated value of $\delta_{i,1}$	−0.15	0.10
t-statistics	−2.09**	0.69
F-statistics		
H_0: $\delta_{i,1}=0$	4.36**	0.47
H_1: $\delta_{i,1}\neq 0$		
F-statistics		
H_0: $\lambda_{i,j}=0$ for all j	0.95	0.96
H_1: $\lambda_{i,j}\neq 0$ for at least one j		

Note: *indicates significance at 10% level and **indicates significance at 5% level.

The results are reported in Table 3. The estimated value of the speed of adjustment coefficient is negative and statistically significant in the industrial production equation as we can see from both the *t*-statistics and the *F*-statistics for each case in Panel A and B.[9] It indicates that the further away industrial production deviates from its long-run relationship with exports, the lower is the growth rate and vice versa. The speed of adjustment coefficient in the export equation is statistically significant in neither of the two cases. The short-run Granger causality test results reported in the last row of each panel in Table 3 indicate that there is no causal relationship between export growth and industrial growth.

III. Conclusion

This article examined time series evidence of export-led growth in Bangladesh. While the analysis suggests that there is a positive long-run equilibrium relationship between exports and industrial production, there is no evidence of short-run causal relationship between these two variables. Furthermore, the long-run causality seems to run from exports to industrial production.

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[9] However, the result is stronger when we use 'exports of goods only'.