THE RELATION BETWEEN OPENNESS AND ECONOMIC GROWTH: POSTWAR EVIDENCE FROM 124 COUNTRIES

Tapen Sinha
Instituto Techonológico Autónomo de México, México

and

Dipendra Sinha
Macquarie University, Australia and Yale University, USA

forthcoming: Seoul Journal of Economics

Abstract:

Conventional wisdom suggests that openness of an economy promotes economic growth. Romer (1989) posits the positive relationship between openness and economic growth as a stylized fact. He uses only ex-post industrialized countries to "prove" his stylized fact thereby introducing a sample selection bias. We correct for this sample selection bias by analyzing the biggest available sample of countries using the Penn World Table 5.6. We also correct for the fact that trade does not mean export only. We obtain quantitative estimates of the impact on trade on growth. In doing so, we use modern time series techniques instead of relying on simple scatter diagrams. Results show that growth in openness is indeed significantly positively related to the growth in real GDP for 94 out of 124 countries.

JEL Classification: F14

Acknowledgement: We thank Professor Tony Hall of the University of Technology, Sydney for his help with programming in Shazam. We also thank Jamie Olsen of the Reserve Bank of Australia for his able research assistance and the School of Business of Bond University for financial assistance. Professor Alan Heston of the University of Pennsylvania clarified some methodological issues about using the Penn World Table 5.6. Finally, we thank an anonymous referee of this journal for helpful comments whose suggesions led to many substantial improvements in the paper. All remaining errors are our own.

INTRODUCTION

In a pathbraking paper Romer (1989) asserts that growth in the volume of trade is positively correlated with the growth of output for a country. To prove his point Romer (p. 67) plots 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 show very tight positive correlation between the variables. This is a classic sample selection trap that Romer falls into. He looks at the countries that are now industrialized had behaved in the past.

Consider the following example. 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)). Thus, inclusion of all countries without regard to their industrial development is necessary to test the robustness of Romer's stylized fact. In this paper, we set out to do exactly that: we do not choose any specific group of countries - we include *all countries* in the world for which data are available for at least 30 years during the post-war period. Therefore, our data span the entire range of countries classified by the World Bank (1992).

Does the relationship hold for import and export together rather than for export only? Romer (and others) have used growth rate of exports rather than the growth rate of openness. We argue that openness is a better measure than export alone. If we use export alone, it implicitly acknowledges that import contributes nothing to growth. This

clearly misses out on a number of channels through which import can contribute to economic growth (see, for example, Clerides et al. (1996)).

The only studies to our knowledge that explicitly looks at import at all was that of Ram (1990) and Liu, Song and Romilly (1997). Ram, however, considers only import (rather than import and export together). He finds that import growth is positively correlated with GDP growth for most countries. Liu, Song and Romilly do measure openness the way we do (see below). However, their study is limited to only one country: China. They find bi-directional causality between GNP and openness.

Leamer (1988) provides a number of measures of openness. The only measure of openness with a quantitative basis is export and import put together. All other measures require some implicit theorizing (for example, one measure looks at the number of restrictions a country puts on capital flow and declares it as a measure of openness). Our method of calculating openness is closely related to the measure used by Summers and Heston (1991) in the widely used Penn World Table. Specifically, we term openness for a country for year t as

$o_t = (im_t + ex_t)$

whereas Summers and Heston use a ratio form $(im_t + ex_t)/y_t$ where im_t is the import for year t, ex_t is the export for year t and y_t is the GDP in year t. Note that we use import and export in real terms (this distinction does not arise in the definition of Summers and Heston because they take the ratio with the GDP for year t).

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

EXISTING LITERATURE

Previous literature has 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 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) 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 some studies, causality between exports and economic growth are explored. But studies prior to 1990 typically suffered from a methodological problem as they studied 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)).

We fit the following model for our data. First we define openness at time t o_t as $o_t = (im_t+ex_t)$ where im_t is the import at time t and ex_t is the export at time t. Since we are interested in the contribution of growth rate of openness on the growth rate of real GDP, we define $GOP_t = (o_t-o_{t-1})/o_{t-1}$ and

$GRGDP_t = (GDP_t-GDP_{t-1})/GDP_{t-1}$.

Thus, our model for empirically testing the relationship between trade and growth takes the following form:

$$GOP_t = a + b\ GRGDP_t + error_t \quad (1)$$

CAUSALITY RELATION

The results from most previous cross section analyses strongly suggest that there is a relation between openess 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 in 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 growth in real GDP and the rate of growth in openness. One way of dealing with such an issue is to study the direction of causality using Granger (1969) method. But before causality can be studied, we need to check for unit roots in our series.

We use the Phillips-Perron (1988) unit root test. The test is well suited for analyzing time series whose differences may follow mixed ARMA (p,q) processes of unknown order in that the test statistic incorporates a nonparametric allowance for serial correlation. Consider the following equation:

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

where $\{y_t\}$ is the relevant time series in equation (2), T is the number of observations and ν_t is the error term. The null hypothesis of a unit root is H_0: $\tilde{c}_1 = 1$. We can drop the trend term to test the stationarity of a variable without the trend. The results are reported in Table 1. Results indicate that for both the variables for almost all countries listed below do not exhibit unit roots at the conventional level of signficance.

Table 1: Results of non-parametric Phillips-Perron unit root tests for growth rate in real GDP (GRGDP) and for growth rate in openness (GOP)

		variable: GRGDP		variable: GOP	
Country	**Obs**	**without trend**	**with trend**	**without trend**	**with trend**
Algeria	33	-5.59	-5.55	-3.85	-3.77
Angola	30	-4.06	-4.11	-3.52	-4.04
Argentina	41	-6.14	-6.82	-6.12	-6.09
Australia	43	-5.96	-6.03	-6.67	-7
Austria	43	-5.28	-6.24	-6.96	-8.2
Bangladesh	34	-7.04	-6.94	-7.3	-7.19
Barbados	30	-5.66	-5.70	-4.56	-4.89
Belgium	43	-5.11	-5.18	-6.88	-7.13
Benin	33	-5.75	-5.82	-6.67	-8.74
Bolivia	43	-6.11	-6.08	-4.3	-4.3
Botswana	30	-5.72	-5.54	-6.6	-6.6
Brazil	43	-4.10	-4.58	-8.15	-8.15
Burkina Faso	34	-4.77	-5.22	-7.04	-7.28
Burundi	33	-6.71	-7.57	-6.78	-7.18
Cameroon	33	-3.01	-3.29	-4.68	-4.69
Canada	43	-5.63	-5.72	-5.6	-5.54
Cape Verde	33	-4.78	-4.70	-3.51	-3.48
Central African Republic	33	-5.80	-5.80	-6.53	-7.83
Chad	33	-5.61	-5.51	-5.64	-5.55
Chile	43	-4.98	-4.92	-5.41	-5.32
China	33	-3.72	-3.70	-3.19	3.38
Colombia	43	-4.99	-5.03	-8.55	-8.53
Comoros	33	-4.50	-4.79	-6.65	-6.82

Congo	33	-5.11	-5.04	-5.8	-5.74
Costa Rica	43	-4.29	-4.85	-7.07	-7.19
Cyprus	43	-5.92	-5.85	-7.89	-7.84
Czechoslovakia	31	-4.26	-4.87	-5.43	-5.53
Denmark	43	-5.16	-5.34	-8.18	-9.02
Dominican Republic	43	-7.11	-7.40	-7.12	-7.01
Ecuador	43	-4.33	-4.43	-6.05	-5.99
Egypt	43	-4.44	-4.33	-5.63	-5.63
El Salvador	43	-3.54	-3.95	-4.6	-4.84
Ethiopia	37	-7.02	-7.48	-5.83	-6.58
Fiji	31	-5.00	-4.95	-3.77	-3.69
Finland	43	-4.70	-5.34	-6.76	-7.42
France	43	-3.91	-4.98	-7.24	-7.21
Gabon	33	-4.59	-4.79	-4.26	-4.68
Gambia	31	-6.37	-6.36	-8.32	-8.17
Ghana	38	-5.63	-5.55	-4.12	-4.23
Greece	42	-5.48	-6.10	-5.02	-5.14
Guatemala	43	-3.79	-3.78	-4.84	-4.77
Guinea	34	-6.06	-6.25	-4.93	-5.3
Guinea-Bissau	33	-6.58	-6.50	-7.89	-7.89
Guyana	41	-5.63	-6.04	-4.19	-4.36
Haiti	30	-5.70	-5.60	-3.47	-3.42
Honduras	43	-4.77	-4.78	-5.01	-4.94
Hong Kong	33	-4.68	-5.05	-6.07	-6.2
Iceland	43	-4.18	4.27	-7.69	-8.04
India	43	-5.77	-5.73	-6.44	-6.65
Indonesia	33	-3.53	-3.50	-8.49	-8.82
Iran	38	-4.58	-4.65	-3.42	-3.39
Iraq	35	-4.80	-5.12	-4.72	-4.86
Ireland	43	-4.42	-4.37	-6.53	-6.54
Israel	40	-4.43	-5.48	-5.65	-6.35
Italy	43	-5.23	-6.80	-7.23	-8.61
Ivory Coast	33	-3.76	-4.63	-5.22	-6.28
Jamaica	39	-4.97	-6.02	-7.34	-7.48
Japan	43	-3.96	-5.40	-6.6	-7.45
Jordan	37	-5.54	-5.77	-6.99	-6.96
Kenya	43	-8.15	-8.04	-8.48	-8.36
Kuwait	30	-5.77	-6.92	-4.77	-6.2
Lesotho	33	-3.95	-4.21	-5.02	-5.18
Luxembourg	43	-6.13	-6.04	-5.4	-5.51
Madagascar	33	-5.31	-5.55	-5.56	-5.5
Malawi	39	-6.84	-7.24	-6.85	-7.01
Malaysia	38	-4.90	-4.84	-4.97	-5.07
Mali	32	-6.15	-6.18	-5.82	-5.68
Malta	36	-3.82	-3.78	-4.88	-4.84
Mauritania	33	-6.31	-6.24	-7.89	-8.22
Mauritius	43	-5.85	-5.88	-6.73	-6.71
Mexico	43	-4.71	-4.87	-4.58	-4.64
Morocco	43	-5.12	-5.06	-5.58	-5.51
Mozambique	33	-4.45	-4.70	-4.75	-4.78
Myanmar	40	-6.45	-6.30	-4.86	-4.8
Namibia	33	-6.39	-7.07	-3.96	-3.9
Netherlands	43	-3.91	-4.01	-6.95	-7.34
New Zealand	43	-5.21	-5.28	-8.23	-8.15

Nicaragua	41	-5.50	-6.46	-6.4	-6.33
Niger	30	-7.34	-7.71	-6.56	-7.21
Nigeria	43	-4.39	-4.43	-5.5	-5.43
Norway	43	-3.95	-4.39	-5.66	-5.88
Pakistan	43	-5.82	-5.92	-6.31	-6.47
Panama	43	-5.06	-5.17	-5	-4.98
Papua New Guinea	33	-3.77	-4.32	-4.19	-4.87
Paraguay	43	-6.65	-6.61	-7.1	-7.14
Peru	43	-4.43	-4.99	-6.99	-8.29
Philippines	43	-3.53	-4.03	-6.3	-6.26
Portugal	41	-4.88	-4.82	-6.06	-6
Puerto Rica	35	-4.41	-5.22	-3.99	-4.02
Reunion	30	-5.15	-6.48	-5.59	-5.36
Romania	30	-5.12	-5.38	-5.01	-5.05
Rwanda	33	-4.19	-4.12	-6.25	-6.2
Saudi Arabia	30	-3.60	-3.76	-3.57	-3.94
Senegal	32	-8.06	-7.95	-6.95	-6.9
Seychelles	31	-4.40	-4.36	-4.45	-4.41
Sierra Leone	32	-5.43	-6.21	-3.59	-3.5
Singapore	33	-4.02	-4.01	-4.22	-4.13
Somalia	30	-8.59	-8.48	-6.01	-5.92
South Africa	43	-5.06	-5.44	-6.37	-6.53
South Korea	39	-4.50	-4.76	-5.36	-5.49
Soviet Union	30	-5.12	-7.59	-9.36	-9.32
Spain	43	-5.34	-6.06	-4.94	-5.73
Sri Lanka	43	-8.59	-8.54	-5.76	-5.75
Suriname	30	-3.77	-4.66	-4.05	-4.72
Swaziland	30	-5.84	-6.22	-5.54	-5.83
Sweden	43	-3.90	-4.80	-7.01	-7.4
Switzerland	43	-3.91	-4.40	-6.75	-7.56
Syria	32	-8.15	-9.18	-7.14	-7.04
Taiwan	40	-6.49	-6.34	-5.8	-5.81
Thailand	43	-5.48	-5.74	-5.57	-5.62
Togo	33	-6.44	-7.15	-6.67	-7.34
Trinidad and Tobago	42	-6.13	-6.98	-6.67	-6.47
Tunisia	33	-5.27	-5.30	-4.13	-4.05
Turkey	43	-7.15	-7.48	-4.73	-4.67
Uganda	43	-8.77	-8.65	-6.83	-6.8
United Kingdom	43	-4.89	-4.96	-7.05	-6.97
United States	43	6.59	-6.87	-6.04	-5.96
Uruguay	43	-6.25	-6.18	-9.63	-9.52
Venezuela	43	-5.52	-5.87	-7.23	-7.15
West Germany	43	-3.85	-1.13	-5.5	-7.05
Yugoslavia	31	-4.70	-5.94	-6.94	-8.49
Zaire	40	-6.51	-7.61	-7.23	-7.12
Zambia	37	-5.23	-5.37	-6.26	-6.41
Zimbabwe	39	-5.62	-5.56	-6.52	-6.73

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:

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

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

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

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 (called GRGDP) as the x variable in equation (3) and the rate of change of openness (called GOP) as the y variable. If past values of growth in openness does not affect the current value of GRGDP, then the corresponding F ratios will be insignficant. Similarly, if we reverse the roles of the two variables, and run a similar test, we can conclude about causality in the opposite direction.

One problem of Granger causality test is that there is no a-priori theory which tells us what lag length to use. One convenient way is to choose a lag length that minimizes prediction error. In our test, we used Akaike's Final Prediction Error (FPE) criterion in deciding the number of lags in equation (3).

Results of F statistics using (4) are reported in Table 2. These are reported as F_1 and F_2 values. F_1 is the F statistic in (4) where the null we are testing is H_0: GRGDP does not Granger cause GOP. F_2 is the F statistic in (4) where the null we are testing is H_0: GOP does not Granger cause GRGDP. There are 13 countries for which F_1 is rejected. These include the following developed countries: Australia, Finland, Sweden and the UK. The rest of these 13 countries are the following developing countries: Bangladesh, Barbados, Colombia, Gambia, Kuwait, Mauritius, Somalia, Uganda and Uruguay. There are 10 countries for which F_2 is rejected. These include the following developed countries: Belgium, Denmark and the USA. The developing countries in this

group are Chad, Guyana, Haiti, Malaysia, Malta, Morocco and Uganda. Of the 124 countries, the two-way causality holds only for Uganda. In a recent study, Liu, Song and Romilly (1997) find two-way causality between openness and economic growth, we find no causality in any direction. However, we use a much longer data period for China. They use more quarterly data from 1980 while we use annual data from 1960. Their data comes from the official Chinese data source. It has been amply demonstrated that official Chinese data (especially quarterly data) is inherently unreliable. What is somewhat surprising is that none of the newly industrializing countries show any causal relationship in either direction (but, it is not surprising according to Hsieh (1999)).

Table 2: Regression results from fitting regression equation (1) and from Granger causality tests (of equation (3))

Country	Obs	R^2	b	a	DW	Model	F_1	F_2	t_b	t_a
Algeria	33	0.309	0.357	0.003	2.1	OLS	0.1	0.58	3.94*	1.79
Angola	30	0.4096	0.532	-0.001	1.8	OLS	1.89	0.24	4.52*	-0.008
Argentina	41	0.0066	-0.04	0.21	1.91	OLS	2.64	0.38	-0.05	2.41*
Australia	43	0.5101	0.311	0.25	1.79	OLS	10.2*	0.87	6.45*	5.86*
Austria	43	0.4404	0.24	0.025	1.86	OLS	1.54	1.03	5.61*	5.62*
Bangladesh	34	0.1083	0.122	0.03	2.07	AR1	6.41*	1.1	1.91	2.65*
Barbados	30	0.1691	0.23	0.003	1.96	OLS	3.9*	0.94	2.58*	3.73*
Belgium	43	0.5086	0.202	0.02	2.15	AR1	0.6	5.61*	6.09*	4.32*
Benin	33	0.4429	0.157	0.012	1.99	OLS	0.71	0.27	5.06*	1.96
Bolivia	43	0.0051	0.111	0.031	1.76	OLS	0.17	0.26	0.45	3.79*
Botswana	30	0.572	0.572	0.017	2.1	AR1	1.03	0.25	6.16*	1.13
Brazil	43	0.1868	0.027	0.05	2.19	AR1	1.98	0.34	0.96	4.94*
Burkina Faso	34	0.0971	0.096	0.02	1.97	AR1	1.17	0.15	1.99*	2.19*
Burundi	33	0.621	0.476	-0.008	2.19	AR1	0.47	0.96	7.79*	-0.11
Cameroon	33	0.525	0.262	0.027	2.08	AR1	1.37	0.2	4.39*	2.11*
Canada	43	0.5618	0.352	0.023	1.87	AR1	0.15	0.18	7.12*	5.12*
Cape Verde	33	0.2281	0.287	0.045	2.02	OLS	1.11	1.21	3.19*	2.86*
Central African Republic	33	0.2823	0.275	0.012	1.92	AR1	1.59	0.02	3.82*	1.96
Chad	33	0.1103	0.226	-0.004	2.09	AR1	1.66	9.6*	2.29*	-0.028
Chile	43	0.0906	0.115	0.031	1.93	AR1	0.36	0.36	1.72	2.26*
China	33	0.2832	0.196	0.028	1.63	AR1	0.28	1	3.08*	1.67
Colombia	43	0.2245	0.098	0.038	1.81	AR1	3.35*	1.11	3.22*	6.21*
Comoros	33	0.4262	0.268	0.021	1.85	AR1	0.32	0.57	4.73*	1.63
Congo	33	0.4236	0.346	0.035	2.04	OLS	0.88	0.84	4.87*	2.51*
Costa Rica	43	0.2471	0.136	0.046	1.57	AR1	1.58	2.85	2.23*	3.83*
Cyprus	43	0.5668	0.444	0.021	1.85	AR1	0.93	0.87	7.4*	2.01*
Czechoslovakia	31	0.1759	0.179	0.023	1.71	AR1	2.17	0.27	2.36*	2.07*
Denmark	43	0.0752	0.169	0.023	1.78	AR1	0.85	3.69*	1.76	3.18*
Dominican Republic	43	0.3217	0.193	0.034	2.04	OLS	0.08	0.04	4.52*	3.52*
Ecuador	43	0.6061	0.211	0.033	2.19	AR1	0.53	0.25	6.95*	3.69*
Egypt	43	0.125	0.05	0.042	1.9	AR1	2.05	1.62	1.46	4.93*

El Salvador	43	0.5964	0.271	0.023	1.91	AR1	1.41	0.19	2.42*	4.2*
Ethiopia	37	0.1226	0.116	0.028	2.1	OLS	1.49	0.19	2.42*	4.2*
Fiji	31	0.4321	0.301	0.011	1.98	OLS	0.24	0.66	4.01*	0.002
Finland	43	0.6517	0.274	0.028	1.8	AR1	7.43*	0.61	8.33*	2.3*
France	43	0.3145	0.664	0.034	2.02	AR1	2.9	2.11	1.88	5.38*
Gabon	33	0.3466	0.512	0.038	1.93	AR1	0.96	1.56	3.97*	1.34
Gambia	31	0.4127	0.401	0.011	1.99	AR1	3.78*	0.81	4.42*	0.82
Ghana	38	0.1572	0.113	0.025	1.94	AR1	0.78	0.44	2.76*	2.17*
Greece	42	0.3458	0.236	0.029	1.98	AR1	2.43	1.12	4.92*	3.93*
Guatemala	43	0.5825	0.169	0.028	1.95	AR1	0.15	0.28	6.14*	5.05*
Guinea	34	0.606	0.317	-0.001	2.16	OLS	0.23	1.23	7.09*	-0.17
Guinea-Bissau	33	0.1804	0.182	0.017	2.04	AR1	0.7	0.27	2.06*	1.2
Guyana	41	0.6004	0.439	0.001	1.94	AR1	3.12	7.66*	10.94*	0.1
Haiti	30	0.2822	0.187	0.012	1.94	AR1	1.59	3.35*	3.49*	2.47*
Honduras	43	0.3458	0.193	0.031	1.85	AR1	2.61	2.36	4.22*	4.73*
Hong Kong	33	0.279	0.297	0.058	2.04	AR1	2.32	0.38	3.24*	4.41*
Iceland	43	0.0808	0.027	0.043	1.09	AR1	0.12	0.59	0.61	3.33*
India	43	0.0368	0.086	0.036	1.95	AR1	0.56	0.66	1.45	4.27*
Indonesia	33	0.1673	0.002	0.062	2.09	AR1	0.76	0.08	0.15	4.31*
Iran	38	0.4161	0.253	0.029	1.89	AR1	1.52	2.08	4.75*	1.67
Iraq	35	0.5613	0.497	0.024	1.87	OLS	0.28	1.37	6.57*	1.4
Ireland	43	0.229	0.145	0.027	1.86	AR1	2.8	0.12	2.85*	4.78*
Israel	40	0.3109	0.091	0.064	1.81	AR1	0.91	1.68	2.13*	5.8*
Italy	43	0.3776	0.157	0.032	1.93	AR1	1.73	0.53	4.5*	6.43*
Ivory Coast	33	0.5626	0.45	0.019	1.89	AR1	0.1	2.69	5.41*	1.4
Jamaica	39	0.137	0.142	0.024	1.9	AR1	2.46	0.95	2.27*	1.85
Japan	43	0.3661	0.179	0.067	1.98	AR1	2.04	0.86	0.54	5.64*
Jordan	37	0.0162	0.112	0.054	1.91	OLS	0.59	0.65	1.25	2.82*
Kenya	43	0.4565	0.371	0.027	2.13	OLS	1.28	0.31	5.95*	3.23*
Kuwait	30	0.941	1.089	0.008	1.92	AR1	6.49*	3.13	24.47*	1.25
Lesotho	33	0.3335	0.248	0.036	1.91	AR1	0.67	3.15	3.54*	2.42*
Luxembourg	43	0.4022	0.317	0.018	2.02	OLS	0.05	0.48	5.34*	2.57*
Madagascar	33	0.228	0.167	0.011	1.97	AR1	0.32	0.78	3.24*	0.19
Malawi	39	0.4679	0.297	0.027	1.96	AR1	0.53	1.32	5.86*	4.93*
Malaysia	38	0.7612	0.434	0.028	1.98	AR1	2.91	5.05*	10.62*	3.65*
Mali	32	0.0052	0.032	0.021	1.95	AR1	0.12	1.94	0.56	2.41*
Malta	36	0.256	0.179	0.041	1.92	AR1	0.31	6.19*	2.49*	3.96*
Mauritania	33	0.2748	0.213	0.017	2.02	OLS	0.17	2.71	3.57*	1.41
Mauritius	43	0.521	0.521	0.007	1.98	OLS	10.5*	1.04	1.32	1.34
Mexico	43	0.2149	0.199	0.042	1.82	AR1	0.07	0.51	2.5*	4.23*
Morocco	43	0.0861	0.144	0.043	1.98	AR1	0.37	5.17*	1.78	4.2*
Mozambique	33	0.0274	0.017	0.009	2.05	AR1	1.57	0.35	0.68	0.67
Myanmar	40	0.4411	0.293	0.043	1.83	AR1	1.74	0.17	5.56*	4.15*
Namibia	33	0.2509	-0.25	0.052	1.92	OLS	1.54	0.07	3.37*	4*
Netherlands	43	0.3652	0.194	0.027	1.78	AR1	0.89	1.27	3.55*	3.75*
New Zealand	43	0.2808	0.218	0.019	1.71	AR1	0.56	1.44	3.97*	2.35*
Nicaragua	41	0.0008	0.009	0.031	1.75	OLS	0.75	0.25	0.17	2.13*
Niger	30	0.5372	0.453	0.005	2.05	AR1	0.25	0.15	5.41*	0.39
Nigeria	43	0.4861	0.337	0.017	1.88	AR1	0.22	0.35	5.61*	0.99
Norway	43	0.5841	0.264	0.025	1.96	AR1	2.62	1.74	6.2*	5.28*
Pakistan	43	0.1657	0.145	0.037	2.08	AR1	2.74	1.69	3.36*	4.55*
Panama	43	0.4439	0.402	0.027	1.8	OLS	0.27	0.49	5.8*	3.76*
Papua New Guinea	33	0.6466	0.447	0.047	1.8	OLS	2.21	0.71	7.59*	0.74
Paraguay	43	0.4782	0.297	0.02	1.93	AR1	2.63	0.39	6.93*	1.61

Peru	43	0.1883	0.13	0.03	1.72	AR1	1.62	3.29	1.9	2.37*
Philippines	43	0.3582	0.057	0.039	1.72	AR1	2.46	0.07	1.63	3.95*
Portugal	41	0.2412	0.152	0.041	0.18	AR1	1.31	1.66	3.24*	5.28*
Puerto Rica	35	0.6441	0.192	0.043	1.99	OLS	0.45	1.99	2.25*	3.81*
Reunion	30	0.0005	-0.19	0.071	1.94	OLS	0.02	1.08	-0.11	3.97*
Romania	30	0.2101	0.125	0.056	2.03	OLS	0.02	0.45	0.99	1
Rwanda	33	0.1488	0.22	0.031	1.87	0LS	1.98	2.51	2.53*	2.03*
Saudi Arabia	30	0.9191	0.804	0.012	1.86	AR1	0.14	0.25	17.13*	1.2
Senegal	32	0.0971	0	0.029	2	AR1	1.93	0.4	-0.03	5.63*
Seychelles	31	0.3029	0.218	0.04	1.86	OLS	0.73	0.94	3.68*	3.18*
Sierra Leone	32	0.4138	0.332	0.013	1.76	OLS	3.25	1.53	4.71*	1.06
Singapore	33	0.3737	0.189	0.071	1.83	AR1	1.22	0.02	2.86*	5.38*
Somalia	30	0.3401	0.136	0.019	2.13	AR1	4.41*	0.21	3.03*	1.15
South Africa	43	0.5206	0.272	0.027	1.73	AR1	1.31	1.87	6.51*	4.58*
South Korea	39	0.1911	0.095	0.068	1.95	OLS	2.7	0.07	2.2*	5.65*
Soviet Union	30	0.0914	0.085	0.044	1.99	AR1	0.22	0.04	1.46	6.05*
Spain	43	0.1013	0.108	0.04	1.78	AR1	0.72	2.06	1.57	4.18*
Sri Lanka	43	0.3988	0.285	0.027	2.07	OLS	1.63	0.25	5.31*	4.87*
Suriname	30	0.4382	0.487	0.009	1.81	OLS	0.18	0.47	4.77*	0.7
Swaziland	30	0.3946	0.444	0.021	2.11	OLS	0.29	0.06	4.38*	1.14
Sweden	43	0.2399	0.063	0.023	2	AR1	4.68*	0.47	1.95	4.47*
Switzerland	43	0.6455	0.254	0.02	1.7	AR1	1.37	0.39	7.09*	2.99*
Syria	32	0.5063	0.428	0.037	2.07	AR1	1.37	2.73	4.6*	2.48*
Taiwan	40	0.2092	0.149	0.067	1.77	0LS	0.14	1.41	3.32*	9.13*
Thailand	43	0.2757	0.259	0.043	2.15	OLS	1	0.23	4.07*	9.4*
Togo	33	0.4894	0.314	0.025	2.1	OLS	1.71	1.42	5.31*	2.32*
Trinidad and Tobago	42	0.5778	0.473	0.028	2.07	OLS	0.67	0.53	7.46*	3.29*
Tunisia	33	0.1977	0.165	0.044	2.12	OLS	2.5	3.06	2.93*	6.29*
Turkey	43	-0.021	-0.01	0.058	1.92	OLS	2.2	0.4	-0.38	5.94*
Uganda	43	0.1187	0.211	0.024	2.05	AR1	6.85*	3.46*	2.13*	1.29
United Kingdom	43	0.1221	0.08	0.022	1.9	AR1	7.07*	0.95	1.97*	5.1*
United States	43	0.1778	0.166	0.021	1.98	AR1	1.76	6.51*	3.17*	4.17*
Uruguay	43	-0.011	0.048	0.018	1.67	OLS	3.64*	1.29	0.75	1.78
Venezuela	43	0.4588	0.231	0.036	2	AR1	1.36	0.11	5.74*	4.8*
West Germany	43	0.3964	0.16	0.031	1.94	AR1	2.99	0.31	2.82*	3.83*
Yugoslavia	31	0.0407	0.12	0.032	1.8	OLS	1.3	0.72	1.49	2.54*
Zaire	40	-0.021	0.023	0.034	1.94	OLS	2.06	1.3	0.486	2.69*
Zambia	37	0.2655	0.282	0.014	2.07	OLS	0.88	2.65	3.69*	1.35
Zimbabwe	39	0.381	0.311	0.027	1.84	AR1	0.4	0.42	5.12*	2.74*

Note: (1) t_b and t_a are t test statistics for b and a respectively (in equation (1)). We have assigned an * for the t values significant at 5% level. The level varies across countries because of the difference in sample sizes. (2) F_1 and F_2 are F statistics for testing the null hypothesis of noncausality between GRGDP and GOP. We have assigned an * for F values significant at 5% level. (3) DW stands for Durbin-Watson statistic. (4) OLS stands for ordinary least square and AR1 stands for autoregressive model of order 1. Autoregression refers to the error process of the regression equation (1).

TIME SERIES APPROACH

For standard OLS estimates to be meaningful, we have to have the underlying dependent and independent variables I(0) or that they be cointegrated. Thus, as noted earlier, we pursue the time series approach for 124 countries for which we have done the causality tests.

It is still possible for the error process in equation (1) to be autocorrelated. Autocorrelated disturbances will not produce an unbiased estimate of b. We have taken into account of the autocorrelated disturbance in our estimates in Table 2. This is indicated under the column heading of error process. It shows that for most countries the disturbances are autocorrelated. However, autocorrelation of order 1 was sufficient to generate reasonable Durbin-Watson statistic. For most countries, estimate of b is positive and significant. The median value of the estimate of b is 0.2050. We use the median value of b (rather than the mean) because the oil producing countries (e.g., Saudi Arabia) will bias the value upward.

This result is very close to the cross section result obtained by Sinha and Sinha (1996) despite their sample being restricted to a handful Asian countries. However, their time series estimates had an average value of 0.18. But they had very few countries for their time series analysis.

We investigate how different regions show differences in the strengths in the estimate of b. For OECD countries, the average value of b is 0.2051. This includes 24 countries (Australia, Austria, Belgium, Canada, Denmark, Finland, France, Greece, Iceland, Ireland, Italy, Japan, Luxembourg, Netherlands, New Zealand, Norway, Portugal, Spain, Sweden, Switzerland, Turkey, United Kingdom, United States, West Germany). Among them, Turkey shows a negative number. All the countries that rely a great deal on trade (such as Luxemburg) come up with very high numbers. It also shows how important trade has been for geographically isolated countries (such as Australia).

For countries classified under Asia by the World Bank (1992), the average value of b is 0.2166. It is widely trumpeted that trade has played a very important role in the newly industrialized countries in Asia. One surprising result is that the value of b is below the Asian average for Singapore, South Korea and Taiwan. Has trade not played as big a role as people have thought earlier? This revisionist view is gaining currency (see, for example, Hshieh (1999)). Among the emerging Asian countries, Malaysia and Thailand have a value of b which is higher than the Asian average, while Indonesia and Thailand have a lower than average value. For Sub-Saharan Africa, the average value is 0.2511. Thus, the average value for sub-Saharan Africa is higher than the average for Asia. This may indicate that at a lower level of economic growth, free trade policies produce bigger dividend. For Latin American countries, the average is 0.1810. It is well known that the Latin American countries followed an inward looking import substitution policy for a longer time than the newly industrialized countries in Asia. Also, the growth record of the Latin American countries has been far less impressive. For Caribbean countries, the average value of b is 0.2164. Generally speaking, the values for b clearly show the importance of trade for economic growth for developing countries.

What does the result show about Eastern European countries? We have data for four countries for long enough period (Romania, Soviet Union, Czechoslovakia and Yugoslavia). The average value of b is 0.1272. Thus, it is clear that trade in the proper sense of the word (that is, not simply subsidy where market price plays no role at all) hardly played any role in the growth rate of these countries.

When we reclassify the countries according to the World Bank (1992) index of development (developed, less developed and least developed), the average value of b for less developed is 0.24 and for least developed countries the average value of b is 0.24. For the countries in the Middle East, excluding Israel, the value of b is 0.5304. In general, OPEC countries which are located in the Middle East show a marked high value

of b is pushed upward because of oil export. Many of these countries ran high trade surplus during the 1970s and parts of 1980's. Obviously for these countries oil boom has indeed generated economic growth (as a stark contrast among the countries of the Middle East, the value of b for Jordan, which has very little oil, is 0.112 much lower than the rest of the countries in the region).

In summary, time series analysis of 124 countries around the world indicates that there is a significant and positive relationship between openness and economic growth. Further, we find the relationship gives a robust value of b around 0.2.

SUMMARY AND CONCLUSIONS

We have explored the relationship between openness and growth based on evidence from 124 countries. We have used the more natural definition of openness. Previous studies have looked at the relationship between exports and economic growth, by using exports as a proxy for openness. We have performed two types of analyses in this paper. First, we pursue causality tests between openness and 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. Causality tests show that we can reject the null hypothesis that growth of openness does not Granger cause growth of GDP for 11 countries. On the other hand, we can reject the null hypothesis that growth of GDP does not Granger cause growth of openness for 18 countries. Second, we conduct time series analysis for those countries for which causality tests are performed. We find that there is a positive significant relationship between the growth in openness and the growth in GDP for 94 countries. Thus, our analyses add weight to Romer's stylized fact.

REFERENCES:

Ahmed, Jaleel and Harnihuran, Somchai (1995) "Unit Roots and Cointegration in Estimating Causality between Exports and Economic Growth: Empirical Evidence from the ASEAN Countries," *Economics Letters*, 49, 329-334.

Balassa, Bela (1978) "Exports and Economic Growth: Further Evidence," *Journal of Development Economics*, 5, 181-89.

Clerides, Sofronis, Lach, Saul and Tybout, James (1996) "Is Learning by Exporting Important? Micro-dynamic Evidence from Colombia, Mexico and Morocco," National Bureau of Economic Research Working Paper No. 5715, August.

De Long, J. Bradford (1988) "Productivity, Growth, Convergence and Welfare: Comment," *American Economic Review,* 78, 1138-1154.

Dollar, David (1992) "Outward-oriented Developing Economies Really Do Grow More Rapidly: Evidence from 95 LDCs, 1976-85," *Economic Development and Cultural Change*, 40, 523-44.

Edwards, Sebastian (1993) "Openness, Trade, Liberalization, and Growth in Developing Countries," *Journal of Economic Literature*, 31, 1358-1393.

Emery, Robert F. (1967) "The Relation of Exports and Economic Growth," *Kyklos*, 20, 470-86.

Feder, Gershon (1982) "On Exports and Economic Growth," *Journal of Development Economics*, 12, 59-73.

Frankel, Jeffrey, Romer, David and Cyrus, Teresa (1995) "Trade and Growth in East Asian Countries: Cause and Effect?" Center for International and Development Economics Research Paper No. C95-050, University of California, Berkeley, CA.

Granger, Clive W. J. (1969) "Investigating Causal Relations by Econometric Models and Cross Spectral Methods," *Econometrica,* 35, 424-438.

Granger, Clive. W. J. and Newbold, Paul (1974) "Spurious Regressions in Econometrics," *Journal of Econometrics*, 2, 111-20.

Granger, Clive W. J. (1988) "Some Recent Developments in the Concept of Causality," *Journal of Econometrics*, 39, 199-211.

Harrison, Ann (1995) "Openness and Growth: A Time Series, Cross Country Analysis for Developing Countries," National Bureau of Economic Research Working Paper No. 5221, August.

Hsieh, Chang-Tai (1999) "What Explains the Industrial Revolution in East Asia? Evidence from Factor Markets", paper presented at the American Economic Association Annual Meeting, New York, NY.

Krueger, Anne O. (1978) *Foreign Trade Regines and Economic Development: Liberalization Attempts and Consequences* (Cambridge, MA: Ballinger for NBER).

Krueger, Anne O. (1990) "Asian Trade and Growth Lessons," *American Economic Review*, 80, 108-12.

Leamer, Edward (1988) "Measures of Openness," in Robert E. Baldwin (ed.) *Trade Policy Issues and Empirical Analysis*, NBER Conference Report Series (Chicago: University of Chicago Press).

Liu, Xiaming, Song, Haiyan and Romilly, Peter (1997) "An Empirical Investigation of the Causal Relationship between Openness and Economic Growth in China," *Applied Economics*, 29, 1679-86.

Maddison, Angus (1982) *Phases of Capitalist Development* (Oxford: Oxford University Press).

Michaely, Michael (1977) "Exports and Growth: An Empirical Investigation," *Journal of Development Economics*, 4, 49-54.

Phillips, Peter C. B. (1986) "Understanding Spurious Regressions in Economics," *Journal of Econometrics*, 33, 311-40.

Phillips, Peter C. B. and Pierre Perron (1988), "Time Series Regression with a Unit Root", *Biometrika*, 75, pp. 335-46.

Ram, Rati (1990) "Imports and Economic Growth: A Cross Country Study," *Economia Internazionale*, 43, 45-66.

Romer, Paul (1989) "Capital Accumulation in the Theory of Long Run Growth" in Barro, Robert (ed) *Modern Business Cycle Theory* (Cambridge, MA: Harvard University Press).

Sengupta, Jati K. (1994) "Empirical Tests of New Growth Theory: Openness and Growth," *Journal of Economic Integration*, 9, 393-415.

Sims, Christopher A., Stock, James and Watson, Mark (1990) "Inference in Linear Time Series Models with some Unit Roots," *Econometrica*, 54, 113-144.

Sinha, Tapen and Dipendra Sinha (1996), "An Empirical Investigation into the Relationship between Openness and Economic Growth: Evidence from Asia", *International Review of Economics and Business*, 43, 359-70.

Summers, Robert and Heston, Alan (1991) "The Penn World Table (Mark 5): An Expanded Set of International Comparisons, 1950-88," *Quarterly Journal of Economics*, 106, 327-68.

Van den Berg, Hendrik and Schmidt, James R. (1994) "Foreign Trade and Economic Growth: Time Series Evidence from Latin America," *Journal of International Trade and Economic Development*, 3, 249-68.

World Bank (1992) *World Development Report, 1992* (New York: Oxford University Press).