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INTERNATIONAL GROWTH LINKAGES: EVIDENCE FROM ASIA AND THE OECD

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ABSTRACT

This paper first shows how the convergence model generally applicable to the OECD and in augmented form to global samples fails to reflect the post-1960 experience of the Asian economies, and then considers some of the factors explaining the differences. Investment rates in physical capital appear to be more important in explaining growth differences among the Asian economies, while education matters less. Various measures of openness to imports contribute importantly to explaining relative growth rates in Asia, with the more open economies generally having significantly faster growth rates, even after allowing for differences in investment rates. After allowing for differences in openness and investment rates, there also appears to be a trade-off between democracy and growth, with the initially less democratic Asian countries having faster subsequent growth, leading eventually to increasing effective demand for democratization.

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Introduction

Attempts to estimate models of comparative growth applicable to all of the world's economies have found the Asian experience to be different in key respects from that of the OECD countries. The faster-growing Asian economies have typically relied on an outward-looking trading strategy, and have rapidly adopted, and sometimes leapfrogged, technical advances developed and originally applied in other countries. This paper seeks to link these two issues, by assessing first the extent to which comparative growth models fitted to global and OECD evidence apply to Asian experience, and then seeing if differing openness among the Asian economies helps to explain their relative growth rates.

The evidence will be presented in stages. First there will some background and results from a model of comparative growth applied to a global sample of countries, with special attention to the extent to which convergence of growth rates is apparent once due allowance is made for differing rates of accumulation of physical and human capital, and for differences in average scale. Then the focus will turn to the same model fitted to the industrial countries, and to a step-by-step assessment of the reasons why, and extent to which, the model does not explain the comparative growth performance of the Asian economies. This will be followed by some tests of the contribution of other factors to explaining the Asian growth experience, with special attention to the extent to which the countries are economically and politically open to the rest of the world.

Evidence on these issues is of interest far beyond the boundaries of the countries concerned, since more than half of the world's population lives in Asia, and what happens in the Asian economies is bound to become ever more important at the global level. This growing importance is due in part to growing international interdependence, whether measured by trade shares or

by the shrinking relative costs of transport and communications, and in part to the fact that average growth rates in Asia are likely to remain above those in the rest of the world for decades to come.

Background and Global Evidence

The initial results reported in this paper are drawn from cross-sectional estimates of a comparative growth model fitted to explain the growth of GDP per adult in 98 countries[1] between 1960 and 1985. The particular equation used is based on an extended form of the Solow (1956, 1957) growth model, as augmented by Mankiw, Romer and Weil (1992) to include human capital accumulation, with real output determined as a Cobb-Douglas function of physical capital, human capital and efficiency units of labour:

$$(1)\quad Y(t) = K(t)^{\alpha}H(t)^{\beta}(A(t)L(t))^{1-\alpha-\beta}$$

where H is the stock of human capital, L the stock of labour (growing at rate n), K the stock of physical capital, depreciating at the rate δ, and A the level of technology, growing at the constant rate g. The coefficients imply constant returns to all factors taken together, and hence diminishing returns to any combination of physical and human capital. If s_k is the fraction of output invested in physical capital and s_h the fraction invested in human capital, then in the steady state the log of output per capita is:

$$(2)\quad \ln[Y(t)/L(t)] = \ln A(0) + gt - ((\alpha+\beta)/(1-\alpha-\beta))\ln(n+g+\delta) + (\alpha/(1-\alpha-\beta))\ln(s_k) + (\beta/(1-\alpha-\beta))\ln(s_h)$$

This framework is extended to include the possibility of what Mankiw *et al.* call "conditional convergence", that if each country starts at some level of output that differs from its steady state value, there will be convergence

towards the steady state growth path for that country. This need not imply that all countries have the same equilibrium level of income per capita (they argue that the level of A can be different across countries, based on variations in natural resources, institutions, and other factors unrelated to the stocks of human and physical capital) or even the same growth rate, since the equilibrium growth rate for each country will depend on its population growth and investment in human and physical capital. The Solow model augmented for human capital accumulation predicts that the rate of convergence of each country towards its steady state growth path will be at the proportional rate λ, where

$$(3)\quad \lambda = (n+g+\delta)(1-\alpha-\beta).$$

The log difference between current income per effective worker and that in any given earlier period 0 is thus given by

$$(4)\quad \ln(y(t)) - \ln(y(0)) = (1-e^{-\lambda t})(\alpha/(1-\alpha-\beta))\ln(s_k) + (1-e^{-\lambda t})(\beta/(1-\alpha-\beta))\ln(s_h) - (1-e^{-\lambda t})((\alpha+\beta)/(1-\alpha-\beta))\ln(n+g+\delta) - (1-e^{-\lambda t})\ln(y(0)).$$

Applied by Mankiw *et al.* to a cross-sectional sample of the growth experience of 98 countries from 1960 to 1985, this equation seemed to fit the experience of the developing as well as the industrial countries. There was evidence of conditional convergence for the whole sample of countries, as well as for the more restricted sample of industrial countries. Their results also showed that allowing for the accumulation of human capital lowered the estimated coefficient on physical capital to a level that was consistent with capital's share in output, and hence with the Cobb-Douglas assumption of constant returns to scale. Mankiw *et al.* interpreted their results as a

vindication of the augmented Solow model, and an implicit rejection of the increasing number of models built on the assumption that knowledge spillovers created the likelihood of increasing returns to scale at the national level.[2] In the light of earlier results finding some significant evidence of modest returns to average scale at the national level[3], the equations used in this paper augment equation (4) to include scale effects, and also impose the coefficient restrictions implied by equation (4), so that the final form for estimation using cross-section data for growth in GDP per adult between 1960 and 1985 is:

$$(5)\quad \ln(GDPa85) - \ln(GDPa60) = a_0 + a_1\ln(scale) + a_2\ln(GDPa60) + a_3(\ln(I/GDP)-\ln(n+g+\delta)) + a_4(\ln(school)-\ln(n+g+\delta))$$

where: $a_2 = -(1-e^{-\lambda 25})$

$a_3 = (1-e^{-\lambda 25})(\alpha/(1-\alpha-\beta))$

$a_4 = (1-e^{-\lambda 25})(\beta/(1-\alpha-\beta))$

In the Mankiw *et al* framework, the productivity index may have a different level in each country (to account for resource endowments, etc.), but has the same exogenous growth rate in each country. This may be contrasted with an alternative that I have previously developed and tested with the collaboration of Alan Chung[4], in which the efficiency indexes initially grow at different rates in each country, with convergence taking place in the rates of growth, and possibly in the levels, of the technology indexes. In this alternative, international transfers of knowledge are given a central role in convergence, with the initially poorer countries able to have efficiency levels that grow faster than those in the richer countries. This is because the initially poorer countries are able to make use of current best practice procedures already in use in the more productive economies. If a large part of convergence takes place through this channel, rather than just by different

investment rates and general use of the same technologies, then it offers strong support for models, such as those of Grossman and Helpman (1991), that treat technology transfer as a costly and time-using process that depends on market structure and relative levels of income and education. It also implies that at least part of the convergence may take place without high levels of investment, although it leaves unspecified the conditions that best facilitate international transmission of technical progress. This issue will be the focus of a later section. For the moment, it is sufficient to note that studies of the OECD economies showed strong convergence in the rates of growth of 'Solow residuals', even after allowing for differences in the rates of investment in human capital[5]. These results force the adoption of a different interpretation of the constant term in cross-sectional growth regressions. In the Mankiw *et al.* framework, the estimated constant term is just the logarithm of the ratio of equilibrium incomes. If convergence of productivity growth is assumed, the estimated constant term in a cross-sectional regression is a function of the equilibrium level differences as well as the speed of convergence of growth rates, and the initial level differences, of the productivity indexes.

Figure 1 shows the conditional convergence for the 98-country global sample. The curve shows the predicted growth rate[6] for any country as a function of its 1960 real GDP per capita, assuming the country to have global average values for all of the other variables in equation (i) of Table 1. The two-letter country codes used in the figures are defined in the data appendix. The vertical distance between each country's rectangle and the curve is that country's error term in the cross-country regression, and hence shows the extent to which the global model fits that country's experience. If separate dummy variables are added for continents, growth rates are found to be lower in Africa and South America. There is no significant difference for average growth in Asia, but the model nonetheless does a poor job of explaining the

growth experiences of the Asian economies, as can be seen by the rectangles for some of the Asian economies. The model fails to capture either the high growth of Singapore, Hong Kong and Korea, or the low growth of India and Sri Lanka. To delve further into this, we turn to consider the model's predictions for each of the key factors it uses to explain growth differences. This will be done using parameter estimates for the OECD countries, which do not differ dramatically from those in the global sample, and permit a closer inspection of actual and predicted growth rates for each of the Asian and OECD countries.

Comparing Growth in Asia and the OECD

Figure 2 is somewhat akin to Figure 1, in that growth is on the vertical axis, and initial real GDP on the horizontal axis. There are three key differences. Here the rectangles show each country's actual average annual growth rate of real GDP per adult over the 1960 to 1985 period, while the plus signs vertically above or below each rectangle show what that country's growth rate is predicted to be, using the parameters based on OECD data[7] and each country's own actual values for each of the model variables[8].

The distance by which the rectangle is above the plus sign is thus the equation error for that country[9]. The curve in Figure 2 shows the predicted growth rate for any country having the initial income recorded on the horizontal axis and average values for the other variables in equation (ii) of Table 1. The distance between the curve and the plus sign for each country shows how much of its growth is explained by that country's differences from average values for investment rates, schooling, population growth and scale. The rectangles for the Asian economies, with the exception of Korea, are far from the curve. In some cases, such as that of Japan, most of the distance is explained by the model, while in others, especially Singapore and Hong Kong, the error of the model is even larger than the distance between the curve and

the actual growth performance. According to the model, these two economies should have had much lower growth rates, given their relatively high initial incomes (relative to those in most non-OECD countries) and very small size, even given their relatively high investment rates. In fact, there is no evidence of convergence among the Asian economies, with the three richest, Japan, Hong Kong and Singapore having the fastest subsequent growth rates, while the two slowest growing, India and Nepal, were also among those with the lowest initial income levels. Direct estimation of the comparative growth model for Asia, as shown in equation (iii) of Table 1, shows (insignificant) diseconomies of scale, (insignificant) divergence rather than convergence, a significant investment effect with twice the coefficient estimated for either the global or the OECD samples, and an insignificant negative effect of schooling.

Figures 3 to 5 investigate the model results more closely, by plotting three of the model's other key partial relationships to show some of the important differences between the Asian and the OECD economies, and among the Asian economies themselves. In all three figures, the curves are drawn using the parameters estimated for the OECD countries. Figure 3 shows growth rates plotted against investment rates, and demonstrates why the investment effect is seen to be so high for the Asian sample on its own (as shown by equation iii in Table 1), with especially high investment in the faster growing countries and abnormally low investment in the slow growers. Of course, simultaneous equations bias is likely to be a serious problem in this case, as growth encouraged by other factors would imply higher investment rates in the faster-growing countries to keep the ratios of capital to labour at their cost-minimizing levels.

Figure 4 shows the relation between schooling and growth. As shown by the flat curve, the estimated relation is weak for the OECD countries, while equation (iii) in Table 1 shows that it is even negative for the Asian

economies. The variable is significant in the global sample, as shown by equation (i) in Table 1, because of educational differences among the African countries, and to a lesser extent among the Latin American countries. In Asia, the relation is upset both by the high growth countries with low schooling rates (Pakistan, Burma, Indonesia and Thailand), and the slow growing countries with high schooling ratios (Sri Lanka and the Philippines). To test whether this result was dependent on the use of a particular measure of educational attainment, three alternative variables were also assessed, including the adult literacy rate, the average years of education in the labour force, and estimated years of education of the population of working age[10]. The simple correlations of these three variables with each other, and with the secondary schooling variable used in the initial regressions, lie between .8 and .9. Each of these three alternative variables attracts an insignificant negative coefficient if used to replace the schooling variable in equation (iii) of Table 1. Thus the insignificant negative coefficient on schooling in the Asian equation (iii) in Table 1 is not simply a result of the use of a peculiar measure of educational attainment, leaving open the question of why measures of educational attainment have less cross-sectional explanatory power in Asia than elsewhere among the developing countries.

Figure 5 shows the relation between scale and growth, which is significant but of modest size for the OECD (degree of returns to scale at the national level of 1.061), and of the reverse sign for the Asian economies, chiefly because of the influence of small but fast-growing Singapore and Hong Kong, and of large but slow-growing India.

Finally, before turning to some attempts to assess the effect of economic openness on relative growth differences among the Asian economies, Figure 6 shows the relation between growth rates and a measure of political democracy in 1960. Attempts to unravel the complex linkages between political

openness and economic growth have generally shown a strong positive relation between a country's level of per capita income and current and subsequent values of several different measures of democracy, including indexes of civil liberties as well as political rights. As for the reverse linkages from democracy to subsequent economic growth, they have proven difficult to measure, in part because of the shortage of data to enable the simultaneous feedbacks from income to democracy to be disentangled from the effects of democracy on economic growth[11]. When simultaneous feedbacks are accounted for, as they are by the use of Bollen's (1980, 1990) index of democracy for 1960, the results tend to show a generally negative but very slight effect on subsequent economic growth, for given levels of investment and education. When the positive effects of democracy on education and investment are taken into account, however, the net effect seems to be about zero for the global sample[12]. Simple correlations between the Bollen index and growth, for both the OECD and Asian samples, tend to confirm this result, as does visual inspection of the data shown in Figure 6. More direct attempts to make use of the Bollen index in explaining growth differences among the Asian economies will be found in the next section, and in the equations reported in Table 2.

Explaining Growth Differences Among the Asian Economies

As noted in the introduction, many of the faster-growing Asian economies have relied heavily on an outward looking strategy. This section draws together some measures of openness collected and distributed by the World Bank (1991) in the course of the research for the Bank's 1991 **World Development Report**. The results reported can only be suggestive rather than conclusive, since the size of the sample is small and only three measures of economic openness have been assessed. However, as shown by Figures 7 through 9, and in equations (iv) through (vi) of Table 1, there is a significant relation between each of the measures of openness and economic growth for

the sample of eleven countries for which both types of data are available[13].

The first of the three measures is the frequency of non-tariff barriers applied to all goods, with the total for each country based on total world imports of the products[14]. The regression explains about 40% of the cross-sectional variation in growth rates, although the risk of simultaneous equations bias may be serious with an independent variable measured four-fifths of the way through the growth period under review, since countries that succeed in growing quickly for some other reasons may thereafter choose to liberalize their trade. However, Figure 7 shows that the countries are divided into two distinct groups, with the faster-growing countries having generally fewer non-tariff barriers not just in 1981 but over the preceding years as well.

The second measure of openness is the black market exchange premium, which presumably relates to the mobility of capital at least as much as of goods, and is averaged over the period from 1971-1985, the longest period for which data are available for all eleven countries[15]. It also has a significant correlation with cross-sectional differences in growth rates, with a 1 percentage point increase in the average black market premium being associated with a .06 percentage point decrease in the average annual growth rate over the 1960 to 1985 period[16]. Of the three measures, it contributes the least to explaining differences in growth rates, with one-third of the variance being explained.

The third openness variable is total import duty collected, measured as a percent of total merchandise imports, averaged over the 1971-1985 period. This variable is transformed for estimation, as shown in Table 1. It has the highest explanatory power of the three variables, with almost half of the cross-sectional variance of growth rates explained by differences in tariff rates. The estimated size of the effect is such that a 1 percentage point increase in average tariffs is associated with a .17% decrease in the average annual

growth rate.

To what extent are the three openness variables providing independent information? Their correlations with each other are relatively low, which may be due in part to different errors of measurement, and in part to the fact that different countries have adopted different types of trade and capital restrictions[17]. The first equation of Table 2 attempts to exploit the independent variance in the three measures by including them all in a single equation. Given the small size of the sample, and the fact that all three variables are measuring closely related policies, it is not surprising that the significance levels of the individual variables is much reduced. However, the adjusted proportion of the variance explained nonetheless rises to .58, with tariffs and the black market premium being the most important contributors. Equation (ii) adds the investment rate, which was the only one of the original growth model variables to be significant in the Asian estimation for 13 countries. Adding the investment variable has the effect of leaving the overall proportion of variance explained slightly reduced, and lowers the effect of the NTBs and the black market exchange premium almost to zero. Removing the latter two variables raises the adjusted R^2 to .68, as shown in equation (iii).

Equations (iv) to (vi) estimate the partial effect of democracy given either investment rates or tariff measures, or both, as basic explanatory variables. When investment rates and the democracy index are both included in the equation, the adjusted R^2 rises to about .89, and is slightly higher when the tariff rate is also included in the equation. The partial effect of democracy is found to be negative, with a coefficient three times as large and more than twice as significant as was earlier found when the Bollen index was added to the global equation[18]. This strong and striking result raises at least two questions of reliability and interpretation. First, the sample size is so small that the result may be heavily dependent of the particularities of one or two

countries, and on ad hoc choices of functional form and variables. Second, there is a real possibility that although democracy may have a negative partial effect given the level of investment, investment rates themselves may be higher in a democratic system. This latter possibility, which was significant for the global sample, turns out not to be important in the Asian sample, where no significant part of the cross-country variation in investment rates was explained by differences in their 1960 indexes of democracy. Huntington (1991) argues, from the evidence of the successive waves of democratization in the twentieth century, that first attempts often fail, in part because of the lack of previous experience in the successful management of democratic institutions. Asian countries that were in their early stages of democracy, or whose first attempts failed during the data period under study, may well show stronger negative correlations with growth than would be true for the global sample including many countries with more decades of successful operation of democracies. In addition, of course, there is the possibility that for some of the countries studied, the conditions were met for the 'conflict perspective' (Huntington 1987, Sirowy and Inkeles 1990) to be applicable, with fledgling democratic institutions being too weak to adopt the policies necessary to foster sustained economic growth.

There is, however, one relationship that is common to the OECD and the Asian economies that is not shared by the other regional groupings of countries. That is the linkage between the real exchange rate and the average level of per capita GDP, as shown in Figure 10 for 1985. The relationship holds quite strongly among the OECD economies (Hill 1986), among the Asian economies, and between the two groups of economies[19]. It was argued in Helliwell and Chung (1992a) that the failure of the same relationship to hold in Africa and Latin America might well be due to the relative lack of economic and financial openness in those economies. To the extent that this

lack of openness led to slower importation of technical progress from abroad, or to the extent that it was due to macroeconomic instabilities[20], then it may have contributed to the lower average growth in Latin America and Africa that appears even after allowance is made for differences in investment in human and physical capital. These intercontinental comparisons, which lack any formal statistical tests at this stage, tend to support the evidence from among the Asian economies that more openness tends to lead to faster growth, presumably by permitting faster flows of ideas from countries where average productivity levels are higher.

Conclusions

The evidence in this paper has confirmed the general inapplicability to the Asian economies of the same convergence model that has fared rather well for the OECD countries and for several global samples. Growth is not higher in the poorer Asian countries, even after allowing for differences in rates of investment in human and physical capital. Among the OECD countries, by contrast, growth has been higher in those that were initially poorer, whether or not separate allowance is made for other variables influencing cross-country differences in growth rates, and whether the comparison is made using Solow residuals or growth rates of per-capita GDP[21]. As for the other variables used for the global samples of countries, investment in physical capital appears more important in Asia, and education less so.

Growth is faster in those Asian countries that are more open to imports and capital movements. The evidence linking openness and growth for the sample of Asian countries seems even stronger than for developing countries as a whole (Harrison 1991), or for the OECD countries (Helliwell 1992b), although these differences remain to be tested. The relatively small number of Asian countries, and the resulting importance of particular

circumstances, may well make general conclusions on this score hard to reach. In any event, there is a clear grouping among the Asian economies under review, with the more open also the faster growing. There are so many other factors distinguishing the two groups of countries that it is clearly premature to make any strong conclusions at this point.

There is also some evidence of a trade-off between more democracy and faster growth for given levels of investment and openness. Whether or not the Asian trade-off between growth and democracy turns out to stand the test of more thorough investigation, it relates more to the 1960 to 1985 period that for the next century, since the positive link between incomes and democracy is likely to combine with the high growth rates of most of these economies to put them all into the class of experienced democracies by the time another 25 years have passed[22]. For the countries with lower per capita growth rates, and higher population growth rates (Brander and Dowrick 1991), the trade-off, is it is confirmed, may well remain in place for some years to come.

One final qualification is necessary. Easterly *et al* (1992) and others have noted that there is substantial variance from one decade to the next in the ranking of growth rates across countries, while there is much more stability in the country characteristics, including the openness measures, used to explain growth rate differences. This suggests that the cross-sectional parameter estimates might be unstable from one period to the next, and have little predictive power for future growth. These risks need to be assessed carefully before attaching too much importance to the correlations based on a particular period of previous growth. Nonetheless, the link between openness and growth that is apparent for the Asian countries over the 1960-1985 period seems a promising candidate for further investigation.

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Footnotes

1. The real GDP data are from the Mark IV data sample described in Summers and Heston (1988), as augmented and implemented by Mankiw *et al* (1992).

2. For examples, see Romer (1986, 1990a, 1990b) and Lucas (1988, 1990). Alternative endogenous growth models by Grossman and Helpman (1989, 1990a, 1990b) assume economies of scale and knowledge spillovers at the industry level, which has no necessary implications for returns to scale at the national level. See Helpman (1991) for a helpful survey.

3. The evidence for increasing returns is based entirely on the experience of the industrial countries. Increasing the sample to include 98 countries does not overturn the result, but neither does it provide any evidence for returns to scale. Tests for non-linearity in the scale effect (reported in Helliwell and Chung 1991c) did not find any apparent threshold effects.

4. In Helliwell Sturm and Salou (1985) and Helliwell and Chung (1991b) for the G-7, in Helliwell and Chung (1991a) for 19 industrial counties, and in Helliwell and Chung (1992c) for 19 industrial and 8 Asian economies. The effects of adding variations to human capital are assessed in Helliwell and Chung (1992a).

5. The Solow residuals are obtained by inverting equation (1) to define a measured series for A (t) using actual values for Y and K, and using the number of employees to represent the labour input HL. Tests supporting convergence of the rates of growth of the Solow residuals for the OECD countries are reported in Helliwell and Chung (1991a) and Helliwell (1992b).

6. The predicted values in the figures are presented as average annual proportionate growth rates, obtained by dividing by 25 the estimated growth rates from the equations reported in Table 1, which estimate the results for growth over a 25-year period. Figure 1 is based on the parameter estimates from the global equation (i), while Figures 2 through 6 are based on the OECD equation (ii).

7. The parameter estimates are shown in equation (ii) of Table 1.

8. For all of the results reported in this paper, Japan is treated as part of the OECD sample, since it is a member of the OECD and since the OECD model fits the Japanese experience closely enough that the parameter estimates do not

depend materially on whether Japan is included.

9. The distance between the rectangle and the plus sign in Figure 2 is thus analogous to the distance between the rectangles and the curve in Figure 1, but is not exactly the same because in Figure 2 the parameters are based on the global sample while the OECD sample is used to estimate the equation used to define the predicted values in Figure 2.

10. All three of the alternative series are drawn from World Bank (1991), with values equal to the average of the reported observations over the 1960 to 1985 estimation period. The values used are recorded in the data appendix. The average years of education variable (EDP4) is a single observation for each country, based on survey data, from Psacharopoulos and Arriagada (1986). The variable for average years of labour-force education (EDT) uses UNESCO data on enrollment, combined with birth and mortality statistics, as initially constructed by Lau, Jamison and Louat (1991) and subsequently published in revised form by Louat (1991).

11. The substantial but inconclusive empirical literature is surveyed by Sirowy and Inkeles (1990).

12. These results are reported in Helliwell (1992a).

13. The sample is reduced from 13 to 11 because the measures of openness are not available for Burma and Nepal. The data used are shown in the data appendix.

14. The series used here is NTBW5, measured as of 1981, based on UNCTAD (1987) primary data and made available and described in World Bank (1991).

15. The data are from the **World Currency Yearbook**, and are included in World Bank (1991) under the series title BLACK.

16. To calculate the effect, the coefficient must be divided by 25, since the dependent variable is the 25-year log difference in real GDP per adult.

17. For the 11-country sample, the correlations are .37 between the tariff and the black market premium, .67 between the tariff and NTB variables, and .41 between the black market premium and NTB.

18. The coefficient on the Bollen index is -.247, with an absolute value of the t-statistic of 1.61 in the 98-country equation reported in equation (2) of Table 3 of Helliwell (1992a).

19. These relationships are more formally estimated and tested in Helliwell and Chung (1992c).

20. The link between macroeconomic instabilities and growth, with macroeconomic instability and high and variable inflation leading to low growth, has been emphasized by Fischer (1991) and Gylfason (1990).

21. The convergence effect applicable to the industrial countries has been reported by Abramovitz (1990), Baumol and Wolff (1988), Dowrick and Gemmell (1991), and Maddison (1982) among others. Helliwell and Chung (1991a) show that convergence is applicable as much to the growth of Solow residuals as to GDP per capita. Levine and Renelt (1992) show that even in global samples such as those used by Mankiw *et al* (1992) and Barro (1991) there is a robust negative effect running from initial GDP per capita to subsequent growth rates, while noting much less stability in the estimated effects of policy variables, including especially fiscal policies but also some of the openness measures used in this paper.

22. The strong positive linkage from the level of real GDP per capita to democracy is documented in Helliwell (1992a).

Table 1
Cross-Country Growth Equations

Equation	(i)	(ii)	(iii)	(iv)	(v)	(vi)
No. of Observations	98	22	13	11	11	11
Sample	Global	OECD	Asia	Asia	Asia	Asia
Constant	1.758	1.579	0.271	2.10	1.087	1.318
	(3.28)	(2.98)	(2.80)	(4.54)	(6.95)	(7.30)
Coefficients:						
scale	.062	.061	-.093			
	(2.53)	(2.79)	(1.02)			
1960GDPa	-.343	-.442	.175			
	(5.60)	(7.29)	(0.66)			
invest-(n+g+d)	.502	.467	1.070			
	(6.26)	(3.54)	(3.14)			
school-(n+g+d)	.197	.237	-.418			
	(3.31)	(1.95)	(1.33)			
ln(NTBs)				-.365		
				(2.80)		
ln(1.0+.01*BLACK)					-1.505	
					(2.39)	
ln(1.0+.01*TARIFF)						-4.308
						(3.20)
$\bar{R}^2$	.495	.752	.563	.406	.320	.481
S.E.E.	.317	.123	.317	.371	.397	.347

Notes: Absolute values of t-statistics are in parentheses. The dependent variable in all equations is the growth in real GDP per adult from 1960 to 1985, i.e. lnGDPa85-lnGDPa60. NTB is the total number of non-tariff barriers, BLACK the average percentage black market exchange premium from 1971-1985, and TARIFF total tariff revenues over total imports, average %, 1971-1985, all three series from World Bank (1991).

Table 2
Combined Growth Equations for Asia

Equation	(i)	(ii)	(iii)	(iv)	(v)	(vi)
No. of Observations	11	11	11	9	9	9
Sample	Asia	Asia	Asia	Asia	Asia	Asia
Constant	1.714	1.579	0.271	3.64	1.512	3.85
	(4.03)	(2.98)	(2.80)	(8.71)	(4.34)	(10.11)
Coefficients:						
Bollen 1960				-.823	-.360	-.904
				(4.03)	(0.81)	(4.62)
invest		.532	.607	1.256		1.415
		(0.98)	(2.58)	(5.43)		(7.55)
ln(NTBs)	-.129	.002				
	(0.86)	(0.01)				
ln(1.0+.01*BLACK)	-.874	-0.20				
	(1.60)	(0.23)				
ln(1.0+.01*TARIFF)	-2.55	-3.029	-3.040	-.947	-3.72	
	(1.55)	(1.76)	(2.61)	(1.13)	(2.33)	
$\bar{R}^2$	.582	.579	.681	.891	.371	.886
S.E.E.	.311	.312	.272	.153	.365	.156

Notes: Absolute values of t-statistics are in parentheses. The dependent variable in all equations is the growth in real GDP per adult from 1960 to 1985, i.e. lnGDPa85-lnGDPa60. NTB is the total number of non-tariff barriers, BLACK the average percentage black market exchange premium from 1971-1985, and TARIFF total tariff revenues over total imports, average %, 1971-1985, all three series from World Bank (1991). The nine countries for which the tariff data and the 1960 Bollen democracy index (from Bollen 1980, Appendix 2) are both available include India (.936), Indonesia (.203), Korea (.517), Malaysia (.835), Pakistan (.400), Philippines (.930), Singapore (.812), Sri Lanka (.940) and Thailand (.331). The 1960 values for the Bollen index are shown in brackets after each country name.

Fig 1: Conditional Convergence
in the Global Economy

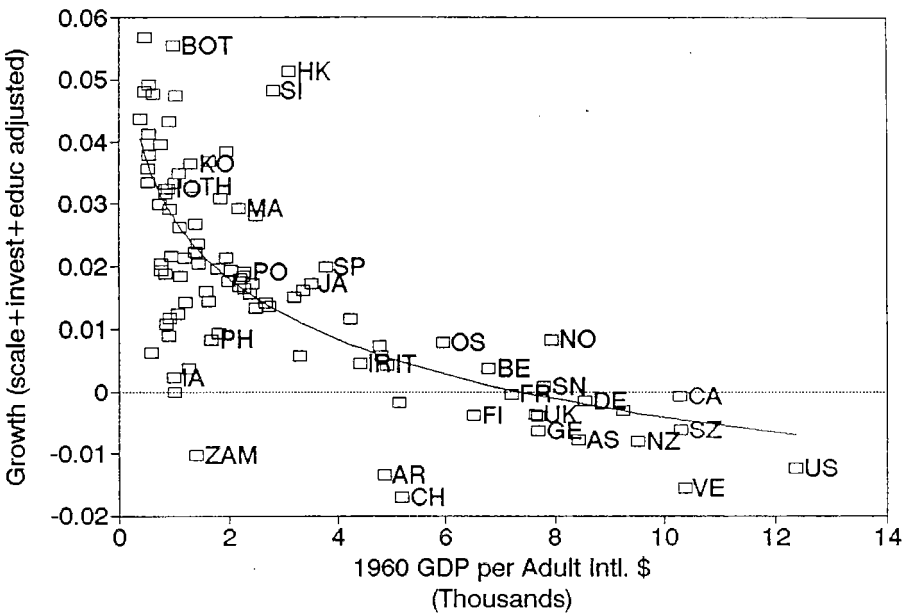


Fig 2: Actual and Predicted Growth
vs 1960 Income Per Adult: OECD and Asia

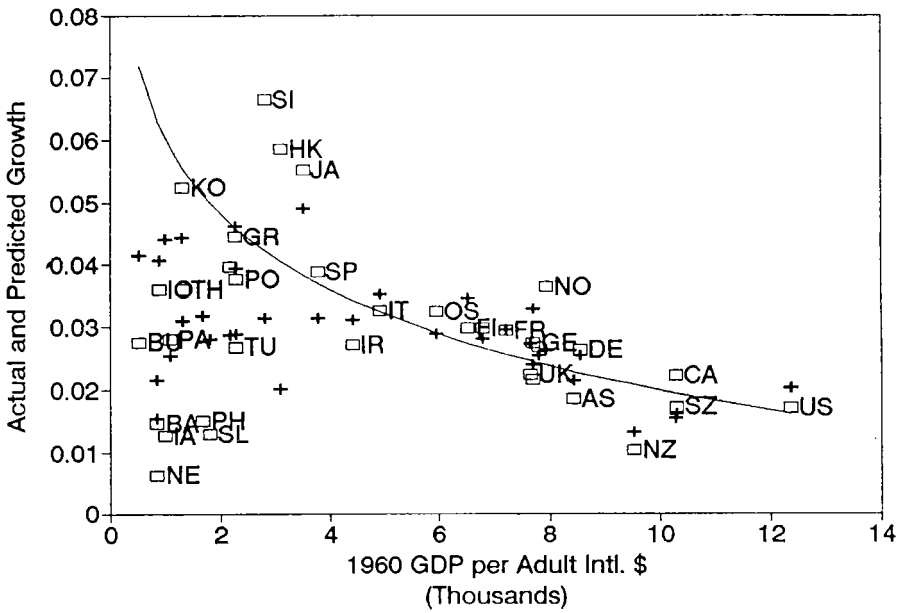


Fig 3: Actual and Predicted Growth
vs Investment as % of GDP in OECD, Asia

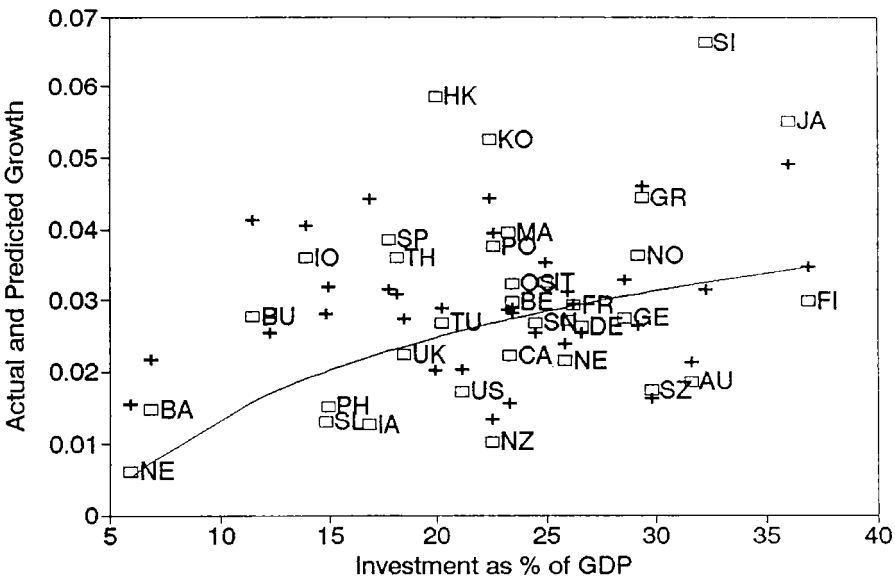


Fig 4: Actual and Predicted Growth
vs Secondary School Enrollment

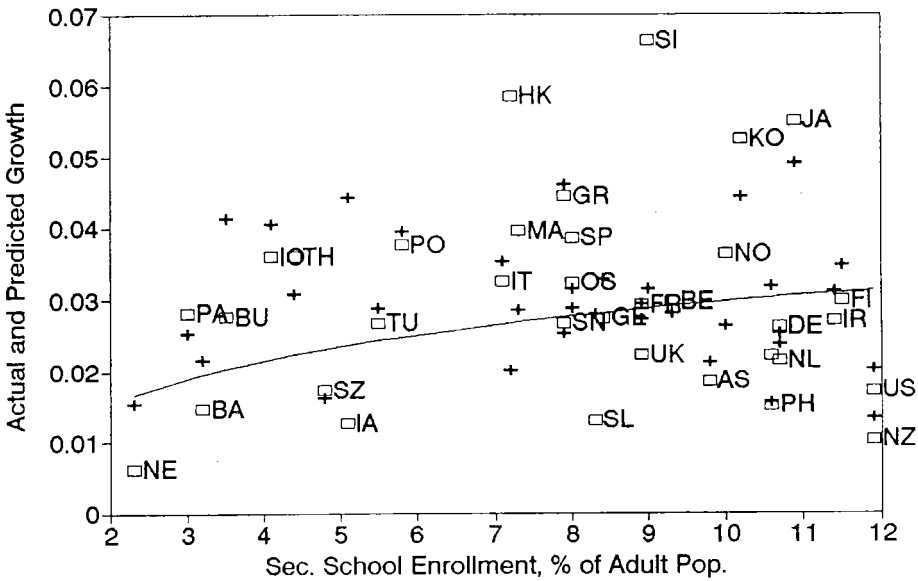


Fig 5: Actual and Predicted Growth
vs Scale

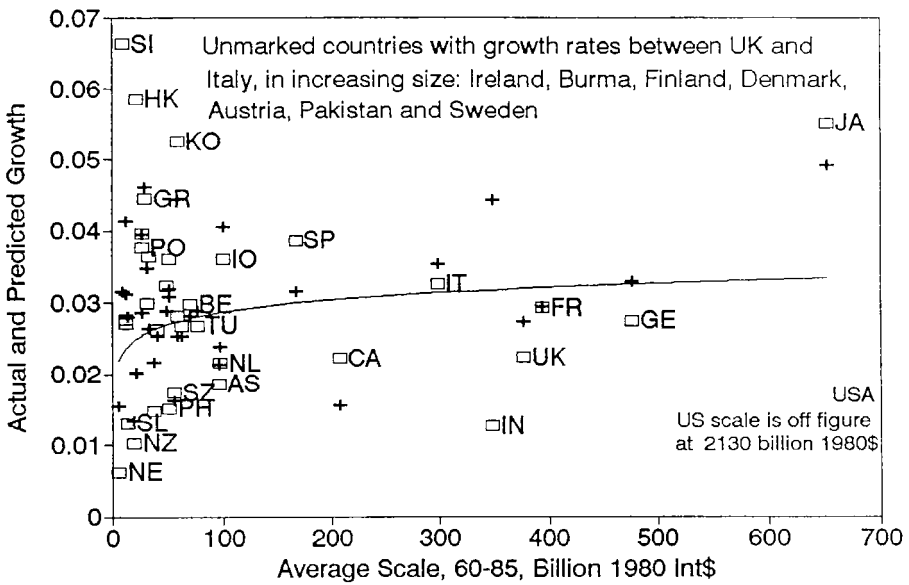


Fig 6: Actual and Predicted Growth
vs 1960 Bollen Index of Democracy

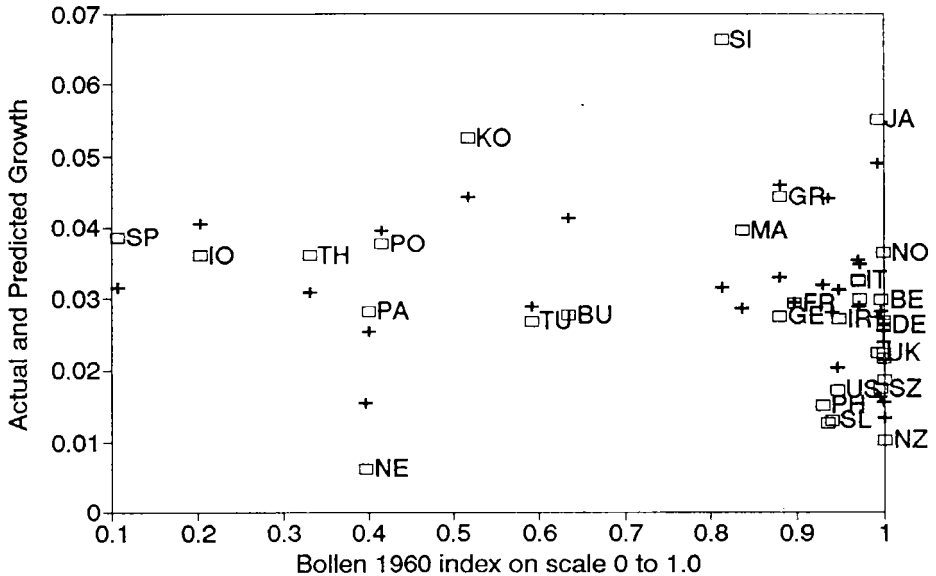


Fig 7: Actual and Predicted Growth
vs Number of Non-Tariff Barriers

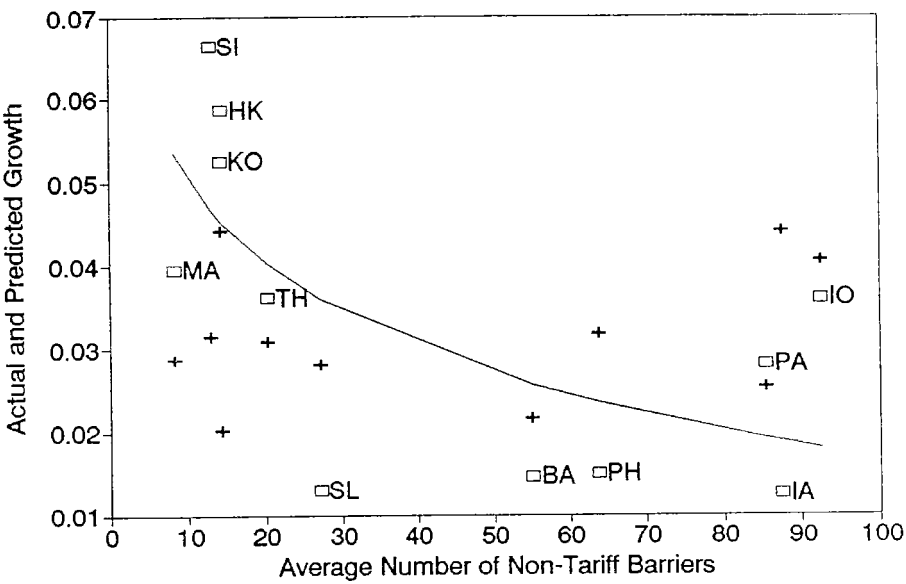


Fig 8: Actual and Predicted Growth
vs Black Exchange Rate

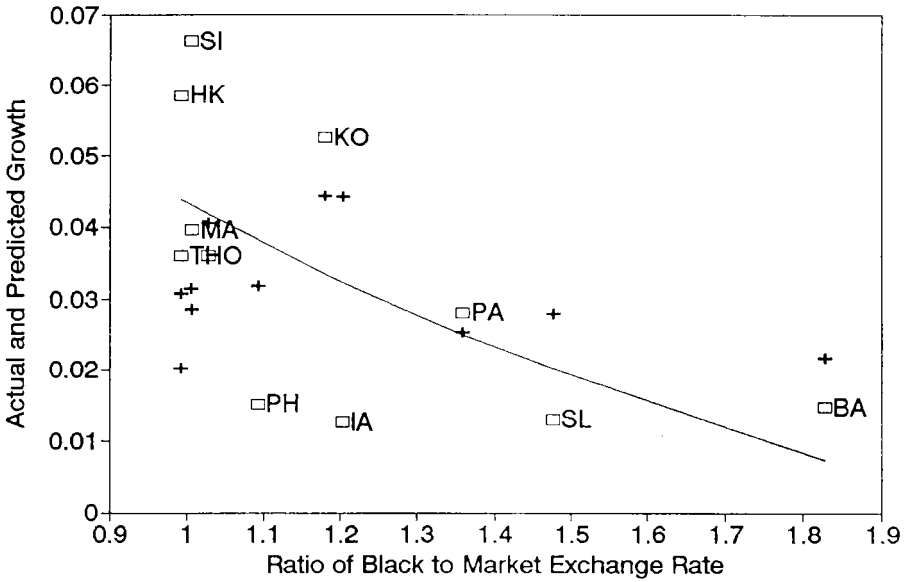


Fig 9: Actual and Predicted Growth
vs Import Tariffs

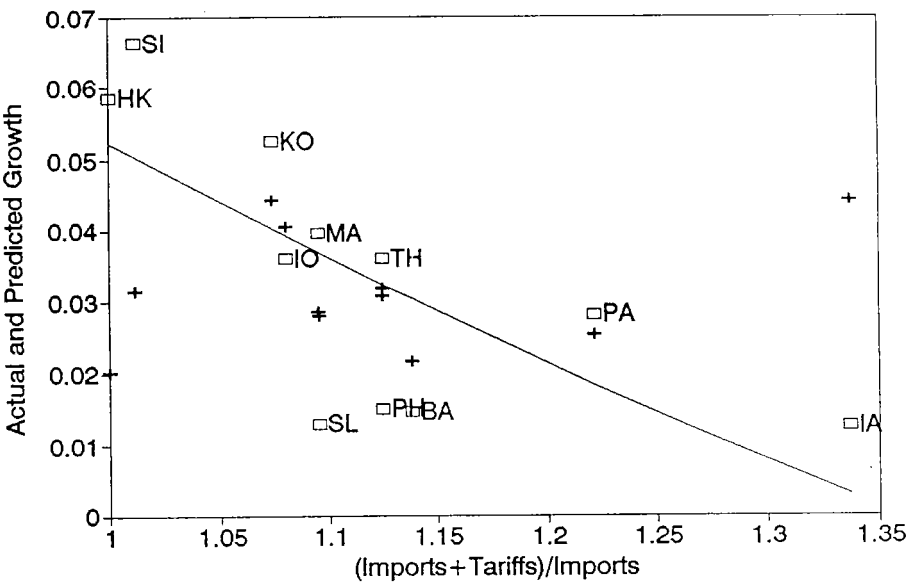
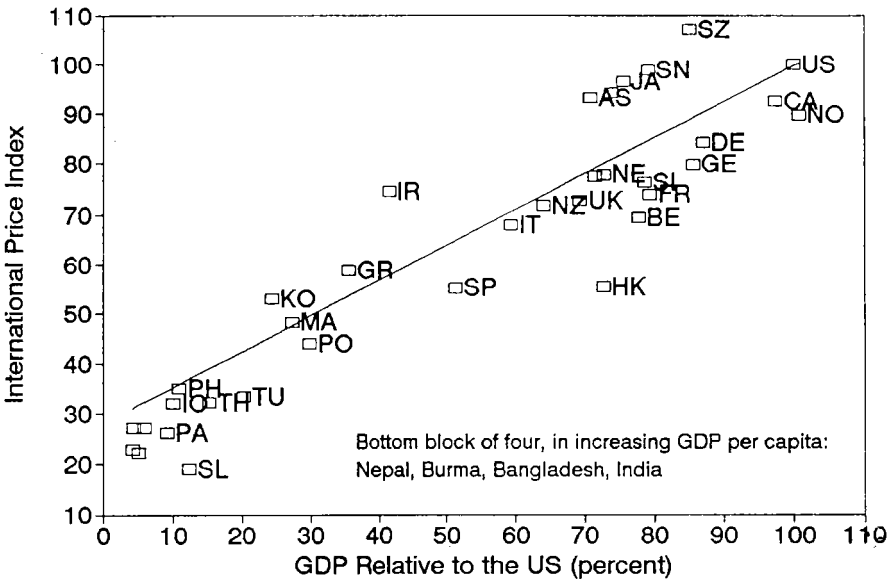


Fig 10: International Price Indices and
Real GDP per Capita 1985: OECD and Asia



Data Appendix

Country	Code	GDP/adult 1960 1960 (1)	GDP/adult 1985 1985 (2)	av growth adult pop adult pop (3)	school % adult pop adult pop (4)	av growth GDP/adult GDP/adult (5)	Investment % of GDP % of GDP (6)	av scale bill 1980$ bill 1980$ (7)
Hong Kong	HK	3085	13372	3.0	7.2	0.0587	19.92	21.7
Singapore	SI	2793	14678	2.6	9.0	0.0664	32.24	9.2
Malaysia	MA	2154	5788	3.2	7.3	0.0395	23.24	26.9
Sri Lanka	SL	1794	2482	2.4	8.3	0.0130	14.82	14.2
Philippines	PH	1668	2430	3.0	10.6	0.0151	14.93	50.7
Thailand	TH	1308	3220	3.1	4.4	0.0360	18.08	51.3
Korea, Rep. of	KO	1285	4775	2.7	10.2	0.0525	22.37	58.4
Pakistan	PA	1077	2175	3.0	3.0	0.0281	12.23	58.6
India	IA	978	1339	2.4	5.1	0.0126	16.82	347.6
Indonesia	IO	879	2159	1.9	4.1	0.0359	13.90	100.2
Bangladesh	BA	846	1221	2.6	3.2	0.0147	6.83	37.1
Nepal	NE	833	974	2.0	2.3	0.0063	5.95	6.2
Burma	BU	517	1031	1.7	3.5	0.0276	11.45	12.4
United States	US	12362	18988	1.5	11.9	0.0172	21.18	2130.1
Switzerland	SZ	10308	15881	0.8	4.8	0.0173	29.79	55.9
Canada	CA	10286	17935	2.0	10.6	0.0222	23.35	207.8
New Zealand	NZ	9523	12308	1.7	11.9	0.0103	22.54	19.9
Denmark	DE	8551	16491	0.6	10.7	0.0263	26.61	40.7
Australia	AS	8440	13409	2.0	9.8	0.0185	31.60	96.3
Norway	NO	7938	19723	0.7	10.0	0.0364	29.19	32.9
Sweden	SN	7802	15237	0.4	7.9	0.0268	24.53	61.8
Germany, Fed Rep	GE	7695	15297	0.5	8.4	0.0275	28.58	475.7
Netherlands	NL	7689	13177	1.4	10.7	0.0215	25.86	97.4
United Kingdom	UK	7634	13331	0.3	8.9	0.0223	18.44	377.0
France	FR	7215	15027	1.0	8.9	0.0293	26.24	394.1
Belgium	BE	6789	14290	0.5	9.3	0.0298	23.43	70.4
Finland	FI	6527	13779	0.7	11.5	0.0299	36.91	30.8
Austria	OS	5939	13327	0.4	8.0	0.0323	23.45	48.0
Italy	IT	4913	11082	0.6	7.1	0.0325	24.94	298.0
Ireland	IR	4411	8675	1.1	11.4	0.0271	25.98	12.4
Spain	SP	3766	9903	1.0	8.0	0.0387	17.74	166.9
Japan	JA	3493	13893	1.2	10.9	0.0552	36.00	652.9
Turkey	TU	2274	4444	2.5	5.5	0.0268	20.21	76.1
Portugal	PO	2272	5827	0.6	5.8	0.0377	22.56	26.5
Greece	GR	2257	6868	0.7	7.9	0.0445	29.35	29.6

Data Appendix: Openness and Additional Educational Variables for Asia

	Code	Black Premium % (1)	Import Tariffs % (2)	Non-tariff Barriers Number (3)	Adult Literacy % (4)	LF educ EDP4 Years (5)	LF educ EDT Years (6)
Hong Kong	HK	-0.77	0.00	14.3	77.3	2.40	3.57
Singapore	SI	0.55	1.17	12.9	75.9	3.57	6.10
Malaysia	MA	0.73	9.49	8.2	57.1	1.90	7.39
Sri Lanka	SL	47.77	9.54	27.1	79.8	3.90	7.92
Philippines	PH	9.18	13.45	63.6	79.3	8.00	7.45
Thailand	TH	-0.74	12.45	20.2	78.1	5.00	5.34
Korea, Rep. of	KO	18.04	7.33	14.2	79.1	1.20	6.74
Pakistan	PA	35.96	22.15	85.4	21.6	7.00	2.47
India	IA	20.31	33.70	87.4	34.2	5.30	3.35
Indonesia	IO	2.75	8.00	92.5	54.3	6.20	3.48
Bangladesh	BA	82.731	13.80	55.1	24.9	4.10	3.73