Economic Growth and Human Resources

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There have been many attempts to determine the role of human capital in the process of economic growth, including growth accounting and the measurement of social and private returns to investment in education. Both approaches have tended to indicate positive returns to investment in human capital, but both have been criticized on theoretical and empirical grounds. This paper is somewhat different in that it examines cross-country evidence for 83 developing countries on literacy, life expectancy, and the growth of GDP per person.

The analysis is conducted on two levels. First, some simple statistical manipulations are used to see what can be inferred about the relation between growth and human resources. Then, multiple regression techniques are used for treatment of the same issue in greater depth. In these regressions, it is assumed that the growth of GDP per person is influenced by three important factors: the rate of investment, the growth rate of imports, and the level of human resource development at the beginning of the period.

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SUMMARY:
ECONOMIC GROWTH AND HUMAN RESOURCES

i. Recent attention toward poverty issues in development has led to renewed interest in reducing poverty through the development of human resources; i.e., through directing more resources to health, education, nutrition, and other needs of the poor. Such a strategy might entail increasing non-development consumption expenditures and reducing levels of investment and economic growth. Thus there might be some sort of trade-off between developing human resources and economic development. On the other hand, these expenditures could be viewed as an investment in human capital having positive returns. Investing in human capital could then have a positive or negative effect on growth, depending whether the returns from human capital were greater or less than returns from other non-human capital investments.

ii. There have been many attempts to assess the role of human capital in the growth process, including the growth accounting approach utilized by Denison and others, and the measurement of social and private returns from investments in education. Both approaches have tended to indicate positive returns from investments in human capital, but both have been criticized on a variety of theoretical and empirical grounds. The approach of this paper is somewhat different in that it examines cross-country evidence for 83 developing countries for both growth of per capita GDP and two indicators of human resource development, life expectancy and literacy.

iii. The analysis is conducted on two levels. First, some simple statistical manipulations are employed to see what can be inferred about the growth/human resource relationship. The twelve fastest growing countries in

our sample for the period 1960-77 also had well-above average levels of literacy and life expectancy at the beginning of the period. Some of this difference is a result of the fact that rapidly growing countries also tend to be those with higher income levels, and hence better social indicators. Even when adjusted for initial per capita income levels, however, the rapidly growing countries had life expectancy levels 11% higher and literacy rates 34% higher than normal. This would suggest that rapidly growing countries had well developed human resources. Whether countries with well developed human resources necessarily experienced more rapid growth is another question. The twelve best countries in terms of life expectancy, which averaged nine years above normal, had growth rates which were also 1.4 points above normal. Thus, there appears to be some support for the hypothesis that countries with higher levels of human resource development do indeed tend to experience more rapid rates of economic growth.

iv. The results of the simple statistical analysis are supported by more indepth treatment of the same issues using multiple regression techniques. The advantage of this approach lies in its ability to consider, and remove the influence of, a variety of other factors that can also cause variations in growth rates between countries. In these regressions, it is assumed that the growth of per capita GDP is influenced by three important factors: the rate of investment, the growth rate of imports, and the level of human resource development at the beginning of the period. Regressions undertaken for the 1960-77 period show a statistically significant association for all three indicators. The estimated equations explain about 60% of the variations

in per capita growth rates, 1960-77. The coefficients of these equations indicate that increasing life expectancies by ten years would be expected to lead to growth rates of per capita GDP about .7 percentage points higher. Likewise, an increase in literacy rates of 20 percentage points would increase growth by about .5 percentage points. These results also hold if the period is changed to either 1960-70 or 1970-77, and if the human resource indicators are expressed in terms of deviations from levels expected by income.

v. An even more severe test of these same hypotheses has been undertaken in a paper by David Wheeler. 1/ Wheeler's approach allows for the fact that human resource developments are both a result of and a cause of economic development, and that there will be interactions between the two over time. By using a simultaneous equation technique, Wheeler is better able to separate out the cause and effect relationships. His results broadly confirm those of this paper in that he finds that human resource development contributes directly to output growth, and also contributes indirectly -- by increasing manufactured export goods, and the investment rate, and by lowering the birth rate.

vi. Thus both simple and more sophisticated cross country analysis of aggregate measures of human resources and growth seem to point in the same

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1/ David Wheeler, "Human Resource Development and Economic Growth in Developing Countries: A Simultaneous Model," World Bank Staff Working Paper, no. 407 (Washington, D.C.: World Bank, July 1980).

general direction: policies directed at human resource development can exert a positive influence on the growth rate by improving the stock of human capital. This analysis does not, however, indicate the proper mix of human resource and other, more traditional investments in physical capital. The correct program of human resource investments will depend on individual country situations and will have to consider the opportunity cost of capital and the current state of human resources. Nevertheless, it does seem clear that investing in people can be an efficient way of both eliminating poverty and increasing the growth rate of output for many developing countries.

ECONOMIC GROWTH AND HUMAN RESOURCES

Norman L. Hicks

Introduction

The failure of rather substantial growth of output in the developing countries in the past twenty-five years to reduce poverty has been widely recognized. Various alternatives have been proposed to redress the problem, including those which focus on employment creation, rural development or redistribution with growth as primary objectives. In recent years, increased attention has been directed at the potential of directly providing the poor with essential goods and services, as a supplement to programs aimed at raising the productivities and incomes of the poor. Particular emphasis is given to improvements in health, nutrition and basic education, especially through improved and redirected public services, such as rural water supplies, sanitation facilities, primary schools, etc. Proponents of this approach argue that the direct provision of essential goods and services will be a more efficient and more rapid way of eliminating poverty. While supporting efforts to raise productivity and income, they emphasize that these alone may not be sufficient or efficient because of lack of knowledge on the part of consumers, maldistribution of incomes within households, the control of essential services by the public sector, and the difficulty of finding productivity-enhancing programs that benefit all of the poor equally. By emphasizing the redistribution of public services so as to serve the poor, this approach implies a more workable means of achieving a redistribution of income than could be attained by taxation, grants, asset redistribution or other means. While the primary goal was to eliminate poverty, it soon became clear that a "basic needs" approach would also improve the quality

of the labor force through the effects of improved health and education. Thus, the emphasis has shifted away from meeting "needs" toward improving the productivity of human resources, by improving human capital, thus reviving interest in the human capital approach pioneered by Schultz and others. The essential question then becomes one of ascertaining whether an approach to development which emphasizes the development of human resources (HR) has a long-run rate of return higher or lower than other investment opportunities available to a country.

A low or zero rate of return would suggest that increased HR activities would necessitate a lower rate of growth, assuming that they direct resources from alternative investments with higher yields. This may not be true, however, since HR type expenditures can be financed by reducing non-essential consumption expenditures of the poor and the rich, or non-HR expenditures of the public sector. Thus, an increase in HR activities could have little or no direct effect on the level of investment and growth, assuming this redirection occurs without a deleterious effect on incentives to work. However, a redirection of consumption to HR activities implies an opportunity cost in that reduced consumption could have been directed to non-HR investments. The issue is further complicated by the fact that some HR activities will be classified as investment (schools, hospital construction) while others will be classified as consumption (teachers' salaries, food subsidies).

While from a <u>theoretical</u> standpoint, there may be no necessary reason for a trade-off between developing human resources and growth, one might wonder if <u>empirically</u> countries which have emphasized HR have not, in fact, done so at the cost of reductions in growth in output. Critics are quick to point to countries which have historically given much emphasis to social sector programs, and have also had relatively low growth rates

(Burma, Cuba, Sri Lanka, Tanzania, for example). On the other hand, one can point to a number of countries which have both grown relatively rapidly and also made commendable progress on providing social services, reducing poverty and/or improving the distribution of income (Korea, Taiwan, Singapore). The issue is complicated by the fact that there are many factors affecting growth performance, other than allocations between social and other sectors. Identifying the true impact of a HR oriented investment program thus becomes very difficult.

Analysis of the role of human resources or human capital in the growth process has a long history in the post World War II literature. The "growth accounting" approach, for instance, attempts to measure changes in total factor productivity by developing an index of output (generally GNP) and an index of factor inputs. This approach traces its origins to work done by Stigler (1947), Schmookler (1952), and Kendrick (1961), among others, but the definitive work remains that of Denison (1967, 1974, 1979). Denison's latest estimates show that less than 60% of the growth in GNP (1929-1973) in the United States can be attributed to the growth of traditional factors, mainly capital and labor inputs. The remaining growth is a result of economies of scale, improvements in resource allocation, and other factors, plus a large residual which is labelled as "advances in knowledge."

Education is considered by Denison to be a factor input, and alone accounts for 14% of the growth in GNP during the 1929-73 period. If education were to be combined with the residual "advances in knowledge," then the human capital component would be about 38% (see Denison, 1979, p. 128). The assumption that the residual can be attributed to improvements in the stock of human capital, however, is only a hypothesis. It may be that the residual represents error in the calculations of other variables, the omission of other important factors, or a faulty assumption about the shape of the underlying production function. Difficulties with the growth accounting approach are more apparent when it is applied to the period 1973-76, when factor inputs (capital and labor) grew further than output, resulting in a negative

growth rate for the residual or negative "advances in knowledge." Such counter-intuitive results for this period cast doubt on the usefulness of the results for the earlier period as well.

Similar examinations of productivity differentials have also been made for the developing countries. Krueger (1968) found that differences in human capital explained about half of the differences in per capita GNP between the United States and a sample of developing countries. Hayami and Ruttan (1970) found that differences in technical and general education could explain about one-third of the differences in agricultural productivity between developed and developing countries. Various authors have found high rates of return from investment in education, particularly primary education in developing countries. On the other hand, H. Correa (1970) found that while health and nutrition factors were very important, education advances appeared unrelated to output growth for a group of Latin American countries. Nadiri (1972) concluded from a survey of literature that education was not very useful in explaining differences in growth rates between countries, although it did seem to explain variations in factor productivity within countries over time. Thus, there appears to be some conflicting evidence over the role of human capital, particularly education, in affecting the growth of output in developing countries.

Another popular approach consists of estimating the rate of return from investments in education, based on measuring lifetime earnings of people at various education levels. These benefits are discounted and compared to the private and social costs of education, including foregone earnings while at school, to estimate a rate of return from investments in human capital. A survey of 17 countries by Psacharopoulos (1973) found an average social return of 25% for primary education. These returns range, however, from 6.6% (Singapore, 1966) to 82% (Venezuela, 1957).

There are considerable conceptual difficulties in measuring rates of return of human capital, as indicated by Blaugh (1976) in his survey. The returns on human capital may be overstated because they capture the "screening" effect of higher education, rather than any true differentials in productivity. While poverty-oriented HR development can be seen as augmenting human capital, not all human capital advances will relate to poverty reduction (i.e., higher education). Furthermore, some types of HR development may not augment the stock of human capital.

Fewer studies have been undertaken of the broad association between growth and progress in developing HR compared to those which more narrowly focused on education and human capital. In a case study of Sri Lanka, Paul Isenman casts doubt on the thesis that Sri Lanka's social programs caused Sri Lanka's low rate of growth during the 1970s. He points out that while output and social programs grew fairly rapidly in the 1960s, both stagnated during the period 1970-77. The cause of this lower growth rate seems to be related to development policies pursued by the Government, and in this situation the financial burden of the social programs becomes a problem. Furthermore, Isenman shows that even if Sri Lanka had reduced its social programs to more normal levels, and invested the surplus in projects having an average capital-output ratio, that while the per capita income would have been higher, the level of social performance would have been worse. Thus, the "trickle down" effects of the higher growth rate would not have been sufficient to offset the gains achieved from direct intervention. Case studies, such as Isenman's, while valuable, are difficult to use to draw on for general principles. An alternative approach is to look at the statistical evidence from a large number of

countries. For instance, Morawetz (1977) comes to some rather uncertain conclusions from a large number of regressions of social indicators and GNP, both in absolute and in growth rate terms. While unable to pinpoint a clear relationship between the two, he did conclude that GNP per capita was not a good proxy for human resource development. Furthermore, he did not find a strong negative correlation between social indicators and growth. This would seem to support the contention made earlier that there is no necessary reason why growth and progress in developing HR has to be competitive.

The problem with simple correlations is that they cannot identify the causality links between HR progress and growth. Progress in HR is just as likely to be a result of higher incomes, as their cause. At the same time, growth in income is clearly going to be affected by other factors. Thus, one needs to isolate basic needs and factors which can be considered important determinants of growth, in order to avoid giving too much weight to the basic needs variables.

Measurement Problems

Unlike GNP per capita, we have no easy measure, however, of basic human resource development. A variety of factors can be measured by social indicators, although the use of social indicators in this regard often presents problems. For instance, some indicators reflect results, others measure inputs. Some indicators measure the average level of social progress for the whole society, while others are based on a "have-have not" principle. Thus, the statistic measuring "percent of households with access to clean water" accurately captures an overall view of the numbers without such service, while "averaging calories consumed per capita as a percent of requirements" is quite misleading, since it combines the overconsumption of the rich and the underconsumption of the poor. Likewise, figures on average life expectancy, or average infant mortality, do not give us a feel for the range from lowest to highest, between the rich and the poor. It would be more useful if we could

look at social indicators grouped by decibles. Two countries with identical statistics for infant mortality, for instance, could have quite dissimilar infant mortality indicators for their least favored groups. There is no reason why we could not construct distribution statistics for social indicators similar to our income distribution measures.

Until better indicators are produced, however, we are forced to utilize what we have readily available. One good indication of HR development is life expectancy at birth since it indicates improvements in health status. In this single measure, we can capture the combined effects on mortality of health care, clean water, nutrition and sanitation improvements, although it is admittedly an average of country experience with no feel for the range of variation. Progress in basic education can best be measured by the level of adult literacy, a better indicator than primary school enrollment since it is oriented toward effects rather than efforts. 1/ These two indicators then, will give crude but fairly useful measures of progress in developing HR. Both indicators are generally available for most developing countries on a fairly reliable basis, a statement that cannot be made for some alternative measures such as infant mortality.

Statistical Evidence: Some Simple Tests

Even if we use these selected social indicators as a measure of HR progress, we have problems identifying whether such progress results from growth in output, or is a factor explaining variations in output growth. One way to avoid this identification problem is to look at the growth rate of various countries over some period compared to the level of basic needs at the beginning of the period. If past achievements in HR require high levels of consumption expenditures for their maintenance, and these require reduced savings and investment then performance should be negatively associated with growth. On the other hand, if the human capital aspects of HR are positive,

1/ Enrollment rates also do not measure school completion or attendance.

then HR indicators should be positively related to growth. The relationship between growth of GDP per capita and the starting values of literacy and life expectancy can be seen from simple scattergrams of these two variables. As shown in the following two diagrams, there is a clear positive relationship between the HR measures and growth, where the growth rate covers the period 1960-1977, and the HR measures are for the year 1960. The degree of association is indicated by the simple correlation coefficient (r) which is .64 for life expectancy and .52 for literacy. 1/ Thus there seems to be a clear, positive association, although HR factors are only part of the explanation of why growth rates differ among developing countries.

Another way of looking at this is to examine the record of those countries which have grown very rapidly in the past, and compare their performance with that of the average country. In Table 1, we present data for the twelve fastest growing countries for the period 1960-1977 (excluding oil exporting countries and those with populations under one million). These countries had an average per capita growth rate during this period of 5.7% per annum, substantially higher than the 2.4% average of all 86 countries in our sample (based on World Development Indicators, 1979). Furthermore, these countries clearly had above average performance on life expectancy at the beginning of this period (1960). The average for life expectancy for the twelve was 61 years, compared with a group mean of 48 years. In other words, the fast growing countries began the

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1/ The simple regression equations are:

$$GRYPC_t = 1.03 + \underset{(4.9)}{.0365}\ LIT_{60} \qquad \bar{R}^2 = .27 \quad n = 63$$

$$GRYPC_t = -3.42 + \underset{(7.06)}{.1221}\ LIEX_{60} \qquad \bar{R}^2 = .40 \quad n = 75$$

$t = 1960\text{-}77$

Numbers in parenthesis are t-ratios, and n = sample size, which varies because of missing data for some countries.

DIAGRAM 1

LITERACY AND GROWTH RATE OF PER CAPITA INCOME

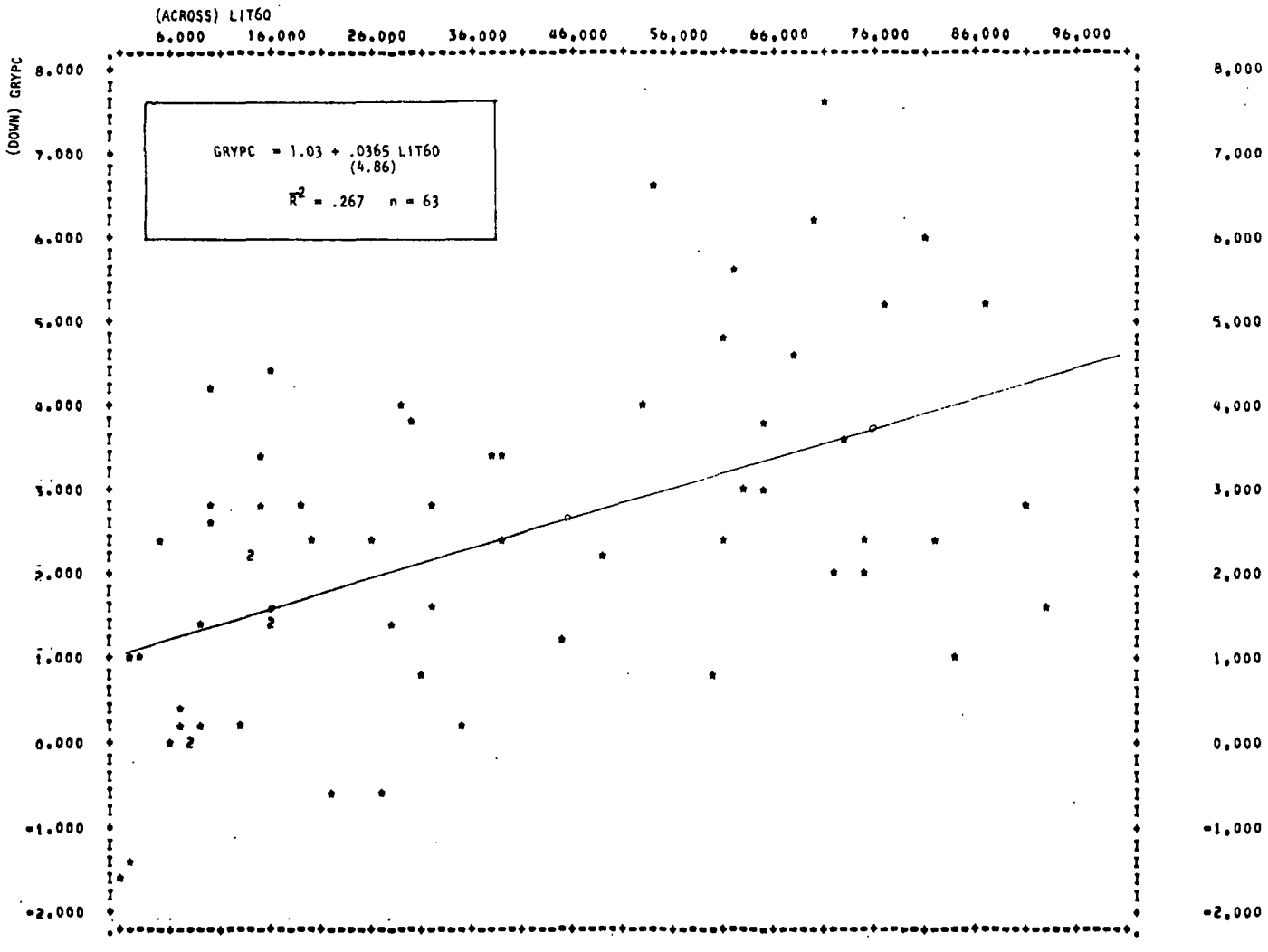
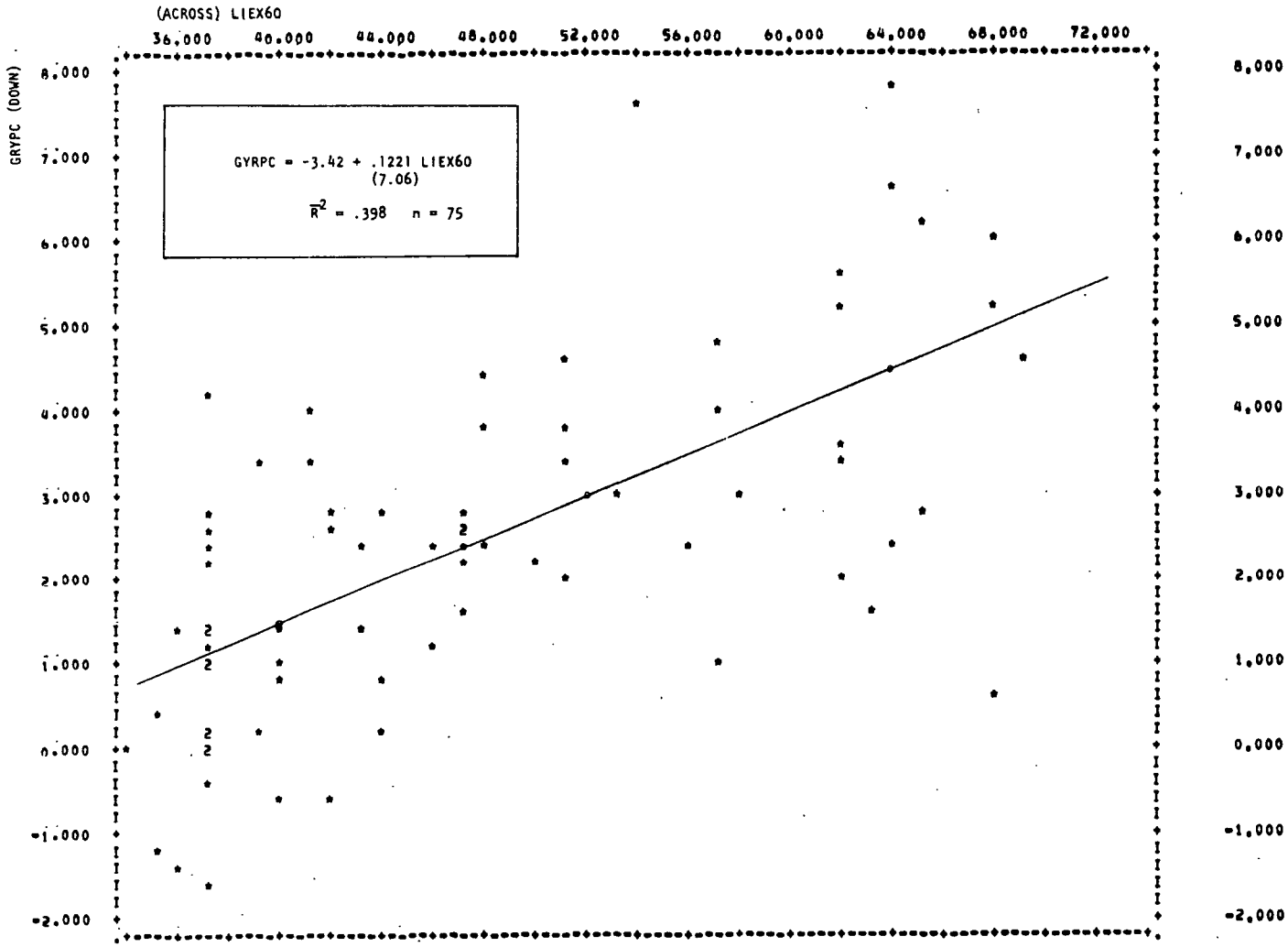


DIAGRAM 2

LIFE EXPECTANCY AND GROWTH RATE OF PER CAPITA INCOME



period with life expectancies 27% higher than the average country. 1/ If literacy is used as a measure of HR development the same pattern emerges. Countries that had rapid growth had average literacy rates in 1960 of 65% compared to an average of 38% for the entire sample. Thus, for these twelve countries, literacy rates were over 70% higher than average.

This would seem to prove that HR progress can augment the rate of growth. While this may be true, the data in Table 1 have a considerable bias in them because the countries that grew the fastest in the 1960-1977 period were also countries which had above average levels of income. Since levels of income and life expectancy tend to be closely (but not perfectly) associated, it is not surprising to find that our twelve countries have above average life expectancy statistics. To overcome this bias, we estimate an equation which relates life expectancy and literacy to income, and thus estimate for every country the "expected" level of each. Better than normal performance on these HR measures can be measured by the deviation between the actual and the expected levels for each variable. Using this method, these indicators have been thus "adjusted" for the level of income. Deviations from the income expected level are shown in the third and fifth column of Table 1. For life expectancy, the mean deviation for the sample of twelve countries is 5.1, meaning that these twelve had levels of life expectancy about five years greater than what normally would have been expected for their income levels. Thus, of the initial difference in the means of 13 years (61-48), about 8 are accounted for by differences in income levels.

Similar results are attained when adult literacy is used as a measure of HR development. When adjusted for income differences, literacy levels were about 13 percentage points higher in the rapidly growing countries at the beginning of the period, compared to the unadjusted difference of the means of

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1/ The average includes the rapidly growing countries; the differences would be greater if they were excluded.

Table 1: ECONOMIC GROWTH AND LIFE EXPECTANCY, SELECTED COUNTRIES

Country	Growth Rate, /a 1960-77	Life Expectancy 1960	Deviations from Expected Levels of Life Expectancy /b	Adult Literacy 1960	Deviations from Expected Levels Literacy, 1960 /b
	---(%)---	----------(years)----------			
Singapore	7.7	64.0	3.1	-	-
Korea	7.6	54.0	11.1	71.0	43.6
Taiwan	6.5	64.0	15.5	54.0	14.2
Hong Kong	6.3	65.0	6.5	70.0	6.4
Greece	6.1	68.0	5.7	81.0	7.5
Portugal	5.7	62.0	4.7	62.0	1.7
Spain	5.3	68.0	1.8	87.0	1.2
Yugoslavia	5.2	62.0	4.7	77.0	16.7
Brazil	4.9	57.0	3.0	61.0	8.6
Israel	4.6	69.0	2.0	-	
Thailand	4.5	51.0	9.5	68.0	43.5
Tunisia	4.3	48.0	-.5	16.0	-23.8
Average: Top 12	5.7	61.0	5.6	64.7	12.0
Average: All Countries	2.4	48.0	-.0	37.6	-.0

/a Growth rate of real per capital GNP.

/b Deviations from estimated values and derived from an equation where life expectancy in 1960 (LIEX) and adult literacy in 1960 (LIT) is related to per capita income in 1960 (Y) in the following way:

$$LIEX = 34.29 + .07679\ Y - .0000430\ Y^2 \qquad \bar{R}^2 = .66$$

$$LIT = 9.23 + .1595\ Y - .0000658\ Y^2 \qquad \bar{R}^2 = .44$$

27 (65-38). Thus in both cases, about half the difference in performance in initial level HR indicators is traced to income levels. On this adjusted basis, it is more correct to say that our 12 rapidly growing countries had life expectancy levels 11% higher, and literacy rates 34% higher, than what would have been expected considering their level of development.

The overall relationship can be seen from the accompanying scattergrams (Diagrams 3 and 4), which show the relationship between the deviations from the expected levels of life expectancy and literacy, and the growth rate of income per capita. Even after the income adjustment has been made, the correlation coefficients remain positive (.45 for life expectancy, .34 for literacy). A simple linear relationship seems to fit the data about as well as any non-linear relationship that might be tried.

The preceding suggest a positive association between our HR indicators and growth even when allowing for the fact that some of the more rapidly growing countries are also those at more advanced stages of development. This clear association does not, however, demonstrate or prove causality nor does it prove that human resource development is a <u>sufficient</u> condition for higher growth. In other words, even if fast growing countries tend to have better HR development, one cannot say that human resource development always leads to faster growth. In order to examine this more carefully, we turn the question around and look at the twelve countries that have the highest deviation from expected levels of life expectancy. As can be seen (Table 2), many of the same countries shown in Table 1 also appear here, namely,Taiwan, Korea, Thailand, Hong Kong, and Greece. However, we now see a number of other countries which have done well in terms of life expectancy but did not have exceptionally high growth rates during the period, such as Sri Lanka, Paraguay, the Philippines, Burma, and Kenya. Nevertheless, the average growth rate for these twelve of 4.0%

DIAGRAM 3

LITERACY DEVIATION AND GROWTH RATE OF PER CAPITA INCOME

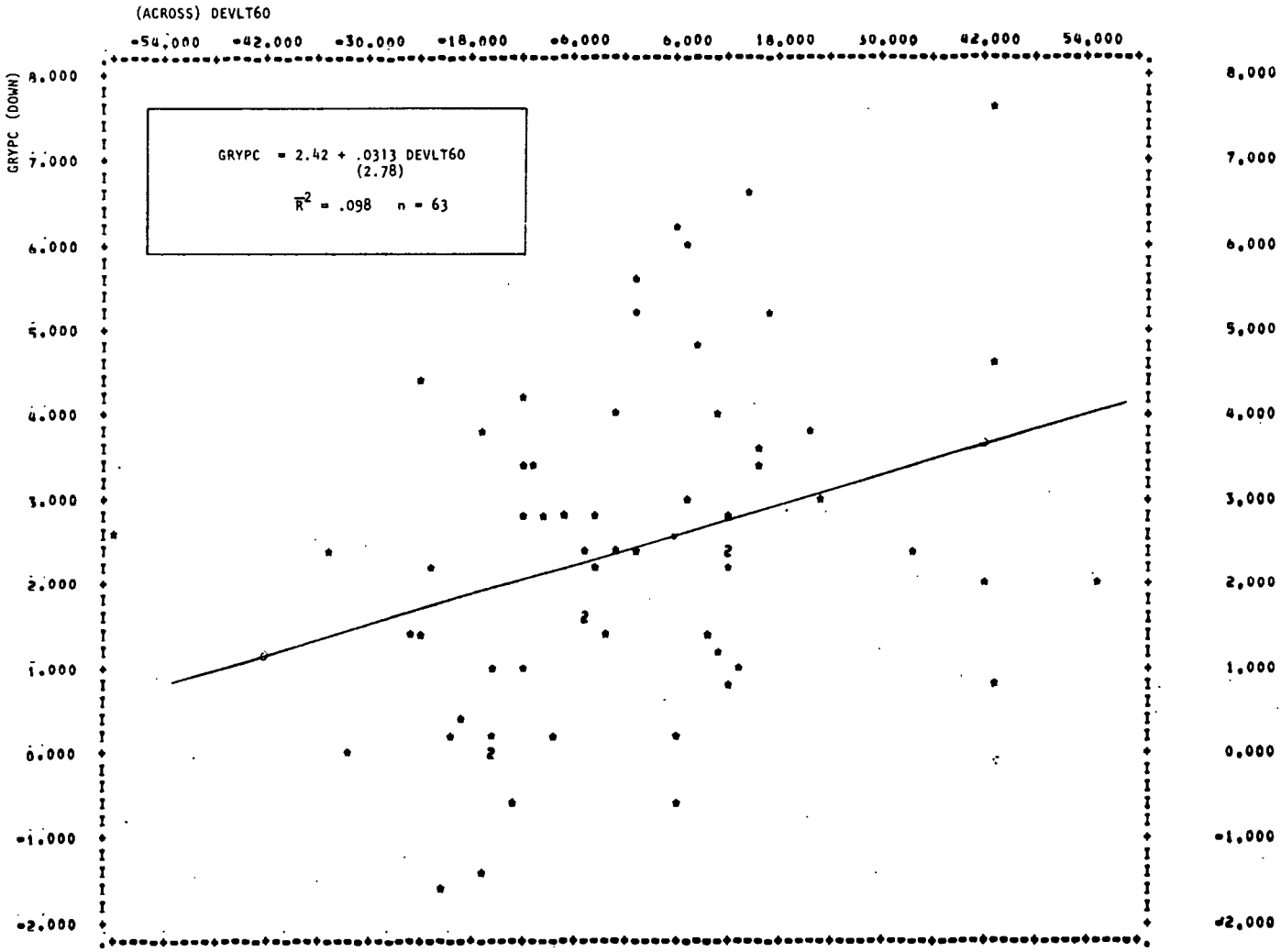

DIAGRAM 4

LIFE EXPECTANCY DEVIATION AND GROWTH RATE OF PER CAPITA INCOME

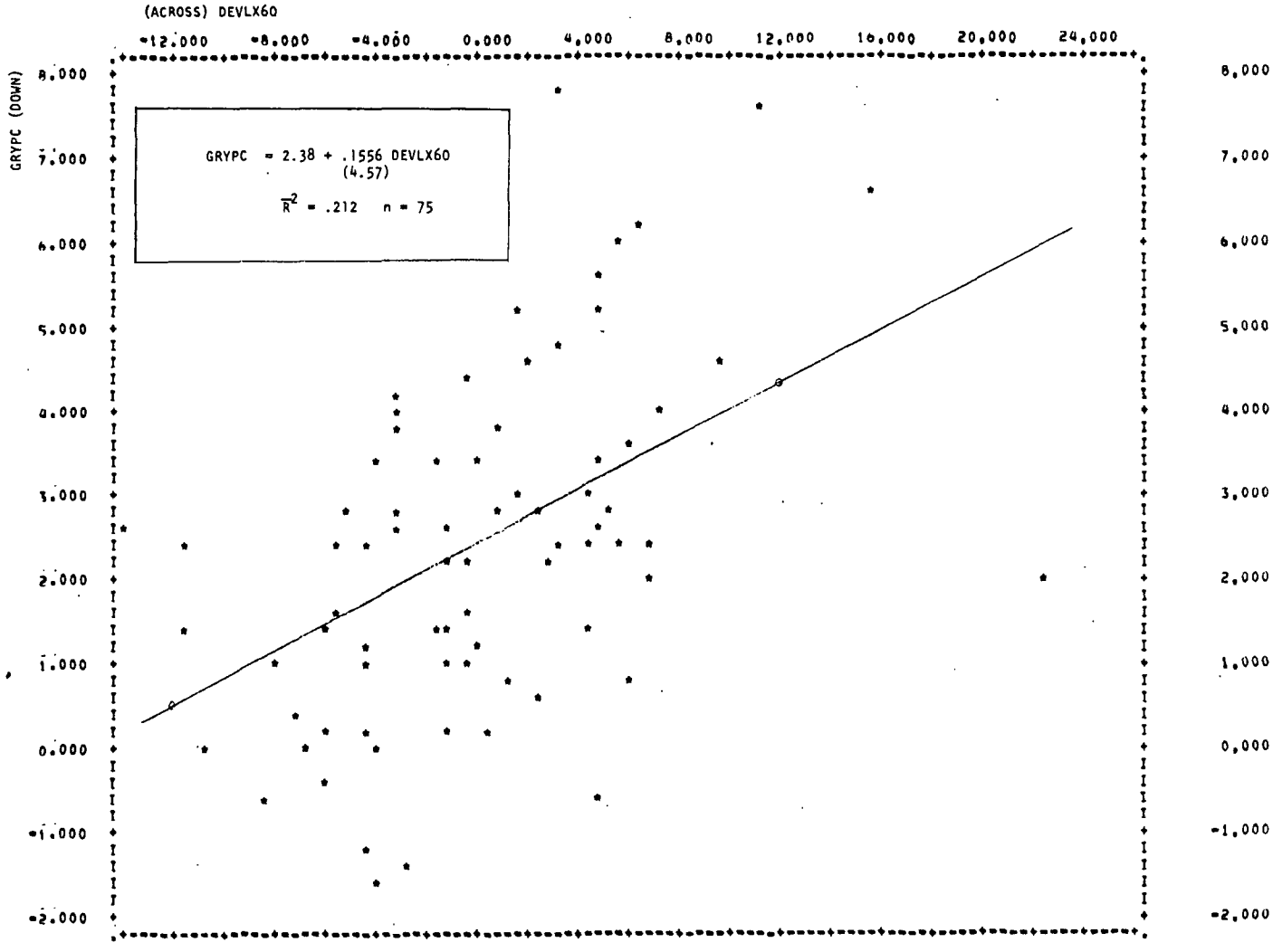

Table 2: ECONOMIC GROWTH AND LIFE EXPECTANCY, SELECTED COUNTRIES

Country	Life Expectancy Deviations	Growth Rate
	--------(years)----------	----(%)----
Sri Lanka	22.5	1.9
Taiwan	15.5	6.5
Korea	11.1	7.6
Thailand	9.5	4.5
Malaysia	7.3	4.0
Paraguay	6.9	2.4
Philippines	6.8	2.1
Hong Kong	6.5	6.3
Panama	6.1	3.7
Burma	6.0	0.9
Greece	5.7	6.1
Kenya	5.5	2.4
Average: 12 Countries	9.1	4.0
Average: 83 Countries	-0.0	2.4

Note: For explanation of variables, see Table 1.

per annum is still considerably higher than the group average of 2.4%. It seems clear that factors other than HR are at work here. The performance of countries is highly dependent on such things as the level of investment, export earnings and capital flows, and the general nature of development policies pursued. On average, however, those countries which do well on basic needs tend to have better than average performance in terms of economic growth. 1/ This would also seem to suggest that a human resource emphasis in development, far from reducing the rate of growth, can be instrumental in increasing it.

Econometric Tests of HR and Growth

A more elegant and scientific approach for isolating contributions to growth in output can consist of estimating a simple model of growth from cross-sectional evidence based on country data. The model introduced here is not the neo-classical production function, in which output is related to capital and labor inputs. The reason for this is the expectation that in developing countries labor is not an important limiting factor for growth in terms of its quantity. In addition, one important constraint to growth is that availability of foreign exchange is an important factor which explains the utilization of capital stocks, as well as the level of investment. Furthermore, modifying a neo-classical production function to include the growth of some measures of HR would not help isolate the casuality between growth and HR development. Instead, we develop a simple model in which the growth of per capita output or per capita GDP is related to three factors: the growth rate of imports, the level of investment with respect to GDP, and the level of HR performance found to exist in the base period. The use of the base period level essentially allows us to test whether countries which in the past had

1/ The opposite is also true: countries with negative deveiations have growth rates below average. See Appendix Table III.

improved their human resources indeed grew faster in suceeding periods, after controlling for other important factors. This ability to control for other factors give the analysis based on multiple correlation a considerable edge over the simpler analysis of country performance described above. Unfortunately, in so doing, much of the individual country experience tends to be lost.

The overall model thus looks like this:

(1) $GRYPC_t = a_1 INVRT_t + a_2 GRIMP_t + a_3 HR_b + k$

where GRYPC = growth rate of per capita real GDP, over time period t,

INVRT = average investment rate over the same period,

HR = some measure of basic human resource development in b, the base period,

a = coefficients, and

k = constant term.

We use per capita output to reduce the influence of population growth, which itself will be a function of HR and the growth of output. This is essentially the same model estimated by the author in an earlier paper. The present work reports on some extensions and modifications of that original work (see Hicks, 1979). The data base in the earlier study referred to the period 1960-73; in the present effort we are able to construct a data base for the period 1960-77, drawing on data prepared for the World Development Report, 1979, the World Tables of the World Bank, as recently updated, and the Social Indicators of the World Bank. Furthermore, we are able to break this data into three distinct time periods: 1960-77, 1970-77 and 1960-77. In addition, we have also introduced regional dummy variables to test the degree to which regional differences explain variations in growth rates.

In the earlier study, where life expectancy at birth was taken as the measure of human resource development, the time period was 1960-73; the estimated equation had the following form:

$$(2) \qquad GRYPC_t = -3.956 + \underset{(5.4)}{0.2085}\ GRIMP_t + \underset{(3.6)}{0.1088}\ INVRT_t + \underset{(4.4)}{.0656}\ LIEX_{60}$$

$$\bar{R}^2 = .624 \qquad n = 78 \qquad t = 1960\text{-}73$$

Where $\bar{R}^2$ is the coefficient of multiple determination adjusted for degrees of freedom, and the statistics under the coefficients are t-ratios. Broadly similar results were had if literacy or years of primary schooling were used as the HR indicator. The coefficients are all significant at the 98% confidence level (two-tailed test) and the equation explains about 62% of the variation in per capita growth rates. A change of ten years in the starting level of life expectancy can contribute to the period growth rate about .7 percentage points, according to this equation.

Similar equations for the three periods described above give very similar results, although somewhat different coefficients for life expectancy. These new equations are given in Appendix Table I for all three periods. For the longer period, 1960-1977, the basic estimated equation is :

$$(3) \qquad GRYPC_t = -3.5227 + \underset{(6.6)}{.2390}\ GRIMP_t + \underset{(1.9)}{.0640}\ INVRT_t + \underset{(4.2)}{.0717}\ LIEX_{60}$$

$$\bar{R}^2 = .637 \qquad n = 65 \qquad t = 1960\text{-}77$$

As indicated (1), the growth rate of imports continues to be the dominant variable explaining variations in the growth rate of output. What is somewhat curious is the rather small coefficients and low t-ratios for the investment rate, which would appear to have the least influence on growth of the three factors in the equation. Raising life expectancy by one standard deviation (10.5 years), however, would increase the growth rate by .75 percentage points.

As discussed above, adult literacy is another important measure of HR development. The use of adult literacy in place of life expectancy, however, produces broadly similar results:

$$(4) \qquad GRYPC_t = -1.02 + \underset{(6.2)}{.2451}\ GRIMP_t + \underset{(1.8)}{.0680}\ INVRT_t + \underset{(3.3)}{.0223}\ LIT_{60}$$

$$\bar{R}^2 = .590 \qquad n = 55 \qquad t = 1960\text{-}77$$

As found in the earlier work, life expectancy seems to perform slightly better than literacy, regardless of the time period, and investment remains a weak variable. A one standard deviation (28 percentage points) change in literacy would increase the growth rate by about .6 percentage points, or a somewhat smaller influence than for one standard deviation in life expectancy.

The overall $\bar{R}^2$ of these equations indicates the ability to explain somewhat less than 60% of the total variance in growth rates, which leads one to speculate on the determination of the remaining 40%. One possible explanation is the variance in regional cultural historical and climate/geographic factors. To test for the influence of regional variations, regional dummy variables were constructred for tropical Africa (D1), Latin America (D2), and East Asia/Pacific (D3). The result for the longer period with the inclusion of these dummies where HR is measured by literacy indicates only a slight improvement in the fit of the equation [$\bar{R}^2$ rises from .590 to .628, compare equations (5) and (4)]. Of the regional dummy variables, only that for Latin America is significant. 1/ Where literacy is used to measure HR, the estimated equation is:

1/ In the 1970-77 period, however, the East Asia/Pacific dummy is more important, and Latin American dummy drops out. The results also vary depending on whether literacy or life expectancy is used to measure HR (see Appendix Tables I-III). With life expectancy, the $\bar{R}^2$ increases from .637 to .683.

$$(5) \quad GRYPC_t = .9092 + \underset{(5.3)}{.2261}\ GRIMP_t + \underset{(1.7)}{.0604}\ INVRT_t + \underset{(2.7)}{.0253}\ LIT_{60}$$

$$- \underset{(1.2)}{.5589}\ D1 - \underset{(2.1)}{1.0470}\ D2 + \underset{(.4)}{.2289}\ D3$$

$$\bar{R}^2 = .628 \qquad n = 55 \qquad t = 1960\text{-}77$$

One problem with the above formulation is that they could be criticized on the grounds that investment rates, human resource development and even the growth of per capita output are all related to the overall level of development, as measured by per capita incomes. In order to overcome part of this bias, we go back to the two-stage approach introduced earlier, where the HR indicators are first related to the level per capita income using a quadratic formulation. An expected level of HR performance (EHR) is then derived which is adjusted or normalized for the level of income, thus:

$$(6) \quad EHR = k + a_1\ YPC + a_2\ YPC^2$$

The deviation from the expected level by the actual level is defined as:

$$(7) \quad DEVHR = HR - EHR$$

or the difference between the actual level less the estimated level. Inserting these deviations into our equations produces generally better fits in all time periods for the HR variables. In this formulation, once again, the life expectancy terms tend to be slightly more important than literacy. For instance, for the 1960-77 period, the equation with life expectancy deviations (DEVLX) yields:

$$(8) \quad GRYPC_t = -1.2674 + \underset{(6.6)}{.2336}\ GRIMP_t + \underset{(4.6)}{.1301}\ INVRT_t + \underset{(4.7)}{.1100}\ DEVLX_{60}$$

$$\bar{R}^2 = .659 \qquad n = 65 \qquad t = 1960\text{-}77$$

The investment variable becomes significant in this formulation, perhaps because of the reduction in multicolinearity between the HR levels and the investment rate when deviations are employed. Similar results are obtained using literacy (DEVLT):

$$(9) \quad GRYPC_t = -1.033 + \underset{(6.2)}{.2449}\ GRIMP_t + \underset{(3.5)}{.1161}\ INVRT_t + \underset{(3.2)}{.0253}\ DEVLT_{60}$$

$$\bar{R}^2 = .586 \qquad n = 55 \qquad t = 1960\text{-}77$$

What is significant are the somewhat higher coefficients for the HR variables. While equation (3) estimated that a ten-year change in life expectancies raised the growth rate by .75 percentage points, equation (8) indicates that the change would result in an increase of 1.1 percentage points. Of course, a large part of the explanation of these differences can be traced to the fact that the last equation is specified in terms of deviations from expected levels, while the earlier equation was in terms of the simple level of life expectancy. The life expectancy deviations themselves have a standard deviation of 6.4, so that a one standard deviation change in this variable would produce an increase in the growth rate of .7 percentage points, similar to the effect expected on the basis of equation (3). For literacy, the standard deviation of the literacy deviations is 21.7, producing an increase of about .5 percentage points. Using both literacy and life expectancy deviations in the same equation tends to reduce the importance of the literacy term:

$$(10) \quad GRYPC_t = -.8178 + \underset{(6.2)}{.2310}\ GRIMP_t + \underset{(3.5)}{.1085}\ INVRT_t + \underset{(3.0)}{.1190}\ DEVLX_{60}$$

$$+ \underset{(.3)}{.00428}\ DEVLT_{60}$$

$$\bar{R}^2 = .640 \qquad n = 55 \qquad t = 1960\text{-}77$$

The fact that life expectancy deviations tend to have higher t-ratios and produce higher $\bar{R}^2$, and dominate the literacy deviations when used together would suggest that health improvements are somewhat more important than basic education. While this may be true, such a conclusion appears to be premature, since there is substantial correlation between literacy and life expectancy (r^2 = .80, 1960). The high correlation between life expectancy and literacy has been remarked on by other studies. 1/ In a multiple correlation framework, literacy tends to be the most powerful variable for explaining variations in life expectancy. While it is virtually impossible to derive causality links from this association, it seems likely that improvements in education have an important effect in understanding of the need for hygiene, and the causality links between improper hygiene and ill health and the ability of people to absorb knowledge of modern medical practices. Thus, while life expectancy may appear, in this last set of equations more important, it may contain some of the influence of better literacy on life expectancy.

It would be possible, for instance, to modify the expected values of life expectancy by inserting a term for literacy. The estimated equation then becomes:

$$\text{(11)} \qquad LIEX_{60} = 32.6280 + \underset{(10.7)}{.2451}\, LIT_{60} + \underset{(4.0)}{.0361}\, YPC_{60} - \underset{(2.5)}{.0000284}\, (YPC_{60})^2$$

$$\bar{R}^2 = .852 \qquad n = 66$$

The result is that the income terms are reduced in importance, and about two-thirds of the explained variation is attributable to the literacy term alone, which has the highest t-ratio. If we believe that the causality runs from

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1/ For an excellent summary of this work, see Susan H. Cochrane, Donald O'Hara, and Joanne Leslie, "The Effects of Education on Health," World Bank Staff Working Paper, no. 405 (Washington, D.C.: World Bank, July 1980).

literacy to life expectancy, and not the other way around, then there is good reason to believe that a large portion of the variation in life expectancy can be traced to variations in literacy. More directly, we can regress the deviation of life expectancy on the deviation of literacy from its expected value:

$$\text{(12)} \qquad DEVLX_{60} = .1704 + \underset{(10.8)}{.2451}\ DEVLT_{60}$$

$$\bar{R}^2 = .642 \qquad n = 66$$

Thus we could expect that if a country were to deviate 22 percentage points (one standard deviation) from its expected value in literacy, this would result in a deviation of about 5.3 years in the expected value of life expectancy. If this value is then inserted in equation (8), we could expect a .6 percentage point gain in the growth rate. This is very close to the direct impact of literacy (.7 percentage points) estimated directly from equation (9). More importantly, while our sample has an average deviation of life expectancy of six years, about three-quarters of that deviation can be traced to variations in literacy. Thus, while a six-year deviation will raise growth rates by .8 percentage points, three-quarters of that deviation, for an average country, is a result of variations in literacy.

It could be argued, of course, that the present work is overly simple and somewhat at variance with orthodox production and growth theory. Furthermore, since there are causal links in many directions between life expectancy, literacy income and the growth of output, it may be misleading to rely on a single equation estimate of a relationship which may be best described in terms of a set of

simultaneous equations. Work undertaken by David Wheeler, 1/ using a simultaneous system of equations to describe human resource and output relationships confirms the results shown here. Wheeler essentially develops a model with a Cobb-Douglas production function augmented with human resource factors. At the same time, the human resource factors are themselves related to the growth of output and other variables, using a simultaneous equation framework, which includes estimated equations for investment, manufacturing exports and the birth rate. The results show that education, literacy and nutrition factors are important determinants of output. More surprising, Wheeler finds a positive relationship between manufactured export growth and health and education measures, indicating that countries using this means to accelerate their output have relied on a stock of human capital, as well as physical capital. Health and education factors were also important in determining the level of investment. Wheeler's results are only at variance with those reported here is that he finds no direct link between health (as measured by life expectancies) and output. This would tend to confirm the thought noted above, that since life expectancy is itself a function of literacy, that there may be a tendency to overstate the effects of life expectancy in the single equation estimates.

Investment and Human Resources

The above discussion has ignored the question of resource allocation between human resources and other forms of investment. While our basic equations (3 and 4) allow for variances in investment rates, it is possible that the higher level of human resource development represents higher levels of

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1/ David Wheeler, "Human Resource Development and Economic Growth in Developing Countries: A Simultaneous Model," World Bank Staff Working Paper, no. 407 (Washington, D.C.: World Bank, July 1980).

investment in human resources in past periods. Hence the higher growth rates capture a lagged return on investments of prior years. Secondly, it might be possible that countries with highly developed human resources find they have to reduce the level of investment in other sectors in order to support recurrent cost expenses of these investments (teacher salaries, hospital administration costs, food subsidies, etc.).

If the first hypothesis is correct, the rate of investment should be related to the change in our HR indicators. If countries which have made rapid advances in HR development have done so by increasing their investment rates, then it would not be fair to treat the resulting increase in growth as a net gain (since investments in physical capital would have also improved growth). To test the second hypothesis, the investment rate for the 1960-77 period is related to the level of HR in the beginning of the period. Countries with heavy investments in HR should have lower investment rates if these HR investments are a burden. In addition, we relate investment to the level of income per capita, since it is logical to expect that richer countries will have higher investment rates, <u>ceteris paribus</u>.

$$(13) \qquad IR_{60-77} = 7.133 + \underset{(2.25)}{.01108}\ YPC_{60} + \underset{(1.7)}{.1393}\ LIEX_{60} + \underset{(.8)}{.2519}\ DLIEX_{60-77}$$

$$\bar{R}^2 = .306 \qquad n = 68$$

$$IR_{60-77} = 12.1714 + \underset{(4.0)}{.0223}\ YPC_{60} + \underset{(1.1)}{.03167}\ LIT_{60} + \underset{(1.7)}{.09470}\ DLIT_{60-77}$$

$$\bar{R}^2 = .442 \qquad n = 29$$

The regression results, in fact, give support for neither the first nor the second hypothesis. The HR indicators are not statistically significant in either equation. The level of HR seems to be positively related to the investment rate, instead of negatively related, even after variations caused by the level of income have been accounted for. While the changes in the HR indicators have postulated sign (positive) neither life expectancy nor literacy changes are statistically significant. Thus rapid changes in HR indicators are probably associated with a shift in investment priorities, or by a shift in the pattern of consumption, rather than by a shift in the investment or consumption share in GNP. If this is true, and at the same time countries which have made progress in meeting HR also have higher growth rates (as in equations 3 and 4) then it might appear that investing in human resources yields higher returns than alternative investments available to developing countries. It may be premature to jump to this conclusion from such aggregate data and regressions based on levels, however, since there may be alternative explanations. For instance, Wheeler (1980) relates the changes in the investment rate to the changes in the HR indicators, on the basis that life expectancy and literacy should be instrumental in increasing savings, and hence investment. His results also show a positive relationship, with somewhat higher statistical properties, but using a slightly different specification. It is not clear, furthermore, that the <u>change</u> in investment rates over a period measured from end points is more valid than the average investment rate over the period used here.

Conclusions

Both simple and more sophisticated statistical techniques seem to point in the same general direction: policies directed at human resource development can raise the growth rate of output since they represent an investment in human capital. While these findings help resurrect the older, more traditional human capital approach, they also extend it considerably since our view of human capital encompasses health improvements as well as primary or basic education. The health-related improvements in human capital, while not totally ignored by the traditional literature, were certainly given far less emphasis.

This analysis does not, however, indicate the proper mix of human resource and other, more traditional investments in physical capital. To do this, one would have to estimate the marginal rate of return for each type of investment, which probably varies widely between countries. Thus, it cannot be said that every country should expand human resource investments. What can be said is that the view that human resource expenditures are purely a consumption activity is wrong, unless the point has been reached where further investments at the margin have returns of zero or less. Furthermore, the fact that on average those countries with higher levels of human resouce development have higher rates of growth, suggests that on average the rates of return from these kinds of investments do exceed those of other forms of physical capital.

A human resource development program probably offers benefits as a more direct way of eliminating poverty, in that it is easier to accomplish than programs which redistribute assets to the poor in order to raise their productivity. Programs that redistribute wealth by reorienting public services so as

to reach the poor are probably more politically acceptable than programs that call for massive redistribution of land or wealth through direct transfers. Thus, investing in people may be an efficient way of both eliminating poverty and increasing the growth rate of output in many developing countries.

Appendix Table I: A. BASIC EQUATIONS, 1960-1977

Dependent Variable: $GRYPC_{60-77}$ /1

Equation No.		k	GRIMP	INVRT	LIEX	LIT	D1	D2	D3	DEVLIEX	DEVLIT	R^2	
31	Life Expectancy	-3.5227	.2390 (6.6)	.0640 (1.9)	.0717 (4.2)							.637	6
32	Literacy	-1.0213	.2451 (6.2)	.0680 (1.8)		.0223 (3.3)						.590	5
33	Regional Dummies with Life Expectancy	-2.8845	.2033 (5.5)	.0551 (1.7)	.0730 (3.4)		-.3384 (.8)	-.7192 (1.8)	.9219 (1.8)			.683	6
34	Regional Dummies with Literacy	.9092	.2261 (5.3)	.0604 (1.7)		.0253 (2.7)	-.5589 (1.2)	-1.0470 (2.1)	.2289 (.4)			.628	5
35	Literacy, Deviations	-1.0330	.2449 (6.2)	.1161 (3.4)							.0253 (3.2)	.586	5
36	Life Expectancy, Deviations	-1.2674	.2336 (6.6)	.1301 (4.6)						.110 (4.7)		.659	6
37	Literacy & Life Expectancy Deviations	-.8178	.2310 (6.2)	.1085 (3.5)						.1190 (3.0)	.00428 (.3)	.640	5
38	Combination, Deviations & Dummy Variables	-.2189	.2086 (4.9)	.1005 (3.1)			-.5277 (1.1)	-.0922 (.2)	.4411 (.7)	.1076 (2.3)	-.00909 (.6)	.635	5

/1 Growth rate per capita GNP.

continued...

Appendix Table I: B. BASIC EQUATIONS, 1960-1970

Dependent Variable: $GRYPC_{60-70}$

Equation No.		k	GRIMP	INVRT	LIEX	LIT	D1	D2	D3	DEVLIEX	DEVLT	$\bar{R}^2$	n
11	Life Expectancy	-3.3563	.1933 (5.4)	.03120 (.8)	.08614 (4.4)							.537	65
12	Literacy	-.5705	.1886 (4.6)	.0622 (1.5)		.0222 (2.7)						.438	55
13	Regional Dummies	-2.5720	.1731 (4.7)	.0238 (.6)	.0956 (3.8)		-.2298 (.4)	-.9663 (2.1)	.4898 (.8)			.574	65
14	Life Expectancy, Deviations	-.6039	.1853 (4.8)	.1143 (3.4)						.0969 (3.4)		.484	65
15	Literacy, Deviations	-.5758	.1923 (4.5)	.1120 (2.8)							.0147 (1.5)	.385	55

continued...

Appendix Table I: C. BASIC EQUATIONS, 1970-77

Dependent Variable: $GRYPC_{70-77}$

Equation No.		k	GRIMP	INVRT	LIEX	LIT	D1	D2	D3	DEVLIEX	DEVLIT	$\bar{R}^2$	n
21	Life Expectancy	-4.3528	.1883 (6.4)	.0186 (.5)	.0970 (4.4)							.510	71
22	Literacy	-.7467	.2026 (4.8)	.0267 (.6)		.0302 (3.2)						.430	54
23	Regional Dummies	-1.1220	.1630 (5.8)	.0105 (.3)	.0544 (1.8)		-1.2967 (2.0)	-.7233 (1.3)	1.7769 (2.6)			.606	71
24	Life Expectancy, Deviations	-.3505	.1833 (6.0)	.0726 (2.2)						.1428 (3.7)		.478	71
25	Literacy, Deviations	-.6890	.2053 (4.7)	.0589 (1.3)							.0317 (2.2)	.378	54

Appendix Table II: BASIC DATA

	LIEX60	LIT60	YPC60	INVRT	GRIMP	GRYPC	DEVLX60	DEVLT60
PORTUGAL	62.0	62.0	380.0	19.7	8.5	5.7	4.7	1.7
GREECE	68.0	81.0	510.0	25.0	9.1	6.1	5.7	7.5
SPAIN	68.0	87.0	660.0	24.4	11.1	5.3	1.8	1.2
TURKEY	51.0	38.0	280.0	18.7	1.1	3.4	-1.4	-10.7
YUGOSLAVIA	62.0	77.0	380.0	31.6	8.9	5.2	4.7	16.7
ALGERIA	47.0	10.0	470.0	30.3	7.2	2.7	-13.9	-59.7
MOROCCO	47.0	14.0	190.0	15.0	6.4	2.2	-0.3	-23.2
TUNISA	48.0	16.0	210.0	23.2	6.3	4.3	-0.5	-23.6
EGYPT	46.0	26.0	100.0	15.6	7.6	2.4	4.5	1.5
BURUNDI	37.0	14.0	50.0	7.2	3.9	2.2	-1.0	-3.0
CAMEROON	37.0	19.0	110.0	17.0	5.1	2.8	-5.2	-7.0
CENTRAL AFRICAN REP.	37.0	7.0	120.0	24.4	3.0	0.3	-5.9	-20.4
CHAD	35.0	0.0	70.0	11.6	2.4	-1.3	-4.5	0.0
CONGO	37.0	16.0	210.0	22.8	4.9	1.4	-11.5	-23.8
ZAIRE	40.0	31.0	60.0	24.1	7.6	0.9	1.3	12.4
BENIN	37.0	8.0	90.0	15.2	8.4	0.1	-3.9	-15.1
ETHIOPIA	36.0	0.0	40.0	12.1	4.4	1.5	-1.3	0.0
GHANA	40.0	27.0	210.0	13.7	-3.7	-0.5	-8.5	-12.8
GUINEA	35.0	7.0	110.0	0.0	0.0	0.3	-7.2	-19.0
IVORY COAST	37.0	5.0	210.0	12.4	8.4	2.4	-11.5	-34.8
KENYA	47.0	20.0	100.0	21.0	4.6	2.4	5.5	-4.5
LESOTHO	42.0	0.0	40.0	13.0	12.1	2.6	4.7	0.0
LIBERIA	40.0	9.0	170.0	19.8	3.2	1.4	-6.1	-25.4
MADAGASCAR	37.0	0.0	120.0	13.0	0.0	-0.4	-5.9	0.0
MALAWI	37.0	0.0	50.0	17.1	6.5	2.7	-1.0	0.0
MALI	37.0	3.0	40.0	0.0	0.0	1.0	-0.3	-12.5
MAURITANIA	37.0	5.0	80.0	0.0	0.0	0.0	-3.2	-16.6
NIGER	37.0	1.0	90.0	10.1	6.1	-1.5	-3.9	-22.1
NIGERIA	39.0	15.0	120.0	13.2	12.1	3.5	-3.9	-12.4
RWANDA	37.0	16.0	60.0	9.5	0.0	1.4	-1.7	-2.6
SENEGAL	37.0	6.0	200.0	14.5	0.8	-0.1	-10.9	-32.5
SIERRE LEONE	37.0	0.0	100.0	0.0	0.0	1.1	-4.5	0.0
SOMALIA	36.0	2.0	60.0	19.8	0.0	-1.3	-2.7	-16.6
SUDAN	39.0	13.0	130.0	18.2	-0.6	0.2	-4.5	-15.9
TANZANIA	42.0	10.0	70.0	17.0	5.0	2.7	2.5	-10.1
TOGO	37.0	10.0	80.0	17.4	5.7	4.2	-3.2	-11.6
UGANDA	44.0	35.0	130.0	12.4	-0.4	0.3	0.5	6.1
UPPER VOLTA	37.0	2.0	50.0	0.0	0.0	1.1	-1.0	-15.0
ZAMBIA	40.0	0.0	200.0	25.7	2.2	1.0	-7.9	0.0
COSTA RICA	62.0	0.0	380.0	20.4	9.3	3.5	4.7	0.0
DOMINICAN REP.	51.0	65.0	240.0	17.6	9.6	3.8	0.8	21.3
EL SALVADOR	50.0	49.0	190.0	14.3	6.0	2.2	2.7	11.8

continued...

Appendix Table II: BASIC DATA (continued)

	LIEX60	LIT60	YPC60	INVRT	GRIMP	GRYPC	DEVLX60	DEVLT60
GUATAMALA	47.0	32.0	240.0	12.0	5.9	2.9	-3.2	-11.7
HATI	42.0	15.0	110.0	0.0	0.0	0.0	-0.2	-11.0
HONDURAS	46.0	45.0	170.0	17.0	7.7	1.2	-0.1	10.6
JAMAICA	64.0	82.0	470.0	25.3	4.8	2.3	3.1	12.3
MEXICO	58.0	65.0	360.0	22.1	6.3	3.1	1.6	6.9
NICARAGUA	47.0	0.0	240.0	19.6	7.0	2.7	-3.2	0.0
PANAMA	62.0	73.0	350.0	23.1	6.4	3.7	6.1	16.0
ARGENTINA	65.0	91.0	570.0	20.7	2.5	2.8	0.9	12.2
BOLIVIA	43.0	39.0	210.0	16.4	6.5	2.3	-5.5	-0.8
BRAZIL	57.0	61.0	310.0	22.8	9.8	4.9	3.0	8.6
CHILE	57.0	84.0	480.0	14.7	4.3	1.0	-4.2	13.4
COLOMBIA	53.0	63.0	210.0	20.3	4.8	3.1	4.5	23.2
ECUADOR	51.0	68.0	0.0	0.0	0.0	0.0	0.0	0.0
PARAGUAY	56.0	75.0	220.0	17.5	6.0	2.4	6.9	33.9
PERU	48.0	61.0	280.0	20.0	5.5	2.5	-4.4	12.3
TRINIDAD & TOBAGO	63.0	93.0	870.0	28.2	3.0	1.6	-5.6	-5.2
URUGUAY	68.0	0.0	630.0	14.0	2.6	0.5	2.4	0.0
ISRAEL	69.0	0.0	700.0	27.5	11.3	4.6	2.0	0.0
JORDAN	47.0	32.0	190.0	18.6	4.1	1.6	-0.3	-5.2
LEBANON	58.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
SYRIA	48.0	30.0	260.0	0.0	0.0	3.8	-3.3	-16.3
AFGHANISTAN	34.0	8.0	90.0	9.6	9.1	0.1	-6.9	-15.1
BURMA	44.0	60.0	50.0	11.5	-6.8	0.9	6.0	43.0
SRI LANKA	62.0	75.0	70.0	15.2	-4.3	1.9	22.5	54.9
INDIA	43.0	28.0	60.0	17.6	1.6	1.4	4.3	9.4
NEPAL	37.0	9.0	50.0	0.0	0.0	0.2	-1.0	-8.0
PAKISTAN	44.0	15.0	60.0	15.5	1.3	2.9	5.3	-3.6
BANGLADESH	42.0	22.0	40.0	8.7	3.0	-0.5	4.7	6.5
TAIWAN	64.0	54.0	210.0	22.3	17.0	6.5	15.5	14.2
HONG KONG	65.0	70.0	410.0	22.1	8.9	6.3	6.5	6.4
INDONESIA	41.0	39.0	90.0	13.6	11.1	3.5	0.1	15.9
KOREA	54.0	71.0	120.0	21.0	19.5	7.6	11.1	43.6
DEMOC. REP. OF LAOS	40.0	28.0	60.0	0.0	0.0	0.0	1.3	9.4
MALASYIA	57.0	53.0	230.0	19.6	4.9	4.0	7.3	10.6
PHILIPPINES	51.0	72.0	140.0	21.8	5.3	2.1	6.8	41.7
SINGAPORE	64.0	0.0	470.0	26.5	9.5	7.7	3.1	0.0
THAILAND	51.0	68.0	100.0	23.0	7.8	4.5	9.5	43.5
PAPUA NEW GUINEA	41.0	29.0	140.0	20.3	9.6	4.1	-3.2	-1.3
CHINA	53.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CUBA	64.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
N. KOREA	54.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

LIFE EXPECTANCY AND GROWTH:
WORST PERFORMERS

Country	Life Expectancy Deviation 1960	Per Capita GDP Growth Rate 1960-1977
1. Algeria	-13.9	2.65
2. Congo	-11.5	1.40
3. Ivory Coast	-11.5	2.43
4. Senegal	-10.9	-0.08
5. Ghana	-8.5	-0.53
6. Zambia	-7.9	1.05
7. Guinea	-7.2	0.35
8. Afghanistan	-6.9	0.10
9. Liberia	-6.1	1.37
10. Cent. Afr. Rep.	-5.9	0.29
11. Madagascar	-5.9	-0.41
12. Trinidad and Tobago	-5.6	1.60
Average: 12 Countries	-8.5	.85
Average: 83 Countries	-0	2.4

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