AN EMPIRICAL INVESTIGATION INTO THE RELATIONSHIP BETWEEN OPENNESS AND ECONOMIC GROWTH: EVIDENCE FROM ASIA

by
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1. Introduction

In his classic paper, Kaldor (1961) set out six stylized facts that the models of economic growth should explain. They are:

1. Output per worker shows continuing growth "with no tendency for a falling rate of growth of productivity".

2. Capital per worker shows continuing growth.

3. The rate of return on capital is steady.

4. Capital output ratio is steady.

5. Labor and capital receive constant shares of total income.

6. There are wide differences in the rate of growth of productivity across countries.

To this list, Romer (1989) added five more:

7. In cross section data, the mean growth rate shows no variation with the level of per capita income.

8. Growth in the volume of trade is positively correlated with the growth of output.

9. The growth rate of population is negatively correlated with the level of income.

10. The rate of growth of factor inputs is not large enough to explain

the rate of growth of output; that is, growth accounting always finds a residual.

11. Both skilled and unskilled workers tend to migrate towards high income countries.

In the literature, stylized fact number 8 has not received sufficient attention. In this paper, we take Romer's stylized fact number 8 seriously. We pose four fundamental questions:

1. Does the relationship hold up for non-industrialized countries as well? To prove his point Romer (1989, p. 67) plotted annual growth rate of GDP and annual growth rate of export for (now) industrialized countries over 1870-1913, 1913-1950, and 1950-1970 using Maddison (1982) datasets. All of them showed very tight positive correlation between the variables. Romer looked at the past behavior of the countries which are now industrialized. This raises the question of sample selection bias. In 1900, Argentina had a per capita income higher than most European countries. But because Argentina has not become one of the industrialized countries today, it is not in the sample considered by Romer (a similar argument was used against the convergence hypothesis by De Long, 1988). We feel that the inclusion of all countries without regard to their industrial development is necessary to test the robustness of Romer's stylized fact number 8. There are 29 Asian countries for which data are available. World Bank (1987) categorized a number of countries according to their trade orientation for the period 1973-85. Our sample includes countries in all these categories. Hong Kong, Korea and Singapore 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.

2. Does it hold for trade volume rather than for export only? Romer (and others) have used growth rate of exports rather than the growth rate of openness. Leamer (1988) provided a number of measures of openness. We will use the ratio of export plus import divided by GDP. This was the way in which openness was defined by Summers and Heston (1991) in the widely used Penn World Table. We use the Penn World Table (Mark 5.5.) data. 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? Publication of high import statistics in the news-

papers 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 is almost always implicitly taken to mean issues of export. The only study to our knowledge that explicitly looks at import at all was that of Ram (1990). He, however, considered only import (rather than trade). He found that import growth was positively correlated with GDP growth for most countries. His study suffered from the simultaneity problem just like other studies relating export to growth of GDP.

3. Does the inclusion of export or import as a part of GDP create a problem of simultaneity? By definition, GDP includes export and import. Thus, as components of GDP, they will contribute to GDP growth. In countries with very high exports (as a percentage of GDP) such as Singapore or Belgium, it clearly makes a difference. To date, there has been no attempt to correct for this problem. Some authors have provided justification for using the conventional approach, that is, the use of a production function approach whereby growth of GDP becomes a function of the growth of exports and other inputs (see Ram, 1986, for example). In this paper, we disentangle the trade effect. We adjust the GDP figures by subtracting export figures and adding in import figures. Thus, the simultaneity problem does not arise in our analysis.

4. We explicitly consider the important issue of causality. Does the openness of the economy cause the growth of real GDP or does the growth itself brings about an associated openness? In our study, we explicitly address this issue.

2. Existing Literature

As pointed out earlier, previous literature looked 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 concentrated on a single country. Recent papers have included Ahmad 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) provided an excellent review of the many previous studies.

One problem with the earlier studies using time series data is that the studies might have estimated spurious regressions as Granger and Newbold (1974) and Phillips (1986) have shown. In other studies, causality between exports and economic growth are explored. But earlier studies suffered from a methodological problem because these studies looked at the causal relationship between the two variables without addressing the issue of stationarity of the variables. If the variables do not have unit roots, then the causality tests are valid (Sims, Stock and Watson, 1990). Causality tests are also valid if the variables are cointegrated (Granger, 1988),

3. Cross Section Evidence

We have a sample of 29 countries from Asia for which data are available in the Penn World Table. We divide the data for each decade. In the literature, researchers have tended to break the data down by world events such as World Wars, oil price shock, the onset of the Great Depression and the like. There is no *a priori* justification for such a breakdown. Lucas (1976) critique of the current macroeconomic practice warned precisely against such breakdown of data. Here, we are trying to discover some intrinsic and fundamental relationship between economic growth and trade. Our choice of time frame, therefore, should not be dictated by some exogenous factors. We have four decades in our sample. The first one taken is 1951-1960. In that sample period, there are 15 countries in our dataset. The second is 1961-1970. We have 22 countries in that sample period. For the decade of 1971-1980, we also have 22 countries. For the decade of 1981-1990, we have 29 countries. For each of the decades we regress the growth rate of real GDP on the corresponding rate of change of openness. The estimated equation is:

real GDP growth rate $= a + b$ rate of change in openness $+$ error   (1)

The results of the regressions are reported in Table 1.

We observe that the coefficient b is significantly positive for every decade. Therefore, we have shown that the growth of openness and the growth rate of GDP are highly correlated. From this observation we cannot infer causality between the two variables. It is impossible to discern the direction of causality from cross section data. For that, we analyze the time series data for each country individually. Note also the size of the effect:

CROSS SECTION REGRESSION RESULTS

Decade	obs.	b	t-statistic	Adj.R^2
1951-60	15	0.31	3.65 *	0.47
1961-70	22	0.29	3.31 *	0.17
1971-80	22	0.49	7.13 *	0.71
1981-90	29	0.28	4.23 *	0.38
1951-90	88	0.30	6.77 *	0.34

* Significant at the 1% level.

the point estimate is around 0.3 with the exception of the decade of 1971-1980. The scatterplot for 1971-80 reveals one country with a large drop in real GDP and openness over the decade. It was Iraq. If we exclude Iraq from the sample, we get a point estimate for 1971-80 similar to other decades: the point estimate of b becomes 0.28 (with a t-ratio of 3.33). We also look at the result of simple OLS for all the four decades (with all 88 observations). The scatterplot of the pooled cross section time series data for 1951-90 is given in Figure 1.

FIGURE 1. Relationship between growth in openness and growth in real GDP.

%growth in real GDP
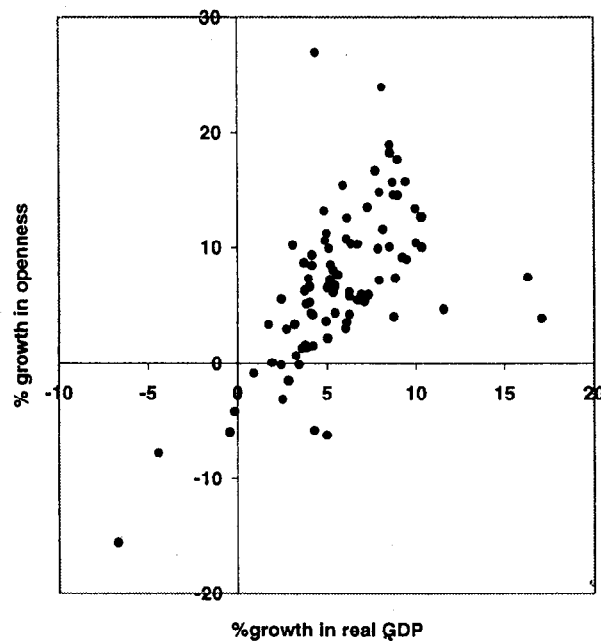
4. Causality Relation

The results from cross section analysis strongly suggests that there is a relationship between the growth of openness and economic growth.

Unfortunately, there is no theoretical way of resolving the direction of causality. Does the rate of change of openness cause economic growth? We can argue that export promotion certainly can improve domestic production technology. Growth of export can cause improvement in living standards by increasing profits and income within the country. Similarly, we can also argue that the threat of import can improve domestically sold products for consumption and thereby raise export further. Similarly, if income within a country increases, domestic demand for foreign made goods will rise. Therefore, *a priori*, we cannot determine the direction of causality between the growth of real GDP and the rate of growth of openness. One way of dealing with such an issue is to study the direction of causality using Granger (1969) method.

However as noted earlier, causality tests are valid in those cases where all relevant variables are I (0) or if the variables are cointegrated. Therefore, we need to test for unit roots of the two variables: growth rate of real GDP per capita and growth rate of openness. We use the augmented Dickey-Fuller (see Dickey and Fuller, 1979 and 1981) test. The augmented Dickey Fuller (ADF) test entails estimating the following regression equation (with an autoregressive process):

$$\Delta y_t = c_1 + \omega y_{t-1} + c_2 t + \sum_{i=1}^{p} d_i \Delta y_{t-i} + v_t \qquad (2)$$

In the equation (2), y is the relevant time series, Δ is a first-difference operator, t is a linear trend and v_t is the error term. The above equation can also be estimated without including a trend term (by deleting the term $c_2 t$ in the above equation). If $\omega = 0$, then there is a unit root. The results of the unit root tests are in Table 2. The augmented Dickey Fuller tests with and without trend yield the same results.

The tests indicate that for Bangladesh, Iran Iraq, Japan, Jordan, Nepal, Singapore, Syria and Yemen at least one of the variables was non-stationary. Only for Yemen, both the variables were found to be I (1). Johansen-Juselius (see Johansen, 1988, and Johansen and Juselius, 1990) maximal eigenvalue and trace tests for cointegration were conducted for Yemen. The null hypothesis of no cointegrating vector was rejected using the critical value at the 95% quantile. Therefore, out of the nine countries for which at least one of the variables is non-stationary, causality tests are valid only for

TABLE 2
RESULTS OF UNIT ROOT (AUGMENTED DICKEY FULLER) TESTS

Country	Growth Rate of GDP	Growth Rate of Openness
Bangladesh	no	yes
Burma	no	no
China	no	no
Hong Kong	no	no
India	no	no
Indonesia	no	no
Iran	no	yes
Iraq	no	yes
Israel	no	no
Japan	yes	no
Jordan	yes	no
Korea	no	no
Malaysia	no	no
Nepal	no	yes
Pakistan	no	no
Philippines	no	no
Singapore	yes	no
Sri Lanka	no	no
Syria	no	yes
Taiwan	no	no
Thailand	no	no
Yemen	yes	yes

Note: "yes" means a unit root present and "no" means unit root not present as indicated by augmented Dickey Fuller tests. A 10% level of significance was used.

Yemen. Therefore, we will exclude the other eight countries from our causality analysis. The same eight countries will also be excluded from our time series analysis (in the next section) because we might estimate spurious regressions if we have non-stationary and non-cointegrated variables.

We proceed with the Granger causality tests as follows. Let $\{x_t\}$ and $\{y_t\}$ be two time series. Suppose we regress y_t on past values of y and past values of x:

$$y_t = a_1 y_{t-1} + a_2 y_{t-2} + \dots + b_1 x_{t-1} + b_2 x_{t-2} + \dots + u_t \qquad (3)$$

We first run this unrestricted regression and then we add conditions that $b_1 = b_2 = \dots = 0$. Let the error sum of squares for the restricted and unrestricted equations be $E(r)$ and $E(u)$. Then

$$F(r, n-k-1) = [E(r) - E(u)/r]/[E(u)/(n-k-1)] \qquad (4)$$

will have a F distribution with r and $n - k - 1$ degrees of freedom where r is the number of restrictions and $n - k - 1$ is the degrees of freedom in equation (3). In our model, we first take the rate of change of real GDP as the x variable in equation (3) and the rate of change of openness as the y variable. If past values of growth in openness do not affect the current value of growth in real GDP, then the corrsponding F ratios will be insignificant. Similarly, if we reverse the roles of the two variables, and run a similar test, we can conclude about causality in the opposite direction. Akaike's Final Prediction Error (FPE) criterion was used in deciding the number of lags in equation (3).

Results of F statistics using (4) are reported in Table 3. The most striking feature is that there is no significant F ratio at the 5% level for any country. There is no relationship between the two variables under consideration unless they are contemporaneous.

TABLE 3

F-RATIOS FOR GRANGER CAUSALITY TESTS

Country	Observations	Growth of GDP on Growth of Openness	Growth of Openness on Growth of GDP
Burma	39	0.38	1.08
China	20	0.59	0.01
Hong Kong	28	1.01	1.02
India	38	0.03	0.23
Indonesia	30	0.89	0.32
Israel	35	1.06	0.38
Korea	34	0.23	1.12
Malaysia	33	0.39	0.15
Pakistan	38	0.54	0.18
Philippines	38	0.01	1.26
Sri Lanka	37	0.47	0.98
Taiwan	37	0.93	0.12
Thailand	38	0.28	0.21
Yemen	18	0.66	0.47

5. *Time Series Approach*

For standard OLS estimates to be meaningful, the underlying dependent and independent variables have to be either I (0) or cointegrated. Thus, as noted earlier, we pursue the time series approach for the same 14

TABLE 4
RESULTS OF REGRESSIONS TO ESTIMATE THE IMPACT OF THE
GROWTH OF OPENNESS ON THE GROWTH OF GDP

Country	b	t-ratio	Error Process
Burma	0.25	5.61 *	OLS
China	0.05	0.5	AR1
Hong Kong	0.37	4.16 *	AR1
India	0.08	1.55	OLS
Indonesia	0.1	3.8 *	OLS
Israel	0.08	1.65	OLS
Korea	0.1	1.98	AR1
Malaysia	0.42	9.41 *	AR1
Pakistan	0.16	4.04 *	AR1
Philippines	0.05	1.16	AR1
Sri Lanka	0.31	6.21 *	OLS
Taiwan	0.16	3.85 *	OLS
Thailand	0.27	4.02 *	OLS
Yemen	0.28	4.42 *	OLS

* Significant at the 1% level.

countries for which we have done the causality tests. It is still possible for
the error process in equation (1) to be autocorrelated. Autocorrelated dis-
turbances will not produce an unbiased estimate of b. We have taken into
account the autocorrelated disturbance in our estimates in Table 4. This is
indicated under the column heading of error process.

For eight countries the error process of white noise produced reasona-
ble Durbin Watson statistics. For six other countries we had to invoke an
autocorrelated error process. For all those countries, an AR (1) process was
sufficient. For nine countries, the t-ratio was significant at the 1% level.
The average value of b was around 0.19.

6. Summary and Conclusions

In this paper, we have explored the relationship between openness and
growth based on evidence from the Asian countries. We have used the more
natural definition of openness. Previous studies have looked at the relation-
ship between exports and economic growth, by using exports as a proxy for

openness. Earlier studies also suffered from the simultaneity problem because exports are a part of GDP. We have avoided the simultaneity problem by adjusting the GDP figures. We have performed three types of analyses in this paper. Our cross section study for various decades as well as for the entire sample period indicate that the growth of openness exerts a positive influence on the growth of GDP. Next, we pursue causality tests between openness and the growth rate of growth. Causality tests have to be preceded by unit root tests to ensure that the variables are either integrated of order zero or that they are cointegrated. For a number of countries, we find that either growth of openness or growth of GDP is integrated of order one. We do not pursue the causality tests for these countries. However, for the remaining countries, causality tests are not significant for even a single country in any direction. Finally, we conduct time series analysis for those countries for which causality tests are performed. We find that there is a positive relationship between the growth of openness and the growth of GDP. Thus, Romer's stylized fact 8 is supported by our analysis adding weight to the robustness of his stylized fact.

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RICERCA EMPIRICA SULLA RELAZIONE TRA APERTURA E CRESCITA ECONOMICA: EVIDENZA DALL'ASIA

Gli autori esaminano la validità dell'argomento discusso da Romer che la crescita del volume degli scambi commerciali e la crescita della produzione sono positivamente correlate. Essi verificano questa correlazione usando i dati della Penn World Table di quattro decenni per 29 economie asiatiche. I test sono effettuati usando dati cross section di 29 paesi. Ulteriori test con serie temporali vengono effettuati per 22 paesi per i quali sono disponibili dati analizzabili. I risultati confermano le affermazioni di Romer. In questo studio vi sono tre aspetti nuovi: 1) come misura di apertura viene usato il volume degli scambi commerciali anziché il volume delle esportazioni; 2) si considera la crescita del PIL reale dopo un aggiustamento delle sue cifre per evitare il problema della simultaneità che ha tormentato la passata letteratura; 3) questa analisi di serie temporali tien conto della non stazionarietà delle serie temporali e di problemi di causalità.