OPENNESS, INVESTMENT AND ECONOMIC GROWTH IN ASIA

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I. Introduction

The purpose of this paper is to explore how growth of openness and the growth of domestic investment contribute to growth of GDP in Asian countries. A large number of papers have looked at the relationship between export and economic growth but until recently no study has looked at the relationship between growth of openness and economic growth (see Sinha and Sinha (1996)). We define openness as export plus import following Summers and Heston (1991). Why should openness and growth be related in a country? Openness has two parts: export and import. Economists have debated the role of export in economic growth at length. There are three channels of connections between economic growth and exports. First, although industrialization is crucial to economic growth, domestic demand may be low. Export provides an outlet for this excess production and generates income (Colombatto, 1990). Second, in the long run, export helps growth because export leads to greater technical progress and more saving (Krueger, 1978). It also improves credit ratings of a country by generating hard currencies and thus makes getting foreign loans easier. Third, export promotion policies improve total factor productivity (Balassa, 1978).

Although most researchers talk about trade policy but in their discussion they focus exclusively on export policy. Does that mean that import does not help a country? Why should import be related to economic growth? Publication of high import statistics in the newspapers stirs up government officials. They feel compelled to defend high import statistics. There is an implicit belief that for a country, a growing rate of import is bad but a growing rate of export is good. Economics literature seems to follow the same line: issues of trade are always implicitly taken to mean issues of export. The only study to our knowledge that explicitly looks at import at all is that of Ram (1990). Ram looks at the relationship between growth rate of import and growth rate of real GDP in many developing countries using an augmented production function approach. He finds a positive relationship for some countries. Import of capital goods and energy can help economic growth for an LDC. However, imports may not always aid economic growth: they need to be used efficiently. We also add two very important internal factors affecting the rate of economic growth: growth of investment and growth of population. Population is used as a proxy for the labor force since reliable time series data are not available for a reasonable period of time for all the countries under consideration. Our model in section II derived from a generalized version of the Solow-Swan model makes growth of GDP a function of growth of investment and the growth of population as well. We use data for 19 Asian countries. World Bank (1987) categorizes a number of countries according to their trade orientation for the period 1973-85. Our sample includes countries in all these categories. Hong Kong, Singapore and South Korea were strongly outward oriented according to the World Bank classification. Israel, Malaysia and Thailand were moderately outward oriented. Indonesia, Pakistan, Philippines and Sri Lanka were moderately inward oriented. Bangladesh and India were strongly inward oriented. Therefore, our data span the entire range of countries classified by the World Bank.

As pointed out earlier, previous literature look solely at the relationship between export and economic growth. Early efforts investigating the relationship between export and economic growth include Emery (1967), Michaely (1977), Balassa (1978), Krueger (1978) and Feder

(1982). Numerous other studies also appeared on the subject. Some of these are multi-country studies while others concentrate on a single country. Recent papers include Ahmed and Harnhirun (1995), Dollar (1992), Harrison (1995), Frankel, Romer and Cyrus (1995), Krueger (1990), Sengupta (1994) and van den Berg and Schmidt (1994). Edwards (1993) provides an excellent review of the many previous studies. The plan of the paper is as follows. In part II, we develop a model relating the rate of growth of GDP, the rate of growth of investment, the rate of growth of openness and the rate of growth of population. In part III, we look at the empirical results. Part IV gives a summary of the paper and draws some conclusions.

II. The Model

Define the following variables:

Y(t) = real GDP adjusted for terms of trade as a (continuous) function of time; K(t) = capital stock at time t; N(t) = labor in person-hours in efficiency units at time t; L(t) = population at time t; T(t) = labor productivity or technical change at time t; R(t) = value of trade (real export plus real import) at time t; We define a continuous time model of the economy as follows: There is a continuous time technology given by the following function:

$$Y(t) = F(K(t), N(t)) \quad (1)$$

and we assume F is homogenous of order 1 in K and N. This formulation is the standard Ramsay-Solow-Swan model but in continuous time. We will use the following form of (1) by using the fact that F is homogeneous of degree 1:

$$Y(t)/N(t) = f(K(t)/N(t)) \quad (1)$$

Capital stock evolves over time as a proportion of real GDP but after correcting for depreciation at a constant rate δ. This is the simplest formulation of Solow (1956).

$$dK(t)/dt = sY(t) - \delta K(t) \quad (2)$$

We assume that the population grows at a constant rate n over time:

$$dL(t)/dt = nL(t) \quad (3)$$

Labor productivity/technology is assumed to change with improvements in per capita capital stock K/L. This is an extension of Arrow's(1962) learning by doing model where α is the learning coefficient. It also captures the spirit of endogenous growth model of Romer (1986). We will assume that α is influenced by import and export. There are two separate sets of reasons why import and export (or trade) induces a higher value of α. First, more sophisticated imported technology stimulate output growth (see Bardhan and Lewis (1970)). Feder (1982) shows how export can produce a higher level of productivity. Second, a purely domestic source stemming from local technological improvement can be proxied by export and a foreign source of knowledge related to innovations generated in other countries can be proxied by imports (see Edwards (1992) for more details on the rationale of using export and import as proxies in this context). Let R(t) denote trade (that is, real export plus real import). In our model the parameter α encapsulates all of these effects of import and export.

$$dT(t)/dt = \alpha(dR(t)/dt)K(t)/L(t) + \lambda T(t) \quad (4)$$

Equation (4) summarizes the rate of technological change. In the standard neoclassical growth model, the technological change is exogenous. This exogeneity means equation (4) simplifies to:

$$dT(t)/dt = \lambda T(t) \quad (4')$$

This is equivalent to assuming the value of to be zero. In this sense, (4) is a generalization of Solow-Swan neoclassical model (Solow (1956), Swan (1956)).

In addition, we have the following identities: $N(t) = T(t)L(t)$ (5)

Equation (5) relates population to effective labor. $k(t) = K(t)/N(t)$ (6)

Equation (6) defines capital intensity. From (2) using (1), we get

$dK(t)/dt = sNf(k(t)) - \delta K(t)$ which simplifies to

$$[dK(t)/dt]/K(t) = sf(k(t))/k(t) - \delta \quad (7)$$

Equation (7) summarizes the rate of change of capital stock to per capita capital stock . Differentiating equation (5), we get, $dN(t)/dt = L(t)dT(t)/dt + T(t)dL(t)/dt$; which after rearranging gives us

$$[dN(t)/dt]/N(t) = [L(t)/N(t)]dT(t)/dt + [T(t)/N(t)]dL(t)/dt \quad (8)$$

By substituting (3) and (4) in the right hand side of (8), we get $[dN(t)/dt]/N(t) = [\alpha(dR(t)/dt)K(t)/L(t) + \lambda T(t)] + nL(t)/L(t)$ or,

$$[dN(t)/dt]/N(t) = \alpha(dR(t)/dt)k(t) + \lambda + n \quad (9)$$

Differentiating equation (6) with respect to t we get

$$dk(t)/dt = [dK(t)/dt]/N(t) - K(t)[dN(t)/dt]/(N(t))^2$$

This gives the following expression for

$$[dk(t)/dt]/k(t) = [dK(t)/dt]/K(t) - [dN(t)/dt]/N(t) \quad (10)$$

By substituting (7) and (9) in (10), we get $[dk(t)/dt]/k(t) = sf(k(t))/k(t) - \alpha(dR(t)/dt)k(t) - \lambda - n - \delta$; On the other hand, using (1′) we get $Y(t) = N(t)f(k(t)$ (11)

and using (5) in (11) we get $Y(t) = T(t)L(t)f(k(t)$ (12)

Totally differentiating (11), we get

$dY(t)/dt = [dT(t)/dt]L(t)f(k(t)) +T(t)f(k(t))[dL(t)/dt] + f'(k(t))dk(t)/dt$ The right hand side simplifies to yield $[dY(t)/dt]/Y(t) = \alpha(dR(t)/dt)K(t)f(k(t))/Y(t) + \lambda T(t)L(t)f(k(t))/Y(t) + T(t)L(t)n/N(t) + f'(k(t))[dk(t)/dt]/Y(t)$ or,

$$[dY(t)/dt]/Y(t) = \alpha(dR(t)/dt)k(t) + \lambda + n + f'(k(t))[dk(t)/dt]/Y(t) \quad (13)$$

If we assume Inada (1963) condition to hold for the per capita production function f in equation (1'), we can show that a steady state solution k* to (13) exists. Non-steady state properties of (13) have been explored in detail by Villanueva (1994). Note that in a steady state $dk(t)/dt = 0$. Therefore, (13) can be rewritten as

$$[dY(t)/dt]/Y(t) = \alpha(dR(t)/dt)k^*(t) + \lambda + n \quad (14)$$

A general functional formulation of (14) would be

$$[dY(t)/dt]/Y(t) = g(\alpha(dR(t)/dt), n, k) \quad (15)$$

Equation (15) says that growth rate of GDP is a function of the (a) the learning function, (b) the rate of growth of investment rate and (c) the growth rate of population. Since the learning rate is a function of the growth rate of trade (export plus import in real terms), a linearized version of (15) can be written as: $gy_t = a_0 + a_1 gxm_t + a_2 gi_t + a_3 n_t + \varepsilon_t$ (16)
where gy_t is the growth rate of real GDP, xm_t is the growth rate of openness, gi_t is the growth rate of real investment, and n_t is the population growth rate. This version of our model will be used in our empirical analysis.

III. Data and Empirical Results

All data come from the Penn World Table (version 5.6). Annual data are used as follows: Bangladesh (1959-92), China (1960-92), Hong Kong (1960-92), India (1950-92), Indonesia (1960-92), Iran (1955-92), Iraq (1953-87), Israel (1953-92), Japan (1950-92), Jordan (1954-90), Malaysia (1955-92), Myanmar (1950-89), Pakistan (1950-92), Philippines (1950-92), Singapore (1960-92), Sri Lanka (1950-92), South Korea (1953-91), Taiwan (1951-92) and Thailand (1950-92). The Penn World Table data, which were developed by the International Comparison Project, have data, which are much more useful for multi-country studies because these data are more comparable than data from any other sources.

It is important to test for stationarity of the variables involved before attempting empirical estimates. We use the Phillips-Perron (1988) test. The test is well suited for analysing time series whose differences may follow mixed ARMA (p,q) processes of unknown order in that it the test statistic incorporates a nonparametric allowance for serial correlation in testing the regression. Consider the following equation:

$$y_t = \tilde{C}_0 + \tilde{C}_1 y_{t-1} + \tilde{C}_2 (t - T/2) + \nu_t \qquad (17)$$

where T is the number of observations and ν_t is the error term. The null hypothesis of a unit root is: $\tilde{C}_1 = 1$. The we can drop the trend term to test the stationarity of a variable without the trend.

The results of the PP tests are in Table 1. The results indicate that all variables are stationary for 15 countries. However, for four countries, namely, Malaysia, Sri Lanka, Taiwan and Thailand, at least one of the two test statistics for n_t (that is, without trend and with trend) shows the presence of a unit root. Thus, we exclude these countries from our regression analyses.

Table 1. Phillips-Perron Unit Root Tests

Country	gy_t W. T.	gy_t Trend	gxm_t W. T.	gxm_t Trend	gi_t W. T.	gi_t Trend	n_t W. T.	n_t Trend
Bangladesh	-11.21	-12.56	-7.19	-7.14	-6.66	-6.63	-10.41	-11.40
	(-2.62)	(-3.21)	(-2.62)	(-3.21)	(-2.62)	(-3.21)	(-2.62)	(-3.21)
China	-3.72	-3.70	-5.73	-6.95	-6.18	-4.12	-4.16	-5.88
	(-2.62)	(-3.21)	(-2.62)	(-3.21)	(-2.62)	(-3.21)	(-2.62)	(-3.21)
Hong Kong	-4.04	-4.55	-6.55	-6.81	-3.49	-3.51	-4.67	-5.39
	(-2.62)	(-3.21)	(-2.62)	(-3.21)	(-2.62)	(-3.21)	(-2.62)	(-3.21)
India	-6.17	-6.64	-6.55	-7.16	-9.05	-9.53	-3.19	-3.32
	(-2.60)	(-3.19)	(-2.60)	(-3.19)	(-2.60)	(-3.19)	(-2.60)	(-3.19)
Indonesia	-3.38	-3.44	-8.25	-9.51	-2.91	-5.81	-2.77	-3.34
	(-2.62)	(3.21)	(-2.62)	(3.21)	(-2.62)	(3.21)	(-2.62)	(3.21)
Iran	-4.68	-4.70	-3.23	-3.18	-5.77	-5.76	-5.22	-5.88
	(-2.61)	(-3.20)	(-2.61)	(-3.20)	(-2.61)	(-3.20)	(-2.61)	(-3.20)
Iraq	-4.80	-4.94	-4.95	-4.98	-4.49	-4.41	-3.14	-3.69
	(-2.61)	(-3.21)	(-2.61)	(-3.21)	(-2.61)	(-3.21)	(-2.61)	(-3.21)
Israel	-3.95	-4.12	-5.61	-6.23	-4.94	-4.86	-3.59	-3.76
	(-2.61)	(-3.20)	(-2.61)	(-3.20)	(-2.61)	(-3.20)	(-2.61)	(-3.20)
Japan	-3.45	-4.31	-8.41	-9.88	-6.70	-6.96	-3.87	-5.45
	(-2.60)	(-3.19)	(-2.60)	(-3.19)	(-2.60)	(-3.19)	(-2.60)	(-3.19)
Jordan	-6.09	-6.53	-6.91	-6.85	-5.29	-6.00	-5.84	-5.82
	(-2.61)	(-3.20)	(-2.61)	(-3.20)	(-2.61)	(-3.20)	(-2.61)	(-3.20)
Malaysia	-4.78	-4.71	-4.83	-5.00	-6.37	-6.29	-1.57	-2.12
	(-2.94)	(-3.20)	(-2.94)	(-3.20)	(-2.94)	(-3.20)	(-2.94)	(-3.20)
Myanmar	-6.44	-6.31	-4.92	-4.78	-7.55	-7.59	-5.10	-5.52
	(-2.61)	(-3.20)	(-2.61)	(-3.20)	(-2.61)	(-3.20)	(-2.61)	(-3.20)
Pakistan	-6.04	-6.11	-6.92	-7.06	-7.26	-7.47	-5.75	-6.21
	(-2.60)	(-3.19)	(-2.60)	(-3.19)	(-2.60)	(-3.19)	(-2.60)	(-3.19)
Philippines	-3.16	-3.82	-6.24	-6.19	-4.85	-4.93	-5.07	-5.79
	(-2.60)	(-3.19)	(-2.60)	(-3.19)	(-2.60)	(-3.19)	(-2.60)	(-3.19)
Singapore	-3.56	-3.48	-4.28	-4.18	-4.37	-4.41	-5.05	-4.96
	(-2.62)	(-3.21)	(-2.62)	(-3.21)	(-2.62)	(-3.21)	(-2.62)	(-3.21)
South Korea	-4.64	-4.80	-6.34	-8.05	-1.99	-9.89	-7.31	-8.20
	(-2.61)	(-3.20)	(-2.61)	(-3.20)	(-2.61)	(-3.20)	(-2.61)	(-3.20)
Sri Lanka	-8.20	-8.26	-5.87	-5.93	-7.51	-7.45	-1.96	-5.49
	(-2.60)	(-3.19)	(-2.60)	(-3.19)	(-2.60)	(-3.19)	(-2.60)	(-3.19)
Taiwan	-5.41	-5.33	-6.00	-6.06	-6.25	-6.23	-2.00	-6.10
	(-2.61)	(-3.20)	(-2.61)	(-3.20)	(-2.61)	(-3.20)	(-2.61)	(-3.20)
Thailand	-5.41	-5.33	-6.00	-6.06	-6.25	-6.23	-2.00	-6.10
	(-2.60)	(-3.19)	(-2.60)	(-3.19)	(-2.60)	(-3.19)	(-2.60)	(-3.19)

Note: W. T. and Trend stand for test statistics for a variable without trend and with trend respectively. Critical values (from Mackinnon (1991)) at 10% level are in parentheses.

The results of regressions are given in table 2. Countries that have followed vigorous trade and (domestic and foreign) investments (China, Hong Kong, Indonesia, Japan etc.) show a very high adjusted R^2. These numbers are surprisingly low for Singapore and South Korea. Unfortunately, we could not carry out similar analysis for Taiwan as the population growth rate for Taiwan exhibit unit root. For a number of countries (Bangladesh, India, Iran, Iraq, Japan, Pakistan and Singapore), population growth rate has a negative coefficient contrary to what we predict from our theory. However, none of these coefficients are significantly different from zero. The only country with a significantly negative coefficient for population growth rate is South Korea. Growth rate of investment and of openness have been insignificant among the countries which have pursued either inward looking policies or policies that have punished local investment through stifling regulation. For example, South Asian countries Bangladesh and India show very small impact of either openness or investment. Pakistan shows a negative impact of investment growth. However, openness or trade (mainly with other Muslim countries in the region) has had positive impact on the growth in Pakistan. But due to high taxation, government intervention and regulation of domestic companies, high investment did not result in higher growth. Most of the investment went to unproductive activities. This is

Table 2. Regression Results

Country	gxm_t	gi_t	n_t	a_0	Adj. R^2	Error Process
Bangladesh	0.130 (1.972)	0.004 (0.072)	-0.224 (-0.11)	0.042 (0.743)	0.03	OLS
China	0.088 (2.186)	0.267 (5.703)	0.514 (0.444)	0.014 (0.675)	0.71	OLS
Hong Kong	0.152 (2.098)	0.277 (5.750)	0.316 (0.912)	0.042 (3.882)	0.66	OLS
India	0.050 (0.732)	0.072 (1.012)	-0.501 (-0.21)	0.045 (0.851)	0.01	OLS
Indonesia	-0.006 (-0.62)	0.150 (5.701)	5.136 (1.712)	-0.055 (-0.90)	0.65	AR(1)
Iran	0.264 (4.660)	0.022 (0.388)	-0.873 (-0.80)	0.058 (1.442)	0.39	AR(1)
Iraq	0.482 (5.086)	0.013 (0.203)	-5.523 (-0.62)	0.201 (0.701)	0.54	OLS
Israel	0.084 (2.362)	0.164 (4.829)	1.112 (2.648)	0.017 (1.298)	0.60	OLS
Japan	-0.099 (-3.93)	0.195 (7.089)	-0.442 (-0.51)	0.055 (3.816)	0.72	AR(1)
Jordan	-0.011 (-0.13)	0.226 (3.101)	0.283 (1.094)	0.040 (2.156)	0.21	OLS
Myanmar	0.308 (5.383)	-0.010 (-0.40)	1.821 (0.709)	0.006 (0.114)	0.42	OLS
Pakistan	0.146 (4.084)	-0.190 (-4.00)	-1.325 (-2.29)	0.087 (4.197)	0.36	AR(1)
Philippines	0.047 (1.514)	0.147 (4.031)	0.335 (0.400)	0.024 (1.036)	0.55	AR(1)
Singapore	0.195 (3.068)	0.173 (3.337)	-0.224 (-0.58)	0.049 (3.922)	0.42	OLS
South Korea	0.058 (1.417)	0.084 (3.858)	-2.065 (-2.04)	0.143 (4.595)	0.42	AR(1)

Note: T values are in parentheses.

particularly true for the late 1960s and 1970s when the public sector investment expanded rapidly. Many industries were nationalized during this period and were very badly managed (Sinha (1997)). These results stand in sharp contrast with the ASEAN economies. For Indonesia, Myanmar, the Philippines and Singapore, the positive impact of openness and investment are robust. For Pacific Rim countries like China, Hong Kong and South Korea, the result of higher investment and higher trade have led to higher economic growth.

IV. Summary and Conclusions

The main purpose of the paper has been to study the effects of growth of openness and investment on the growth of GDP. First, we develop a model relating the growth of GDP to the growth rates of openness (export plus import), domestic investment and population. Most previous studies relate economic growth to export. But this is likely to create a missing variable bias in such studies because investment is clearly an important factor affecting economic growth. Next, we use Phillips-Perron unit tests on the data for 19 countries to find out whether the data are stationary or not. For 15 countries, all the variables are found to be stationary. However, for four countries, namely, Malaysia, Sri Lanka, Taiwan and Thailand, the growth of population is found to be non-stationary either for trended or for non-trended or for both cases. We exclude these countries from our regression analysis. Our theory predicts that the growth rate of GDP should be positively related to the growth rates of openness, domestic investment and population. For many countries, the results support the theory. For China, Hong Kong, Iran, Iraq, Israel, Myanmar, Pakistan and Singapore, the coefficient of the growth of openness is positive and significantly different from zero. For China, Hong Kong, Indonesia, Israel, Japan, Jordan, Philippines, Singapore and South Korea, the coefficient of the growth of domestic investment is positive and significantly different from zero. In some cases, the coefficient of the growth of population is negative but in all such cases, it is not significantly different from zero. Thus, generally speaking, we find support for the proposition that the growth rate of GDP is positively related to the growth rates of openness and domestic investment. However, the relationship between the growth rate of GDP and the growth rate of population is not that clear cut.

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