# Revisiting Export-Led Growth for Bangladesh: A Synthesis of Cointegration and Innovation Accounting

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## Abstract

Bangladesh, with spectacular growth in both exports and output in recent years, has drawn attention to the hypothesis of export-led growth. The results on this hypothesis are nevertheless inconclusive. By selecting a relatively liberalized regime from 1979 to 2010, this study engages both the Johansen cointegration approach and innovation accounting with Bangladesh's output, exports, and imports. This comprehensive approach finds significant evidence on export-led growth in Bangladesh for both the long run and the short run. It finds that output growth also leads to export expansion. While export-import feedback is high, the import-output relation appears to be insignificant for the country. These findings suggest further export promotion and import liberalization not only for Bangladesh, but also for other emerging economies that aspire to grow fast but confront dilemmas with economic openness.

**Keywords:** Export-led growth, Bangladesh economy, Cointegration, Impulse responses, Variance decompositions

**JEL Codes: F41, F43, C32, O53**

## 1. Introduction

The new wave of trade liberalization in the last two decades has contributed to a revival of the research on export-led growth in developing countries. Emerging Asian countries, which vigorously confronted the challenges of globalization, became objects of special interest in this respect. Bangladesh, being one of the South Asian "tiger-case" economies, has been gradually shifting its policy from anti-export bias to export promotion, and registering spectacular annual growth of around 5 percent in the last two decades. This scenario has triggered a number of questions such as: 1) Have exports played a significant role in Bangladesh's growth performance? 2) Has higher growth in Bangladesh contributed to export expansion? 3) Is export-led growth in Bangladesh, if there is any, a long-run or short-run phenomenon? This study addresses these questions by examining the export-import-output relationship of Bangladesh.

Although the concept of export-led growth has long occupied a huge area in literature, there has been little parallel research on Bangladesh with this hypothesis. There are two main reasons for this deficiency. The first is that while Bangladesh dropped its anti-export bias and fixed-exchange-rate policy at the end of the 1970s, the simultaneous growth in both exports and gross domestic product (GDP) was not evident until the 1990s. Hence, experimenting with the export-GDP relationship for Bangladesh did not become appealing scholarly until the mid 1990s. Second, the unavailability of a sufficient number of observations hindered any time-series estimations on the export-GDP relationship. While export-import data can be collected quarterly, GDP data for Bangladesh have remained annual since the country's independence in 1971. Based on the data with yearly frequency, researchers had to wait until the 2000s to make their sample size fairly acceptable in time-series estimations. Thus, a spurt of research on the export-GDP relationship of Bangladesh was quite evident in the 2000s.

Now the question arises as to what these studies find, and what the necessity of a new study is. As we will see in literature review, most studies find the hypothesis of export-led growth effective for Bangladesh, but their methods are often deficient or improper, as is their sample selection. Moreover, the result on whether export-led growth is a long-run or short-run phenomenon is widely inconclusive. Hence, a gap has been created, and my work fills that gap.

This study overcomes the shortcomings of studies in the past and presents a synthesis of cointegration and innovation accounting to reconcile the long-run and short-run dynamics of the trade-GDP relation in Bangladesh. An open and comprehensive approach of this sort has never been executed before.

Bangladesh pursued the policy of trade controls since its independence. After the regime change in 1975, the new government began to mitigate the prevailing anti-export bias and established an export promotion bureau in 1977. The year of 1979 can be treated as a landmark in Bangladesh's trade history when the country abandoned the fixed exchange rate and launched a managed exchange rate pegged with a basket of currencies. This first attempt to liberalize the exchange rate invariably gave fresh impetus to trade in Bangladesh. While economic reforms are still far from complete, the year of 1979 is regarded as the starting point of trade liberalization in Bangladesh, because the exchange rate policy, which affects both exports and imports, is instrumental to the dynamics of the external sector. Hence, my sample begins in 1979 and ends in 2010. I argue that examining the export-GDP interaction requires a relatively liberalized regime. Otherwise, the estimates on the interaction of these variables are likely to be flawed if a sample carelessly includes restricted regimes when trade controls were high. Most studies in the past ignored this reality. Hence, revisiting the trade-output relation over the relatively liberalized regime from 1979 to 2010 becomes imperative.

Although my objective is to unveil the export-income relation, I include imports in all estimations to avoid omitted variable bias. While the Johansen technique along with the vector error correction (VEC) model is used to test the long-run relation among these three variables, the vector autoregression (VAR) and the resulting impulse responses and variance decompositions, which are jointly called innovation accounting, are used to derive the short-run interaction of these variables. As Hamilton (1994:291) asserts, impulse response functions and variance decompositions are used to summarize the dynamic relations between variables in a VAR.

This study finds unqualified support for export-led growth in Bangladesh in the short run. The long-run cointegration between exports and GDP is significant, but is not as robust as the short-run interaction. Imports are found to have no significant interaction with output, but exports and imports have positive feedback to each other in the short run. Thus, the indirect relationship between GDP and imports through the channels of exports may have had worked in the wake of trade liberalization since the late 1970s. These findings have policy implications not only for Bangladesh, but also for other developing economies that aspire to grow fast but confront dilemmas with export promotion and economic openness. This work comprises seven sections. The next section is devoted to literature review. Section 3 describes trade policies in the country and defines the sample. Data and methodology issues are discussed in Section 4. Section 5 includes the cointegration and error correction models. Innovation accounting occupies Section 6. And Section 7 concludes.

## 2. Literature on The Export-Output Relationship in Bangladesh

In the Keynesian growth theory, the rate of economic growth is influenced by the rate of demand growth. Export growth represents a means of growing demand, and thereby raising economic growth. Thus, the positive impact of exports on output in the short run is not surprising as exports enter the aggregate income equation (Kravis 1970, Feder 1982). As the open economy output function and the growth equation state:

$(1)$    $Y = C\,(Y\text{-}T) + I\,(Y,\,i) + G + X\,(Y^*,E) - M\,(Y,E)$

$(2)$    $g_t = ln\,(Y_t) - ln\,(Y_{t\text{-}1})$

where $Y$ is output, $C$ is consumption, $T$ stands for taxes, $I$ is investment, and $G$ signifies government spending. $X$ stands for exports, $M$ for imports, $Y^*$ for foreign country's income, $i$ is the interest rate, and $E$ is the exchange rate defined as the price of one unit of domestic currency in terms of foreign currencies. The second equation shows how output growth is measured by the first order log difference of output for two consecutive years. Exports are a positive function of foreign income and the exchange rate, while imports are a positive function of domestic income and a negative function of the exchange rate (see Blanchard 2011:401). Apparently, a rise in exports or a fall in imports is beneficial for output growth. The relationship, nevertheless, may be complex. For example, a rise in imports may be needed to support more exports, and hence the net exports ($X$ minus $M$) may rise eventually, causing further output growth.

There are other theories justifying the export-led growth hypothesis which can broadly be arranged in four categories. First, export growth leads to income growth via the foreign trade multiplier. Second, foreign exchange from exports can be used to finance imported manufactured and capital goods and technology, which contribute to growth. Third, the export sector in a country is by nature competitive for its existence in the global arena. This competition leads to scale economies, technological progress, and eventually growth. Fourth, the export sector

creates positive externalities, such as more efficient management and production techniques, which lead to further growth.

In the long run, exports may affect growth through availing economies of scale, introducing incentives of improving the quality of the products, reducing inefficiencies, and finally, innovating new technology due to competition in the world market (Balassa 1978, Bhagwati and Srinivasan 1978, Tyler 1981, Rodrik 1988). The two-gap model argues that external resource inflows can remove foreign exchange constraints. If domestic production grows faster than domestic demand, the excess amount of output can be exported to the foreign countries, and thus foreign exchange can be earned (Sharma and Dhakal 1994). These external resources can be used to import essential raw materials and capital goods that would otherwise be expensive to produce domestically. In effect, export expansion may affect aggregate growth by lowering production costs and relaxing the crucial bottleneck in developing countries (Edwards 1993, Liu et al. 1997, Markusen et al. 1995). As Krugman and Obstfeld (2009:260) argue, a group of Asian economies achieved high rates of economic growth and did so via a process that involves rapid growth of exports rather than substitution of domestic production for imports. Studies by Michaely (1977), and Sachs and Warner (1995) report a positive association between export growth and output growth. Studies by Chow (1978) and Darrat (1987) also find significant causal effects of exports on output growth.

Since the main objective of this study is to examine export-led growth for Bangladesh, I present the most relevant studies in this respect. Dodaro (1993) uses the simple Granger causality procedure, and finds evidence of export-led growth in Bangladesh for the 1967-1986 period. The major part of this sample falls in the regime of the fixed exchange rate and trade control. Part of this sample falls in Bangladesh's pre-independence era. Thus, Dodaro's result, being plagued by sampling issues, has considerable distortions. Islam and Iftekharuzzaman (1996) run a study on the export-growth nexus of Bangladesh over the 1971-1990 period. In OLS estimation, they find no significant effect of export growth on GDP growth. The authors, however, included the growth rates of labor and capital productivity along with the spending growth of the government budget in the RHS of the regression. Most of the RHS variables in their estimation are arguably endogenous. Moreover, their sample could not capture the greater impact of trade liberalization, which took place more extensively after 1990 than before.

In a study over the 1962-1992 period, Begum and Shamsuddin (1998) find that export growth significantly increases economic growth through its positive impact on total factor productivity in Bangladesh. The first limitation of this study is that it includes the pre-independence sample of 1962-1970 when Bangladesh was not in existence. The second limitation is that the study ends in 1992, after which liberalization in the Bangladesh economy began more vigorously than before. Razzaque et al. (2003) work with a sample from 1980 to 2000, and find no evidence of a long-term relationship between exports and economic growth in the Bangladesh economy. While the estimated model turns out to be satisfactory, none of the indicators of trade liberalization achieve statistical significance in any of the regression results.

Using quarterly data from 1974 to 1999, Hossain and Karunaratne (2004) find the evidence of export-led growth for Bangladesh in both the long run and short run. The main objective of their study is to verify whether manufacturing exports have become a new engine of export-led growth in Bangladesh. The authors use the Lisman and Sandee (1964) method to disaggregate GDP data from annual to quarterly frequency. This method is quite dated, and there are numerous improved methods nowadays (Bloem 2002). The authors included investment to proxy for capital formation, but ignored imports in this respect. In a study over the 1972-2000 period, Love and Chandra (2005) find both long-run and short-term causality from income to exports in Bangladesh. Export-led growth for Bangladesh is not evident in their study.

Using quarterly data for a period from 1976 to 2003, Mamun and Nath (2005) find unidirectional causality from exports to growth in Bangladesh. Since the GDP data for Bangladesh are not available at quarterly frequency, the authors use the index of industrial production (IIP). While the study simply examines the export-IIP relation, its claim for proving export-led growth for Bangladesh seems overstated. Moreover, the work of Mamun and Nath arguably has omitted variable bias, since they do not include imports. Working with annual data for the 1973-2003 period, Dawson (2006) finds unidirectional causality from exports and imports to GDP. Exports cause GDP to grow whereas imports lower GDP. Orthogonal impulse responses are sensitive to the orderings of the VAR, and Dawson does not try alternative orderings (see Enders 2010:311). Bahmani-Oskooee and Oyolola (2007) work with 44 developing countries over the 1960-2002 period. They find evidence on export-led growth for Bangladesh in the long run. The short-run effect of export growth on GDP growth is highly insignificant. This work excludes imports.

Using annual data for the 1973-2008 period, Hossain et al. (2009) find long-run evidence on export-led growth for Bangladesh. They also find that exports significantly affect imports both in the long run and short run. This work has sample selection issue. A relatively liberalized regime, which began in 1979 in Bangladesh, is desirable while

examining the GDP export-import interaction. The cointegration result, which is the main finding of the study, is only based on the trace test of the Johansen technique. Rahman (2009) examines the contributions of exports, foreign direct investments, and remittances to GDP of South Asian countries including Bangladesh. Based on a sample from 1976 to 2006, Rahman works on an autoregressive distributed lag (ARDL) bounds test approach, and finds the evidence of cointegration among these variables in Bangladesh. He also finds short-run net effects of exports on GDP for the country. The error correction term in this work is very small (-0.0345) and highly insignificant (*p*-value 0.63), suggesting an unstable long-run equilibrium model. Finally, Rahman runs a VAR with these variables in levels to derive impulse responses. If the variables have any sort of cointegrating relationship, running them in a VAR instead of a VEC model is inappropriate (Maddala and Kim 1998:185). Enders (2010:397) cautions that the impulse responses at long forecast horizons are inconsistent estimates of the true responses if the VAR has I (1) variables.

In summary, the existing literature on Bangladesh's export-led growth has three major shortcomings: 1) methodological deficiencies 2) improper sample selection and 3) omitted variable bias. This study attempts to overcome these shortcomings, and reexamines the export-import-income relationship for Bangladesh with an extended dataset on the liberalized regime.

## 3. Trade Liberalization in Bangladesh and Sample Selection

After its independence in 1971, Bangladesh followed a highly restricted trade regime strategy. This was characterized by high tariffs and non-tariff barriers to trade and an overvalued exchange rate system that was supported by the import-substitution industrialization strategy of the Government (Raihan 2008). This policy was pursued with the objectives of improving the balance of payment position of the country and creating a protected domestic market for manufacturing industries (Bhuyan and Rashid 1993). As the World Bank (WB 1999) comments, Bangladesh started with an extremely restrictive set of trade barriers characterized by pervasive quantitative restrictions and prohibitively high import tariffs on many finished consumer goods. For example, the major administrative instruments employed in implementing the import control policy during the 1972-1980 period were the foreign exchange allocation system and import policy orders (IPOs). Under IPOs, it was specified whether items could be imported, were prohibited or required special authorization (Raihan 2008). As Bhuyan and Rashid (1993) argue, the system of IPOs was characterized by complexity, deficiency in administration, cumbersome foreign exchange budgeting procedures, poor interagency coordination, rigid allocation of licenses and time-consuming procedures.

Until 1975, the Bangladesh government pursued a public ownership strategy to attain a socialist economy (see Begum and Shamsuddin 1998, Dawson 2006). This goal, however, was abandoned in late 1975 in favor of a mixed economy. As time passed after the regime change in 1975, it became clear that the country was moving towards the market economy with export promotion and gradual import liberalization. The declaration of the Industrial Investment Schedule in 1976, the withdrawal of the private investment ceiling in 1978, and the promulgation of the Foreign Investment Act in 1980 are the significant steps of capitalist transition during the late 1970s. Bangladesh's Export Promotion Bureau (EPB), a national export promotion agency under the ministry of commerce, was reorganized by the promulgation of a presidential ordinance in 1977 as a semi autonomous body (EPB 2009).

Bangladesh maintained a fixed exchange rate until the late 1970s. In 1979, the Bangladesh Bank followed a semi-flexible exchange rate policy, revaluing the Taka (Bangladesh currency) on the basis of a trade-weighted basket of currencies, with fluctuation margins of 2.5 percent on either side (IE 1999). The exchange rate policy Bangladesh has taken in 1979 was mainly designed to promote exports, reduce extra pressure of imports and thereby improve the balance of trade. The Bangladeshi currency, Taka, went under significant devaluation in 1979, as an attempt to reflect the market value (see Rashid 2000). By highlighting the performance of the export sector in 1979, Haque (1980) mentions that export earnings amounted to Taka 9.17 billion, exceeding the target by Taka 173 million and last year's earnings by Taka 1.7 billion.

Although there was another regime change in 1982, the new government continued the economic reform and empowered the goal of the market economy with its new industrial policy (NIP). Bakht (1993:74) asserts that the NIP reflected a rapid acceleration of the measures that were initiated during the earlier regime. Islam (2007) argues that the most important move towards a privatization process in Bangladesh started with the announcement of the NIP of 1982. Mondal (2000) asserts that by promulgating this NIP, Bangladesh introduced fundamental changes to the industrial policy environment in order to promote private sector-led industrial growth. In the post 1982 period, the government pursued the policies of denationalization of the banking and industrial sectors, deregulation of the capital market, structural reform of the tax system, and trade liberalization.

Bangladesh's trade liberalization effort picked up its pace in the early 1990s as an important component of the country's structural reform program (WB 1999). In 1992, the Secondary Exchange Market System was abolished. One year later, the dealings of the Bangladesh Bank with domestic authorized banks were restricted to the U.S. Dollar and the currencies of member countries of the Asian Clearing Union. Authorized banks were free to set their own buying and selling rates for the U.S. Dollar and the rates for other currencies based on worldwide cross rates (IE 1999). The World Bank comments that initial steps were *ad hoc* and focused on the removal of quantitative restrictions, but in the early 1990s a more comprehensive trade policy reform program extended its reach to both tariffs and non-tariff barriers. Since the mid 1990s, however, movement toward a lower tariff rate slowed down due to concerns for budgetary revenues, the balance of payments, and possible adverse effects of trade liberalization on import-competing industries (WB 1999). In 2003, Bangladesh introduced a kind of 'clean floating' exchange rate policy by making it fully convertible on the current account, although capital account controls still remain (Aziz 2008).

As discussed, Bangladesh entered a new era of trade liberalization by abandoning the fixed exchange rate and launching a managed float in 1979. Since the exchange rate is the only common factor that enters both the export and import functions, the flexibility of the exchange rate turns out to be crucial to trade liberalization. In a World Bank study, Shatz and Tarr (2000) show that a fixed or overvalued exchange rate is often the root cause of protection, preventing the country from returning to more liberal trade policies. A large reason for rapid Asian liberalization and growth is exchange rate management to keep the nominal rates close to market-clearing levels (see also Roemer 1994). Aziz (2008) shows that the exchange rate has a significant influence on Bangladesh's trade balance in both the short and the long run. Choudhury (2008) defines the period from 1979 to 1990 as the initiation of trade reform when liberalization took place in a slow but moderate pace. A seminal study by the World Bank (WB 1999) asserts that a managed flexible exchange rate system has significantly contributed to trade liberalization in Bangladesh. Hence, the year of 1979 can be treated as a landmark in the history of trade liberalization in Bangladesh.

The economic rationale for trade liberalization since 1979 has been reinforced by a number of significant political events in Bangladesh. The military regime, which came to power after the regime change in 1975 and was committed to liberalize the economy, managed its political legitimacy for the first time through a landslide victory in the parliamentary election in 1979. By portraying 1979 as a significant political year, Haque (1980) points out that the parliamentary election of 1979 was long-awaited, because it was the second since Bangladesh's independence. Haque also argues that being inspired by its election to the Security Council in 1979, Bangladesh pursued a vigorous foreign policy. Widner assers that the constitutional amendment in 1979 legalized political parties, lifted martial law, and restored fundamental civil and political rights. The government accelerated its pro-market liberalization programs, which were on the agenda since 1976, more authoritatively than before. Based on these observations and findings, 1979 is made the starting point of my sample.

Hossain and Alauddin (2005) assert the positive role of trade liberalization on growth. As trade liberalization allows the export sector to grow along the line of comparative advantages, one may expect a more pronounced contribution of exports to economic growth in a regime of freer trade (Begum and Shamsuddin 1998). Hence, we expect to see the functioning of the export-led growth hypothesis for Bangladesh in its relatively liberalized regime that begins in 1979. While it is unclear whether GDP affects exports, it can be hypothesized that exports affect GDP in a positive direction.

## 4. Data and Methodology

The variables of GDP, exports, and imports are expressed at the 2000 constant U.S. dollar prices, and have been collected from the World Development Indicators (WB 2010). These series commence in 1979 and end in 2009. Based on the figures and estimates by Bangladesh's Ministry of Finance (MoF 2010a, 2010b), I add one observation for each series for 2010. Although discarding the observations of 2010 does not make any difference in the basic findings of this work, I prefer to keep these data points to increase the degrees of freedom in estimations. Thus, my sample begins in 1979 and ends in 2010 for all three variables.

Nelson and Plosser (1982) find that most macroeconomic variables are characterized by unit-root processes. Three macroeconomic variables, as we see in Panel A of Figure 1, are most likely to have unit roots. The variables must be integrated of order one, i.e. I (1), before they can be tested for cointegration. The first differences of nonstationary I (1) variables are I (0) and thus are stationary series, which are needed for impulse responses. As Maddala and Kim (1998:185) assert, if the variables are all I (1) but no cointegration relation exists, then application of an unrestricted VAR in first differences is appropriate. The Augmented Dickey-Fuller (ADF) test is widely used in this regard (Dickey and Fuller 1979, 1981). Phillips and Perron (1988) proposed a modification of the Dickey-Fuller (DF) test

and have developed a comprehensive theory of unit roots. The Phillips-Perron (PP) test has introduced a *t*-statistic on the unit-root coefficient in a DF regression, corrected for autocorrelation and heteroskedasticity. Monte Carlo simulations show that the power of the various DF tests can be very low (Enders 2010:234). Maddala and Kim (1998:107) comment that the DF test does not have serious size distortions, but it is less powerful than the PP test. Choi and Chung (1995) assert that for low frequency data like mine the PP test appears to be more powerful than the ADF test. Accordingly, I adopt the PP methodology to test unit roots in the variables. If the variables are found to be I (1), testing them for cointegration will be followed as per the Johansen approach, due to Johansen (1988), and Johansen and Juselius (1990). In this three-variable case, the number of the cointegrating relation must be less than three if the series are really cointegrated. If both the trace and maximum eigenvalue tests recommend the presence of one cointegrating relationship, the long-term relationship exists in the system. Then estimating them in a VEC model will be required.

There are five options to make an assumption before carrying out the Johansen test. Option 1 assumes no deterministic trend in data, and no intercept or trend in the cointegrating equation or the test VAR. Option 2 is the same as Option 1 except for intercept in the cointegrating equation. Options 3 and 4 allow for linear deterministic trend in data, and assume intercept in both the cointegrating equation and the test VAR. Option 4 just adds trend in the cointegrating equation. Option 5, being implausible in the present case for allowing quadratic deterministic trend in data, is not considered. Based on the data, as shown in Figure 1, either of Options 3 or 4 will be appropriate in this study.

The results of VAR estimation are sensitive to the lag length and the ordering of the variables. For determining the lag length, the most common procedure is to estimate an unrestricted VAR with the variables, and to use the Akaike information criterion (AIC) or Schwartz Bayesian criterion (SBC) to decide on the lag length (Enders 2010:402). Given my sample size, I decide to use the SBC to determine the lag length of the VAR, because the SBC chooses the most parsimonious model (Enders 2010:120). In a simulation study, Lutkepohl (1985) finds that for low order VAR processes, the SBC does quite well in terms of choosing the correct VAR order and providing good forecasting models. Although the SBC will reign supreme in lag selection, one lag will be chosen in the cases where the SBC signals zero lag. At least one lag is required to test the stability of the VAR system, which implies that all the roots of characteristic polynomial lie inside the unit circle (see Agung 2009:325). The issue with the ordering of the variables will be inapplicable since impulse responses and variance decompositions will be generalized. Pesaran and Shin (1998) first proposed the generalized impulse response and variance decomposition analyses for unrestricted VAR models. Unlike the traditional impulse response analysis, their approach does not require orthogonalization of shocks and is invariant to the ordering of variables in the VAR.

## 5. Cointegration and Vector Error Correction Estimations

Table 1 presents the results of the Phillips-Perron unit root tests with Bangladesh's GDP, exports and output. All the variables exhibit unit roots, whereas they become stationary in first differences. Thus, all of them being I (1) are ready for the cointegration test. Based on the SBC and the minimum lag requirement for stability, one lag is taken. To make the test more general, I check for both Options 3 and 4. Both the trace and maximum eigenvalue tests exhibit no evidence of cointegration under Option 4. Option 3, however, delivers conflicting results: the maximum eigenvalue test complies with no cointegration, whereas the trace test signals one cointegrating relation among the three variables. Cheung and Lai (1993) recommend following the trace statistic, but Johansen and Juselius (1990) suggest that the maximum eigenvalue test gives better results. Enders (2010:392) asserts that when the results conflict, the maximum eigenvalue test is usually preferred for its ability to pin down the number of cointegrating vectors.

Although Enders sounds more convincing than others, there is room for a synthesis by examining cointegration in the VEC model as well as innovation accounting in the VAR. Since we do not know the actual data generating process (DGP), a synthesis of both the long-run and short-run estimates will provide us with a more comprehensive view of the GDP-export-import interaction in Bangladesh. Herein lies the difference between my approach and all the previous ones. First, I estimate the variables in a VEC framework primarily to check for long-run level relations, and next, I estimate the stationary series in a VAR to see the short run interactions of the variables.

Table 3 presents VEC estimates with Bangladesh's GDP, exports, and imports. The cointegrating equation, as placed at the bottom of the table, shows a long-run level relationship between GDP and exports. The relationship between imports and GDP is not significant at the 5 percent level. The error correction term on the regression with first difference GDP is significant, suggesting the adjustment nature of output if the long-run equilibrium relationship is ever shocked. Pesaran and Pesaran (2009:307) assert that the sign of the error correction term must be opposite to that of the coefficient on the same variable in the cointegrating equation. The long-run equilibrium

equation has been normalized on output, and hence possesses a positive sign. The corresponding error correction term on first differenced output has a negative sign as expected. Exports appear with a negative sign in the cointegrating equation. The corresponding sign of the first differenced exports is also negative but insignificant, suggesting exports are weakly exogenous in the export-output relationship. Moreover, long-run export led growth is vindicated, because only GDP performs error correction in this system, but exports do not. Imports are insignificant both in the long-run cointegrating equation and short-run error correction dynamics. None of the coefficients on all three first-differenced variables are significant, indicating that there is no short-run interaction between any of the variables. Although long-run export-led growth without short-run interaction is not unusual to accept, the error correction term on first-differenced GDP appears to be very weak. This implies that only 1.34 percent of the last year's disequilibrium is corrected this year, requiring almost 75 years to bring the system into the steady state once it is disturbed. Maddala and Kim (1998:236) caution that long-run relations imply cointegration, but cointegration may not necessarily imply long-run relations. Since imports and exports do not adjust significantly in the present case, only output is responsible for correction, and this unusually lengthy period of adjustment seems implausible. Hence, looking into short-run dynamics through a stationary VAR becomes imperative.

## 6. VAR Models, Impulse Responses, and Variance Decompositions

As we saw in Table 1, the first differences of all three variables, which are their growth rates, are I (0), and hence stationary. Now we can examine all types of short-run interaction and relation among these growth rates. Figure 2 shows scatter plots and regression lines with the growth rates of GDP, exports, and imports. The relationship between export and import growth looks highly positive, suggesting a strong interdependence between these variables particularly for a country like Bangladesh. Readymade garments (RMG) occupy the lion-share in Bangladesh's exports. The RMG sector, in turn, is heavily dependent on the import of raw materials. Moreover, the import of capital goods promotes exports of manufactured goods. Thus, the symbiotic relationship between exports and imports is expectedly positive. The contemporaneous relationship between GDP and import growth appears to be insignificant. While output growth can boost import growth, more import growth can reduce output growth, because imports appear with a negative sign in the income equation. Thus the import-income relationship may appear unclear or insignificant on the net effect. The contemporaneous relation between export and GDP growth appears to be strongly positive as shown in Figure 2.

Table 4 presents the correlation coefficients with the growth rates of three variables. The correlation coefficient with export and import growth is almost 50 percent, and is significant at the 1 percent level. This coefficient between GDP and import growth is negative but insignificant. The correlation coefficient between export and GDP growth is 0.39, and is significant at the 5 percent level. We are not sure whether this significant correlation is an outcome of either export-led growth or growth-led export, or a combination of both. Hence, running these variables in the VAR (1) to unveil block exogeneity and innovation accounting becomes useful to the objective of this study. The VAR is used as a vehicle to derive the results on block exogeneity and innovation accounting. The lower panel of Table 4 presents Chi-square statistics of block exogeneity tests. The only statistic, which is significant at the 10 percent level, tells us that lagged export growth causes GDP growth.

Generalized impulse responses, as presented in figure 3, substantiate the export-income and export-import relations for Bangladesh. The response GDP growth to export growth is positive and significant, lending further credence to export-led growth for Bangladesh. GDP growth, in turn, can lead to export growth. Although the question of how it happens remains an area of further research, it appears that income growth can cause export growth by raising domestic productivity. The positive feedback between export and import growth, and an insignificant relation between GDP and import growth are simultaneously evident in Figure 2 and Table 4. These results reappear in Figure 3 and remain consistent. Generalized forecast error variance decompositions of Bangladesh's GDP export and import growth are presented in Figure 4. Forming a 95 percent confidence band for all variance decomposition lines is possible by adopting the bootstrap method. None of the lower limit lines become exactly zero by design. Hence, I have skipped the inclusion of these bands to avoid clutter in the graphs. In a 10 year horizon, the variance decomposition of GDP growth due to export growth remain much higher than that due to import growth, suggesting that exports play a more robust role in Bangladesh's output than imports do. The variance decompositions of GDP growth due to import growth become practically insignificant by lying near the zero line over the entire horizon. We also see that output plays a stronger role in the variance decompositions of export growth than it does for import growth.

The lower panel of Figure of 4 again shows considerable interdependence between Bangladesh's exports and imports. Each of them plays a significant role in forecast error variance of the other variable. The variance decompositions of import growth due to export growth are higher than that of export growth due to import growth.

The results of Figure 4 are consistent with that of Figures 2 and 3, and Table 4. Thus, the hypothesis of export-led growth is strongly evident for Bangladesh in the short run.

## 7. Conclusion

The hypothesis of export-led growth has heightened attention for the emerging Asian economies in particular. Bangladesh, being a spectacularly growing economy of South Asia, has an export sector that has thrived in the recent decades ever since the country embarked on trade liberalization. A comprehensive approach with appropriate sample to examine export-led growth for Bangladesh in both the long run and the short run has never been tried before. This study fills that lacuna by examining the export-import-income relationship over a relatively liberalized regime of trade policy, which most studies in the past ignored in their sample selection.

In a study over the 1979-2010 period, this work overcomes these sample-related and methodological shortcomings of the previous papers, and finds strong evidence on export-led growth for Bangladesh, particularly for the short run. The long-run evidence, however, is not as robust as the short-run evidence. While imports are found to have no significant relation with income, they have a bidirectional positive relation with exports in the short run. Thus, it concludes that the economic growth of Bangladesh significantly benefited from its trade-liberalization and export-promotion policies that commenced in the late 1970s and continued to upgrade in the years since. These findings have policy implications not only for Bangladesh, but also for other developing nations that aspire to grow fast but confront dilemmas with trade liberalization and export promotion.

This paper raises some additional questions: 1) Why is not the long-run export-income relationship as robust as the short-run one? 2) Why is not the feedback between GDP and import significant? 3) How do we estimate the import demand function for Bangladesh? These questions are intriguing, and thus are left for future research.

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Table 1. Phiilips-Perron unit root tests with Bangladesh's output, exports, and imports: 1979-2010

| Variables: | In levels | | In first difference | | |
| --- | --- | --- | --- | --- | --- |
| | Model A | Model B | Model A | Model B | Integration |
| Output | 7.39 (1.00) | - 1.17 (0.90) | - 3.91 (0.01) | - 7.29 (0.00) | I(1) |
| Exports | 0.60 (0.99) | - 2.20 (0.47) | - 6.65 (0.00) | - 6.80 (0.00) | I(1) |
| Imports | - 0.23 (0.92) | - 2.43 (0.36) | - 6.62 (0.00) | - 7.65 (0.00) | I(1) |

Note: Model A includes intercept, and Model B includes both intercept and trend. The null hypothesis states that the variable has a unit root. p-values are shown in the parentheses following each adjusted t-statistic. The critical values and details of the test are presented in Phillips and Perron (1988).   Source: World Bank (WB 2010), and Bangladesh Ministry of Finance (MoF 2010a and 2010b).

Table 2. Johansen cointegration Tests with Bangladesh's output, exports, and imports: 1979-2010

| | | | Option 3 | | | Option 4 | | |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| | | | $\lambda$ Stat | CV | CE | $\lambda$ Stat | CV | CE |
| $\lambda_{trace}$ tests: | | | | | | | | |
| | $H_0$: r = 0 | $H_A$: r > 0 | 30.19 | 29.80 | 1 | 37.43 | 42.92 | 0 |
| | $H_0$: r ≤ 1 | $H_A$: r > 1 | 12.00 | 15.49 | 0 | 19.08 | 25.87 | 0 |
| $\lambda_{max}$ tests: | | | | | | | | |
| | $H_0$: r = 0 | $H_A$: r = 1 | 18.19 | 21.13 | 0 | 18.35 | 25.82 | 0 |
| | $H_0$: r = 1 | $H_A$: r = 2 | 11.36 | 14.26 | 0 | 13.55 | 19.39 | 0 |

Note: The λtrace and λmax are calculated as per Johansen (1988) and Johansen and Juselius (1990). p-values are calculated as per MacKinnon et al. (1999). CV signifies critical values calculated for the 5 percent significance level. CE stands for cointegrating equation. r stands for the rank of the matrix, which denotes the number of the CE between the variables. H0 and HA denote the null and alternative hypotheses, respectively. Option 3 includes an intercept in the CE and the test VAR, whereas Option 4 includes an intercept and a trend in the CE without any trend in the VAR. The λTrace and λMax test statistics under both models are computed by allowing for linear deterministic trends in data. Source: Same as in Table 1.

Table 3. Vector error correction estimates with Bangladesh's output, exports, and imports: 1979-2010

| LHS variables | output (t) | | exports (t) | | imports (t) | |
| --- | --- | --- | --- | --- | --- | --- |
| Regressors: | | | | | | |
| Constant | **0.0537** | (0.0090) | **0.2550** | (0.0899) | 0.2418 | (0.1322) |
| output (t-1) | -0.1210 | (0.2102) | -3.3210 | (2.0943) | -4.7042 | (3.0801) |
| exports (t-1) | -0.0235 | (0.0241) | -0.1917 | (0.2397) | 0.5411 | (0.3526) |
| imports (t-1) | 0.0084 | (0.0146) | 0.0740 | (0.1455) | -0.2882 | (0.2139) |
| ect (t-1) | **-0.0134** | (0.0032) | -0.0573 | (0.0320) | -0.0769 | (0.0470) |
| Adjusted $R^2$ | 0.54 | | 0.06 | | 0.02 | |
| Cointegrating equation: ect (t) = output (t-1) **- 2.29\*exports (t-1)** + 1.39\*imports (t-1) - 5.06 | | | | | | |

Note: The error correction estimation follows Model A as explained in Table 2. Coefficients are bold when significant at the 5 percent level. All values in parentheses against each coefficient are standard errors. " Δ " stands for first-order difference operator. "ect" stands for error correction term. Source: Same as in Table 1.

Table 4. Correlation and block exogeneity tests with Bangladesh's output, exports, and imports: 1979-2010
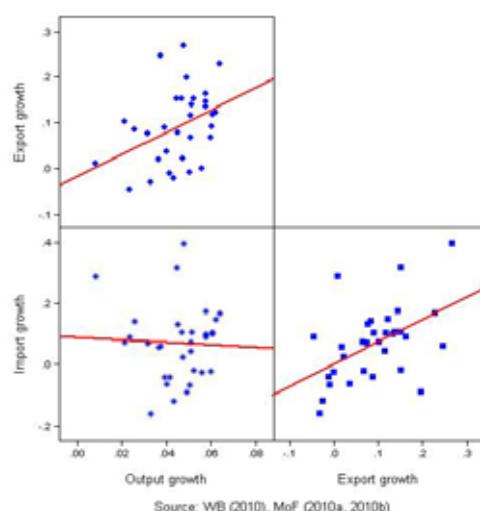
| Correlation tests: | statistics |
|---|---|
| Corr [output growth (t), export growth (t)] | 0.39** |
| Corr [output growth (t), import growth (t)] | -0.04 |
| Corr [export growth (t); import growth (t)] | 0.49*** |
| Block exogeneity tests: Null hypotheses: | statistics |
| Lagged export growth does not cause output growth | 2.786* |
| Lagged output growth does not cause export growth | 0.053 |
| Lagged import growth does not cause output growth | 0.882 |
| Lagged output growth does not cause import growth | 0.171 |
| Lagged import growth does not cause export growth | 0.684 |
| Lagged export growth does not cause import growth | 1.794 |

Note: "Lagged" means lag of 1, as determined in the VAR model. r statistics provide correlation coefficients. c2 stands for Chi-squared. *, **, *** indicate the significance of the statistics at the 10%, 5%, and 1% levels, respectively. Source: Same as in Table 1.
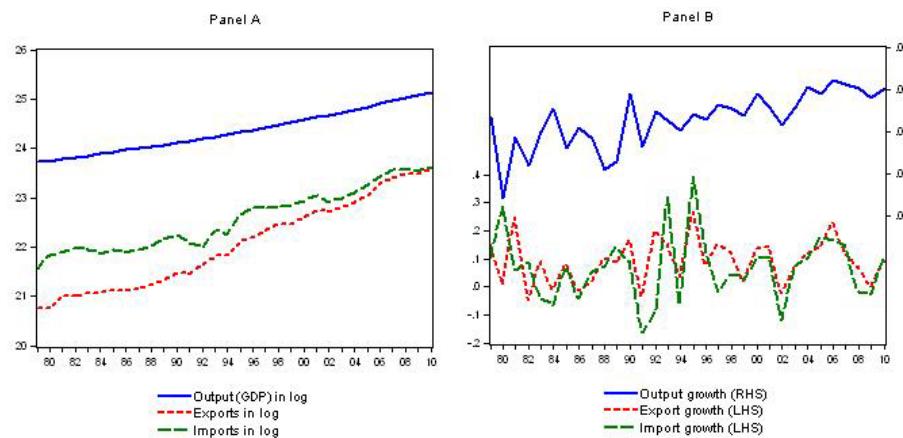


Figure 1. Bangladesh's output, exports, and imports in levels (Panel A), and in differences (Panel B).



Figure 2. Scatter plots with the growth rates of output, exports, and imports in Bangladesh.
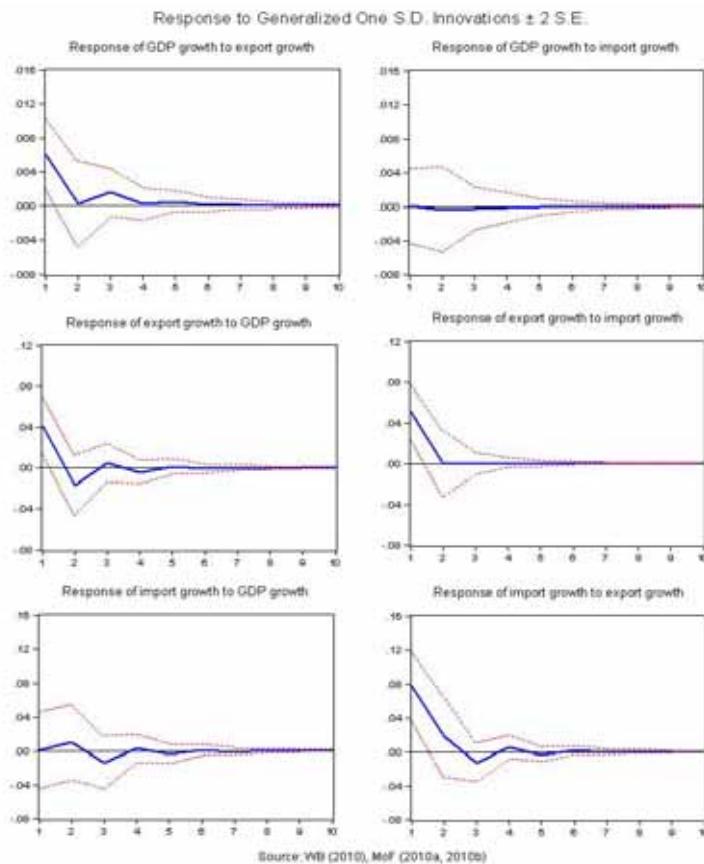
Figure 3. Generalized impulse responses of the growth rates of output, exports, and imports in Bangladesh.
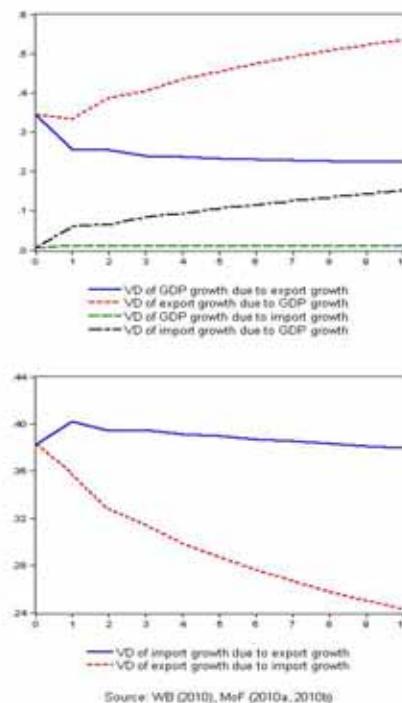


Figure 4. Generalized forecast error variance decompositions (VD) of various growth rates in Bangladesh.