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Openness and growth in emerging Asian economies: Evidence from GMM estimations of a dynamic panel

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Abstract

With the progress of globalization, the openness-output nexus has drawn more attention than ever before. Results in this aspect, however, are inconclusive. Based on the average growth rate for the last two decades, we select 12 top performed Asian countries: Bangladesh, China, India, Indonesia, Korea Republic, Malaysia, Nepal, Pakistan, Philippines, Singapore, Sri Lanka, and Thailand. Working with these 12 emerging Asian economies over the 1971 to 2009 period, we find a positive and significant impact of openness on economic growth. The system GMM technique is used to overcome the shortcomings of endogeneity as found in most previous studies. While growth in labor force has insignificant effect on output growth, growth in capital stock exhibits a positive and significant impact on output growth. These findings have policy implications for other emerging economies of the world.

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1. INTRODUCTION

Since the early 1980s, many developing countries from South-East and South Asia have experienced high rates of economic growth. Concomitant with this change, these countries have also welcomed widespread liberalization and adoption of market-based policies. Because of the successes of emerging outward-looking countries, and the failures of inward-looking countries, it was widely accepted that trade openness favored economic growth. The seminal paper of Rodriguez and Rodrik (2001), however, disagreed with the presumption of the positive growth effect of openness, and reignited the debate of whether openness has any statistically significant impact on economic growth.

A sizeable body of empirical research has been conducted, in recent years, to establish a relationship between economic growth and trade openness. Despite the overabundance of literature, "…the nature of the relationship between trade policy and economic growth remains very much an open question" (Rodriguez and Rodrik, 2001: 266). Several factors, including the definition of openness and misspecified models, could be held responsible for results which are often elusive.

Earlier studies used exports (or exports as a percentage of GDP) as a measure of trade openness (Michaely, 1977; Balassa, 1978; Tyler, 1981; Kavoussi, 1984). One problem of using exports as a measure of trade openness is that exports and GDP are assumed to have a positive correlation. Therefore, it is almost inevitable that estimation using exports as a proxy of openness will suffer from a problem of autocorrelation (Bahmani-Oskooee and Niroomand, 1999). More recent studies have attempted to overcome this problem by using either total trade volume or trade to GDP ratio as a measure of openness (Sinha and Sinha, 1996; Liu *et al*. 1997; Bahmani-Oskooee and Niroomand, 1999; Sinha and Sinha, 1999; Yanikkaya, 2003; Wang *et al*. 2004; Tsen, 2006). The use of these measures, however, fails to address the problem of endogeneity, since both the numerator and denominator are linked to GDP growth (Lee *et al*. 2004). One possible way to correct this problem is to use lagged instrument variables which are uncorrelated with other factors persuading changes in growth (Dollar and Kray, 2003). While instrumenting the change in openness solves the problem of endogeneity, existing studies do not fully control for simultaneity bias and the use of lagged dependent variables in growth regression (Lee *et al*. 2004).

The aim of this paper is to investigate whether there is any link between openness and the growth of real GDP in emerging Asian economies. This is done in three steps. First, we construct a panel dataset of 12 emerging countries from Asia over the period of 1971 to 2009. The countries in our dataset are: Bangladesh, China, India, Indonesia, Korea Republic, Malaysia, Nepal, Pakistan, Philippines, Singapore, Sri Lanka and Thailand. The selection of these countries is based on the average growth rate. Table I shows that all these countries have growth rates of at least 4 percent in the last two decades of 1989 to 2009. Second, we conduct the well known Fisher panel unit root tests. Finally, we use the generalized method of moments (GMM) panel estimator proposed by Blundell and Bond (1998) to extract consistent and efficient estimates of the impact of openness on economic growth. This particular GMM procedure allows for the inclusion of the lagged dependent variable as a regressor, and controls for endogeneity of all the explanatory variables.

TABLE I

Average Growth Rate of Countries in the Dataset

Countries:	Average Growth Rate (1989-2009)
Bangladesh	4.9%
China	9.6%
India	6.5%
Indonesia	5.3%
Korea, Republic	5.0%
Malaysia	6.6%
Nepal	5.0%
Pakistan	4.0%
Philippines	4.0%
Singapore	6.0%
Sri Lanka	4.6%
Thailand	4.2%

Source: World Development Indicators (WB 2011)

The rest of the paper is organized as follows. Section 2 presents the literature review. Section 3 discusses the methodology. Results and analyses are presented in Section 4. Section 5 concludes the paper.

2. LITERATURE REVIEW

The relationship between openness and economic growth has been of great interest to researchers for the last few decades. However, whether economic openness has any effect on economic growth remains an unresolved question in the empirical literature (Rodriguez and Rodrik, 2001; Vamvakidis, 2002). One set of studies that found either a positive relationship between openness and economic growth or between trade distortions and a slow rate of growth includes Sachs and Warner (1995), Sinha and Sinha (1996), Edwards (1998), Proudman and Redding (1998), Vamvakidis (1998), Bahmani-Oskooee and Niroomand (1999), Frankel and Romer (1999), Vamvakidis (1999), Yanikkaya (2003), Wang *et al*. (2004), and Tsen (2006). Harrison (1996) used seven different measures of openness to examine the impact of openness on economic growth. These measures include an annual index of trade liberalization based on exchange rate and commercial policies for 1960-1984, trade liberalization based on tariff and non-tariff barriers for 1978-1988, black market premium, total trade volume to GDP ratio, price movements towards international prices, price distortion index, and finally an index measuring bias against agriculture from industrial sector production. Six of these seven measures were found to be statistically significant either in level or differences. Additionally, Harrison found that greater openness was associated with positive economic growth.

As opposed to this optimistic view of the openness-growth nexus, the other set of studies questioned the robustness of this positive result. In particular, Rodriguez and Rodrik (2001) argued that the positive results found by earlier studies were not robust mainly due to two reasons. First, there were shortcomings in the measure of openness. Second, econometric models were misspecified. No unique conclusion can be drawn from studies which focus solely on Asian economies. Given the unavailability of time-series data on different openness indices for many Asian countries; researchers often used the simplest measure of trade orientation based on actual trade flows, such as imports plus exports as a share of GDP. Sinha and Sinha (1999), for example, used this measure and found a positive relationship between the growth rates of trade and GDP for 94 countries over a 30-year period. Liu *et al*. (1997) used a similar measure and found that openness was positively related to Chinese economic performance during the 1983 to 1995 period. In a time-series study during the 1961-2002 period, Sarkar (2008) did not find any significant relationship between openness, measured as trade to GDP ratio, and economic growth for most of the South Asian countries. Chandran and Munusamy (2009) calculated trade openness as a ratio of manufacturing imports plus exports to manufacturing output. Using annual data from 1970 to 2003, their results from the cointegration approach suggested a positive long run relationship between openness and growth in Malaysia.

Using trade volume as a share of GDP, or manufacturing trade volume as a share of manufacturing output, as a proxy of openness suffers from the problem of endogeneity, because both the numerator and denominator may move in the same direction. Recent studies attempted to address this problem by using total trade as a more accurate measure of openness. The time series analysis of Sinha and Sinha (2002) used total trade as a proxy of openness and examined the openness-growth relationship for 15 Asian countries. The conclusions from this study are not immediately clear. The coefficient of the growth of openness was found to be significant only in 8 of the 15 countries. From a methodological perspective, one possible reason for such disappointing results may be due to not controlling for simultaneity bias.

Essentially, this problem can be solved in a panel estimation of the method of moments. Particularly, the system GMM technique allows us to control for simultaneity bias. Using valid instruments will also take care of the problem of endogeneity for all the explanatory variables. Moreover, the so-called memory effect of economic growth can also be captured by incorporating lagged growth in our model. Therefore, this technique is expected to generate consistent and efficient estimates which are robust. To our knowledge, this investigation, using a recently developed panel estimation approach for emerging countries in Asia, is the first of its kind.

3. METHODOLOGY

3.1 Data and Estimation Issues

Our empirical model relies heavily on the neoclassical Solow growth model, which suggests that economic growth (g_y) is determined by investment and growth in the labor force. Following Balassa (1978) and Sinha and Sinha (1996), we calculate GDP by adding imports and subtracting exports. Since some part of GDP growth is attributable to trade growth, such recalculation of GDP takes care of the problem of simultaneity.

$$g_y = f\left(g_{y_{-1}}, inv, g_L, g_O\right) \tag{1}$$

Time series variables are often persistent. This is particularly true for the output variable (Bond *et al*. 2001). Our specification includes lagged growth rate $(g_{y_{-1}})$ as a regressor to control for persistence in growth (Alesina *et al*. 1992). Investment (inv) is measured as growth of gross capital formation. Time series data on labor force is not readily available for most of the developing countries. Thus, the rate of growth in the economically-active population, defined as the number of people who belong to the age group from 15 years to 64 years, is used as a proxy of the labor force (g_L). Finally, the basic Solow model is modified by adding the growth of openness (g_O) to accommodate the potential effect of trade openness on GDP growth. The rate of growth of total trade volume is used to measure the growth of trade openness. This approach to calculate trade openness was also used by Liu *et al*. (1997), Sinha and Sinha (1999; 2002), Din *et al*. (2003) and Van Hoa (2003).

The model specified above is estimated using panel data covering 12 Asian countries (See Table I for the list of countries) for the period of 1971 to 2009. Since Bangladesh came to independence in 1971 and West Pakistan became Pakistan in the same year, our exercise begins in 1971 and ends in 2009. The data is collected from the World Development Indicators, published by the World Bank (2011).

The behavioral equation is a dynamic specification as it contains the lagged dependent variable as an explanatory variable. Therefore, any estimation using least squares procedures will produce inconsistent estimates of the relevant coefficients (Greene, 2003: 221). An instrumental variable procedure, however, is an information efficient means of obtaining consistent coefficient estimates. In this regard, we use the GMM technique to estimate the dynamic behavioral equation. The dynamic panel approach proves advantageous to the OLS approach in a number of ways. First, the pooled cross-section and time series data allow us to estimate the growth-openness relationship over a long period of time for a range of countries. Second, any country-specific effect can be controlled by using an appropriate GMM procedure. And finally, our panel estimation procedure can control for any potential endogeneity that may emerge from explanatory variables.

Because we are dealing with time series variables over a relatively long period (i.e. 39 years), nonstationarity of variables is a real possibility. A strict GMM approach will be inappropriate if the dependent variable is found to be nonstationary for all, or a large majority of, panels. In this situation, a panel cointegration method will be most appropriate. To determine the level of stationarity, we employ the Fisher test for nonstationarity of all panels for all variables. The Fisher test combines the p-values from N independent unit root tests, as developed by Maddala and Wu (1999). The null hypothesis of this test is the nonstationarity of all series, while the alternative hypothesis is the stationarity of at least one series in the panel. Unit root results are presented in Table II.

TABLE II

Fisher-type Stationarity Test for Relevant Variables

Variables:	Test statistics
Growth of GDP	291.66***
Growth in Capital Stock	383.24***
Growth in Labor Force	122.26***
Growth in Openness	270.45***

Note: 1) Null Hypothesis: Full panel contains unit roots. 2) *** indicates significance at the 1% level

Our results suggest that the null hypothesis of unit root for all variables was strongly rejected at the 1 percent level. Given these results, an approach that does not presume nonstationarity, as described above, remains valid.

3.2 The System GMM

To estimate the relationship between economic growth and openness, we use the system GMM estimator proposed by Blundell and Bond (1998). System GMM is a preferred approach since this approach has better finite sample properties when the instruments are weak, which occurs mainly when the GDP series is persistent. Moreover, it utilizes both lagged and differenced versions of the regressors as instruments in obtaining coefficient estimates. Hoeffler (2002) provides a detailed explanation to show why system-GMM is a preferred approach.

Consider the following panel model with unobserved country-specific effects:

$$y_{i,t} - y_{i,t-1} = \beta_0 + \beta_1 y_{i,t-1} + \beta_2 X_{i,t} + \varsigma_i + \tau_{i,t} \qquad (2)$$

For $i = 1,2,...,N$ and $t = 2,...,T$. ς_i is the component for the time invariant country-specific effect and $\tau_{i,t}$ is the time variant component, where $\varepsilon_{i,t} = \varsigma_i + \tau_{i,t}$ has the standard error component structure, $E[\varsigma_i] = 0$, $E[\tau_{i,t}] = 0$ and $E[\varsigma_i \tau_{i,t}] = 0$ for $i = 1,2,...,N$ and $t = 2,...,T$. $y_{i,t}$ and $y_{i,t-1}$ are the log level of income at the current year and previous year respectively, and $X_{i,t}$ is measured at the beginning of each period. Since the growth rate in equation (2) is the logarithmic difference in GDP, further decomposition of equation (2) gives us the following:

$$y_{i,t} = \beta_0 + (\beta_1 + 1) y_{i,t-1} + \beta_2 X_{i,t} + \varsigma_i + \tau_{i,t}$$

$$\Rightarrow y_{i,t} = \beta_0 + \beta_1^* y_{i,t-1} + \beta_2 X_{i,t} + \varsigma_i + \tau_{i,t} \qquad (3)$$

β_1^* in equation (3) represents $(\beta_1 + 1)$. The time invariant country-specific effect can be eliminated by taking the first difference of equation (3).

$$\Delta y_{i,t} = \beta_1^* \Delta y_{i,t-1} + \beta_2 \Delta X_{i,t} + \Delta \tau_{i,t} \qquad (4)$$

While this transformation solves the problem of heterogeneity (since $\varsigma_{i,t} - \varsigma_{i,t-1} = 0$), it introduces the problem of endogeneity because the new error term $(\tau_{i,t} - \tau_{i,t-1})$ is correlated with the lagged variable, $(y_{i,t-1} - y_{i,t-2})$. Therefore, estimating equation (4) by simple OLS produces biased estimates of β_1. The use of instruments is necessary to correct this problem. The GMM dynamic panel estimator uses the following moment conditions under two assumptions: i) the error term is not serially correlated and ii) the explanatory variables are not correlated with future realizations of the error term (Carkovic and Levine, 2005).

$$E[y_{i,t-j}.(\tau_{i,t} - \tau_{i,t-1})] = 0 \ \ for \ \ j \geq 2,...,(T-1); t = 3,...,T \qquad (5)$$

$$E[X_{i,t-j}.(\tau_{i,t} - \tau_{i,t-1})] = 0 \ \ for \ \ j \geq 2,...,(T-1); t = 3,...,T \qquad (6)$$

The first difference estimator suffers from the following problem: the instruments available for first-differenced equations are weak when the explanatory variables are persistent over time. Such weak instruments can bias the coefficients when the sample size is small. Blundell and Bond (1998) proposed a new estimator that has superior finite sample properties. This new estimator combines the regression in differences with the regression in levels in a system of equations. Under the following additional assumption, this new estimator has been shown to have superior finite sample properties in an autoregressive model with panel data:

$$E[y_{i,t+p}.\tau_i] - E[y_{i,t+q}.\tau_{i,t}] = 0 \ \text{ and } \ E[X_{i,t+p}.\tau_i] - E[X_{i,t+q}.\tau_{i,t}] = 0 \ for\ all\ p\ and\ q \qquad (7)$$

Considering the second part of the system, which includes the regression in levels, the additional moment conditions are:

$$E[(y_{i,t-1} - y_{i,t-2}).(\varsigma_i + \tau_{i,t})] = 0 \qquad (8)$$

$$E[(X_{i,t-1} - X_{i,t-2}).(\varsigma_i + \tau_{i,t})] = 0 \qquad (9)$$

Hence, our approach uses the moment conditions presented in equations (5), (6), (8) and (9) and employs a GMM procedure that generates consistent and efficient parameter estimates.

4. RESULTS AND ANALYSIS

The results from estimating the growth equation specified in the earlier section, are reported in Table III. Our estimation meets the Arellano-Bond criteria for valid specification. This evidence of AR(1) is acceptable. Both the Sergen test and the Hansen test of overriding restrictions and the difference-in-Hansen tests of exogeneity of instruments do not reject the hypothesis that GMM instruments are valid and exogenous.

TABLE III

GMM Estimations of the Growth Equation

Dependent Variable: Growth of GDP	
Variables:	Test statistics
Constant	0.014***(0.008)
Growth of GDP (Lagged)	0.201***(0.053)
Growth in Capital Stock	0.176**(0.063)
Growth in Labor Force	0.098(0.215)
Growth in Openness	0.181***(0.061)
Arellano-Bond Test for AR(1)	-2.55**(P Value: 0.01)
Arellano-Bond Test for AR(2)	-0.20(P Value: 0.84)
Sargen Test of Overriding Restrictions	369.84(P Value: 0.86)
Hansen Test of Overriding Restrictions	9.11(P Value: 1.00)
Number of Groups	12
Number of Observations	456

Note: 1) ***, ** and * indicate significance at the 1% level, 5% and 10% level respectively. 2) Standard errors are in the parenthesis. 3) Instrument variables: Growth in Labor Force (Lagged), Growth in openness (Lagged), Growth of food production index

As expected, the coefficient for the lagged growth is very significant at the 1 percent level. The magnitude of this coefficient is 0.20 which proved extremely insensitive to any change in the specification. This result strongly supports the hypothesis of the persistence characteristic of economic growth as suggested by Alesina *et al*. (1992). The coefficient for the growth in capital stock is 0.18 and is found to be significant at the 5 percent level. The only variable that is not significant in the growth equation is the growth in the labor force. This variable does not prove to be statistically significant, although it exhibits the expected sign. This result is not surprising as the variable is a proxy for the real labor force.

In the growth equation, the coefficient for growth in openness is 0.18. This coefficient is also statistically significant at the 1 percent level. In other words, on average, one unit of increase in the trade volume contributes to the GDP growth in emerging Asian countries by 0.18 units over the period of 1971 to 2009.

Hence, the statistically significant short run relationship between growth in openness and growth in GDP suggests that openness has a positive impact on economic growth in emerging Asian economies.

5. CONCLUSION

With the progress of liberalization in the last three decades, the relationship between economic growth and openness has drawn the attention of researchers and policy-makers, particularly in developing countries. Despite voluminous work in this area, the findings are far from unanimous. This is particularly true for studies that examine Asian countries.

Unfortunately, many important factors, including the definition of openness and misspecified econometric modeling, posed a limit on the effectiveness of most of these studies.

Using the system GMM approach, this paper attempts to determine the relationship between openness and economic growth for a dynamic panel of 12 emerging countries from Asia. A modified version of the neoclassical growth equation is used for the period of 1971 to 2009. The system GMM technique proposed by Blundell and Bond (1998) is an information-efficient means of obtaining consistent coefficient estimates. From the methodological point of view, this is a better approach than other GMM or instrumental variable techniques, since it utilizes both lagged and differenced versions of regressors as instruments while obtaining coefficient estimates. Our results indicate that openness has a strong positive effect on economic growth in emerging Asian economies. Our approach to estimate the openness-growth nexus is different from any previous work in many ways. First, we measure openness as total trade volume, which is free from the problem of endogeneity. Second, the simultaneity bias is captured by the econometric technique. Third, the persistent characteristic of GDP growth is captured in our estimation procedure. Finally, no previous work has examined the relationship between openness and growth for emerging economies in Asia.

This research brings up several additional questions such as 1) Does this panel relationship hold for individual countries? 2) Is this relationship different from other developing regions, such as Sub-Saharan Africa or Latin America? 3) What is the best method to capture growth in the actual labor force in the developing economies of Asia? These questions are important, and hence, are left for future research.

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