

## Trends in Human and Economic Development Across Countries

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Convergence of the Human Development Index (HDI) and per capita income were tested between 1975 and 1998 using a yearly adjustment model. The results indicated convergence for HDI and divergence for income. Furthermore, there was an increase over the years in the average HDI for every group of countries as classified by HDI from low to high. The only group of countries with significant increase in income were the rich countries.

### I. Introduction

Economic growth, captured by such a single figure as gross domestic product per capita (GDP), is an imperfect measure of the wider conditions of humans. The gap in terms of per capita income, as conventionally measured between two countries over two periods of time, may expand, yet the level of well-being may decrease. To determine whether citizens of a country are better off requires a different type of measure, a measure of well-being (Slotje (1991)). To devise such a measure, the United Nations Development Program (UNDP) has undertaken since 1990 the construction of a composite index called the Human Development Index (HDI).

The HDI merges per capita income with longevity and knowledge for a large number of countries. The usefulness of HDI for rating countries for their levels of human development was debated by Rao (1991), McGillivray (1991), and Hopkins (1991) immediately after its arrival. Yet, in the year 2000 the HDI, after a decade of annual publications, remained a very useful and legitimate tool to gauge progress or decline of a country from year to year as noted by Mbaku (1997). The three variables constituting the HDI invariably are the least contested for their neutrality from cultural, ethnic diversity, and level of development biases. Each variable portrays desirable qualities in its own right as well as standing as a proxy for other variables. While longevity is desirable, knowledge greatly enhances the enjoyment of a long life, and per capita income stands as a proxy for a decent standard of living enhancing freedom from worries about poverty and survival.

The HDI, as indicated earlier, is composed of three components. Each component is transformed to a performance index for each country  $i$  and component  $j$ ,  $j=1,2,3$ , according to the formula:

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$$I_{ij} = (\text{actual minimum})/(\text{maximum minimum}) \quad (1)$$

where the minimum and maximum values are fixed as follows:

- (a) Life expectancy at birth: 25 years and 85 years,
- (b) Educational attainment
  - (i) Adult literacy rate, age 15 and above: 0% and 100%,
  - (ii) Combined gross enrollment ratio; 0% and 100%, and
- (c) GDP per capita (PPP US \$): \$100 and \$40,000.

The educational attainment is a weighted measure of adult literacy rate (two-thirds weight) and the combined gross primary, secondary, and tertiary enrollment ratio (one-third weight).

Note that GDP per capita is in terms of U.S. purchasing power parity (PPP US \$). Note also that income is used as a proxy for a decent standard of living. In the opinion of UNDP, achieving a respectable level of human development does not require unusually large income. Per capita income “*y*” is therefore discounted for inclusion in the HDI by the formula

$$W(y) = [\log y - \log y(\min)] / [\log y(\max) - \log y(\min)].$$

Thus, the logarithms of per capita income “*y*” are used instead of the actual values “*y*” in the computation in Equation (1).

Now that the three performance indexes are transformed by Equation (1), the composite HDI index for country *i* is obtained as the average of the transformed components,

$$I_i = (1/3) \sum_j I_{ij}, \quad j = 1, 2, 3,$$

which ranges between zero and one; the closer to one, the better is the average achievement in a country.

The countries are classified by UNDP according to human development scores in 1998 into three clusters:

- High:  $0.800 \leq \text{HDI} \leq 1.000$ ,
- Medium:  $0.500 \leq \text{HDI} \leq 0.799$ , and
- Low:  $0.000 \leq \text{HDI} \leq 0.499$ .

Note that the HDI value is the distance that a particular country has to travel to reach the maximum possible value of 1.00. In other words, it is a measure of the shortfall from the best score. This aspect makes inter-country comparisons meaningful, and provides the challenge for every country to find ways to reduce its shortfall.

A unique opportunity to assess the changes over a long period of time in HDI is made possible in UNDP (2000) whereby the HDI is computed farther back to 1975 in five-year intervals, the last year being 1998. In the same manner, corresponding to HDI data, per capita income in U.S. 1995 dollars is provided. The correspondence between HDI and

income makes it possible to compare their trends in the sense that some countries with relatively low per capita income may be able to score relatively high in the HDI index. Note that the UNDP classified the countries into the three groups (high, medium, low) for the period 1975 to 1998 according to the scores in 1998 as indicated above even though there were slight movements of few countries between the three classifications. By far, most movement of countries were within their own group rather than between the groups.

## **II. Aim and Purpose**

In general, studies regarding economic growth and well-being have in common their provision of determinants through explanatory variables such as educational imbalance and political freedom as was done by Graff (1999), or export growth as was done by Ekanayake (1999) and Rahman and Mustafa (1997). Government spending as a determinant of economic growth is provided, for instance, by Ghali (1997) for Saudi Arabia, and Sinha (1998) for Malaysia.

Instead of an assessment via explanatory variables, the purpose of this paper is to evaluate the convergence or divergence of human and economic growth among the sample of 100 countries to find, in essence, whether differences among them have widened or narrowed. Furthermore, the paper will provide for both the HDI and per capita income, lists of countries for significant upward or downward changes. For this end, HDI and income data for the 100 countries are sorted into an overall effect component and a particular country component.

## **III. The Theoretical Model**

Recent interest in the concept of convergence in economics, especially as evidenced by the works of Barro and Sala-i-Martin (1992) and Blanchard and Katz (1992), arose with considerations of income convergence, as, for instance, across states in the United States. The idea behind the concept, as Milne (1993) and Quah (1996) explain, pertains primarily to poor economies catching up with richer economies in per capita income. In other words, economies below average tend to grow faster than economies that begin with per capita income above the average.

Vohra (1996) and Koo, Kim, and Kim (1998) explain that the research in growth convergence may be classified into beta and sigma convergence where the former refers to poor economies catching up with richer economies, while the latter refers to decline in the dispersion over time. Other competing models of convergence, as pointed out by Galor (1996), are the conditional beta convergence, where economies with identical structural characteristics converge to one another, and club convergence, where economies with similar economic conditions converge to one another. Doyle (1997) and O'Leary (1997) use the concept of convergence in a broader sense where social economic variables other than income for a group of countries display narrow dispersions.

The patterns of convergence or divergence in this study decompose the change in a country's performance over a period of time into overall and national effects. The procedure can show whether significant changes in localized effects have taken place. The methodology is adopted from Congdon and Shepherd (1988) and McClendon (1977).

A country's annual HDI and income data for year  $Y_t$  were regressed correspondingly on a previous year  $Y_{t-1}$  to capture the time-dependent patterns. A central assumption is that the conditional distribution for  $Y_t$  given  $Y_{t-1}$  is normal with the mean (expected or equivalently predicted value) estimated by least squares ((Larson (1982), Kleinbaum *et al.* (1988)) as

$$Y'_t = \bar{Y}_t + b(Y_{(t-1)t} - \bar{Y}_{t-1}). \quad (2)$$

$Y'_t$  and  $\bar{Y}_t$  are the expected value of country  $i$  and the overall annual mean in the later period, respectively.  $Y_{(t-1)t}$  is the observed value of country  $i$  and  $\bar{Y}_{t-1}$  is the overall mean in a former period. The slope " $b$ " is the feedback effect of an origin value in inducing lesser or greater value in a destination period. Note that when  $-1 < b < 1$ , convergence among countries takes place. Divergence takes place when  $b > 1$  or  $b < -1$ , because countries with HDI or income above or below the mean in a former period diverge farther from the mean in the later period.

The difference  $Y_{it} - Y_{(t-1)t}$ , which measures for a given country  $i$  the absolute vertical change in human development or income, can be disaggregated into an overall effect and a national effect as

$$Y_{it} - Y_{(t-1)t} = (Y'_t - \bar{Y}_{t-1}) + (Y_{it} - Y'_t). \quad (3)$$

The first term on the right-hand side of Equation (3) denotes the amount a country's human development or income would have increased (or decreased) had they grown at the same rate as the overall HDI or income computed from knowledge of a specific country's expected HDI or income score in year  $t$  as compared to the overall mean in year  $t-1$ .

Because the focus of this study is how well a specific country has performed over a given time span, the overall change is subtracted from total change to yield a country's net relative change given in the second part of Equation (3). It is the difference between an actual observation in the later period and its prediction from regression, termed the country's positional change. When positive (negative), the indication is that a country's HDI or income has increased (declined) relative to its previous position, depicting the extent to which the country's accomplishment deviates from the regression line.

Note that the difference  $(Y_{it} - Y'_t)$  is termed positional change rather than disturbance in regression sense. In regression, the disturbance component is placed to account for other determining explanatory factors not included explicitly in the regression equation. On the other hand,  $(Y_{it} - Y'_t)$  measures vertical relative position (or achievement) of an individual country above or below expectation. A distinction should be made between vertical mobility and horizontal mobility. The latter is concerned with change in rank in a country's accomplishment as compared to other countries between earlier and later observations.

#### IV. Empirical Results

##### 1. Preliminary Findings

For the period covered by the data (1975 to 1998), Table 1 shows the mean, the median, the standard deviation, and the coefficient of variation for both the HDI and income by groups of countries according to UNDP classification (high, medium, low, all).

**Table 1 Descriptive Statistics for HDI and Income**

Classification	N	HDI				Income			
		m	M	S	CV	m	M	S	CV
<b>HIGH</b>									
1975	32	.807	.829	.054	.067	14415	14161	8716	0.605
1980	32	.827	.844	.048	.058	16410	15171	9306	0.567
1985	32	.842	.854	.044	.052	17323	16393	9363	0.540
1990	32	.861	.873	.040	.046	19676	18987	10414	0.529
1998	32	.893	.908	.038	.043	23107	21804	11257	0.487
<b>MEDIUM</b>									
1975	47	.563	.575	.102	.181	1564	1156	1605	1.026
1980	47	.596	.581	.098	.164	1772	1246	1884	1.063
1985	47	.623	.614	.088	.141	1688	1328	1418	0.840
1990	47	.646	.652	.084	.130	1737	1372	1379	0.794
1998	47	.677	.705	.086	.127	1941	1465	1450	0.745
<b>LOW</b>									
1975	21	.317	.312	.063	.199	362	301	210	0.580
1980	21	.343	.336	.066	.192	353	314	206	0.584
1985	21	.363	.396	.061	.168	331	271	170	0.514
1990	21	.377	.376	.057	.151	317	258	150	0.473
1998	21	.405	.416	.058	.143	316	267	161	0.509
<b>ALL</b>									
1975	100	.591	.616	.195	.330	5431	1372	7972	1.468
1980	100	.618	.650	.191	.309	6166	1642	8884	1.441
1985	100	.640	.677	.186	.290	6411	1763	9233	1.440
1990	100	.660	.699	.186	.282	7186	1734	10454	1.455
1998	100	.690	.733	.188	.272	8381	1790	12005	1.432

Note: N, m, M, S, CV refer to numbers of observations, mean, median, standard deviation, and coefficient of variation (s/m).

Source: Human Development Report (2000).

There was an increase in values for HDI for every classification. The thirty-two countries in the high HDI category increased their HDI by 8.6 percent from 0.807 to 0.893. For the forty-seven countries in the medium category, the increase was 11.4 percent. For the twenty-one countries in the low category, the increase was 8.8 percent. Thus, the medium

group had the best performance among the three groups. Overall, for all the 100 countries in the sample, the HDI moved from 0.591 to 0.690, an increase of 8.9 percent. The trends for the coefficient of variation (m/s), where m and s are the mean and the standard deviation, denote a decrease in within-group dispersion for all the classifications, including all the countries, a sign of narrowing of HDI scores among the groups.

It is of interest here to note the income results in Table 1. There was an increase of 60 percent and 24 percent in per capita income for the high and medium categories between 1975 and 1998, but a decrease of 13 percent for the low category from \$362 to \$316. Also, in a similar manner as the HDI, the coefficient of variation consistently decreased, with three exceptions. Overall, it appears that within-group dispersions declined for all the classifications.

**2. Comparisons by Groups of Countries**

The supposition that for HDI and income there is a respective large and small variability in means between and within the three classifications observed earlier can be tested statistically by analysis of variance. The analysis of variance is applied for HDI and income in two ways. The first is to test for each classification as well as all the countries whether the means of HDI and income for the periods under consideration are significantly different. The results are shown in Table 2.

**Table 2 Analysis of Variance for Equality of Means of HDI and Income by Years**

Classification	N	F		P-Value	
		HDI	Income	HDI	Income
HIGH	32	16.89	3.67	0.000	0.007
MEDIUM	47	10.70	0.35	0.000	0.841
LOW	21	6.21	0.28	0.000	0.891
ALL	100	4.04	1.31	0.003	0.265

Note: HDI and per capita income means are tested for equality by classification (high, medium, low, and all) for the years 1975, 1980, 1985, 1990, and 1998.

Source: Human Development Report (2000).

The remarkable findings in Table 2, by observing the F-values and their P-values, is that the noticeable increases in averages for HDI for each classification is significant. Over the period 1975 to 1998, there was an improvement in HDI for every classification level.

Not so for income. The only classification of countries, as shown in Table 2, with significant F and P values is the high classification of countries. In other words, the only group of countries that showed relatively substantially large increase in income was that with high scores in HDI. The results, however, bring to light that respectable improvements in levels of human development are possible even at modest or insignificant increases in levels of income.

Pelizzon and Casparis (1996) contend that a considerable degree of increase in welfare worldwide was the result of efforts by individual countries. Pelizzon and Casparis also note the role of the United Nations in the endeavors. The United Nations provided direct helpful programs by specialized agencies such as WHO for health, UNESCO for education, and

FAO for food. Easterly (2001) confirms the disparity in improvement between human well-being and economic well-being. Easterly observed that although health, education, fertility, and infrastructure generally improved in most developing countries in most recent years, the growth in per capita income was almost absent. For instance, between 1960 and 1979, the per capita income growth was approximately 2.5 percent while such growth was nil between 1980 and 1998.

### 3. Comparisons Over Time

The second use of analysis of variance is to test, for each period, whether the means in HDI and income among the three classifications differ. The results are shown in Table 3, where in every period, the F values and their corresponding P values show significant differences.

**Table 3 Analysis of Variance for HDI and Income by Classification**

Year	F		P-Value
	HDI	Income	
1975	226.06	74.93	0.000
1980	237.83	84.69	0.000
1985	285.51	97.20	0.000
1990	323.32	103.65	0.000
1998	322.45	123.45	0.000

Note: HDI and per capita income means by the levels of classification (high, medium, low) are tested for equality for each year.

Source: Human Development Report (2000).

These results are not surprising and confirm a supposition of differences. Still, reading between the lines of the F-value, the striking observation is the continual increase in these values. For HDI, there was an increase from F=226 in 1975 to F=322 in 1998. For income, the increase was from F=75 to F=123. These increases signify a widening of gaps between the three classifications for both HDI and income.

### 4. Yearly Adjustments Findings

Results of Equation (2) for HDI and income are presented in Table 4, showing the “Intercept  $a$ ”, where  $a = \bar{Y}_t - b\bar{Y}_{t-1}$  and the “Slope  $b$ ”. The final two columns contain the  $t$ -values for significance of  $b$ , and  $r$ , the correlation coefficient, which is positive and significant at the 1 percent level tested (Ostle and Malone (1988)) by

$$t = r(n - 2)^{1/2} / (1 - r^2)^{1/2},$$

where  $r$  and  $n$  are the correlation coefficient and the number of observations.

**Table 4 Regression Results for HDI and Income**

Classification	HDI				Income			
	a	b	t-value	r	a	b	t-value	r
<b>HIGH</b>								
80 vs 75	0.119	0.878	47.47	0.99	1162	1.060	40.11	0.99
85 vs 80	0.095	0.904	36.11	0.99	1550	0.961	17.69	0.96
90 vs 85	0.107	0.895	24.84	0.98	809	1.090	26.45	0.98
98 vs 90	0.133	0.882	16.11	0.91	2901	1.030	16.67	0.95
<b>MEDIUM</b>								
80 vs 75	0.062	0.948	43.84	0.99	-38	1.600	39.79	0.99
85 vs 80	0.088	0.898	45.19	0.99	404	0.725	23.57	0.96
90 vs 85	0.083	0.935	39.38	0.99	130	0.952	31.89	0.98
98 vs 90	0.050	0.972	20.42	0.96	158	1.030	29.91	0.98
<b>LOW</b>								
80 vs 75	0.014	1.040	21.63	0.99	4	0.963	22.39	0.98
85 vs 80	0.054	0.902	23.42	0.99	46	0.808	20.03	0.98
90 vs 85	0.045	0.916	19.32	0.99	28	0.873	29.63	0.99
98 vs 90	0.069	0.893	8.08	0.96	-7	1.020	13.10	0.95
<b>ALL</b>								
80 vs 75	0.040	0.978	139.40	0.99	139	1.110	109.13	0.99
85 vs 80	0.039	0.972	137.43	0.99	110	1.020	53.66	0.98
90 vs 85	0.021	0.998	136.35	0.99	-23	1.120	83.39	0.99
98 vs 90	0.032	0.999	79.51	0.99	258	1.130	55.39	0.99

Source: Human Development Report (2000).

The important conclusion from Table 4 is the trend toward convergence of the HDI, evidenced by values of  $0 < b < 1$  for all classifications except one instance in the low classification, between 1975 and 1980. Of special significance here are the values  $b$  for all the countries; they hover around 1.00, implying no movement either to convergence or divergence. In contrast to HDI, per capita income showed, with the exception of the low category, more trends towards divergence, indicating widening of income gaps among the countries in the high and medium classifications as well as worldwide for all the periods under consideration.

To establish statistical significance of the positional change  $(Y_i - Y'_i)$  of Equation (3) for country  $i$ , the statistical test according to Congdon and Shepherd (1988) is

$$t = (Y_i - Y'_i) / [S_y^2(1 - r^2)]^{1/2}. \quad (4)$$

The results are shown in Table 5, which lists the countries with significant  $t$  values of the residuals  $(Y_i - Y'_i)$  for both HDI and income.



NISSAN: TRENDS IN HUMAN AND ECONOMIC DEVELOPMENT ACROSS COUNTRIES

When performance is above the regression line, the  $t$ -values are positive. In this case, the countries with values larger than expected are denoted by the “+” sign, and are denoted by the “—” sign otherwise. Significance is for a one-sided test at the 5 percent level. The results for each period provide a guide to examine patterns across countries with statistically significant accomplishment in HDI and income above or below expectation.

For instance, the significant deviational change for 1980 versus 1975, where Japan and Hong Kong registered above expectation accomplishments for HDI is indicated by a “+” sign. For income, again Japan and Hong Kong, along with Iceland, had positive accomplishment above expectation denoted by the “+” sign, while The United Arab Emirates, with a “—” sign, had accomplishment below expectation. A survey of Table 5, therefore, provides contrasts between countries for their HDI and income accomplishments.

## V. Conclusion

The United Nations Development Program has constructed summary indexes across countries for a period that spans twenty-five years. The aim was to make evident that examination by a one dimensional measure between and within countries, usually income, is not an accurate representation of quality of life. By use of a multimeasure such as the HDI, a better picture is produced.

This paper, using this rich source of data for some twenty-five years, grouped the 100 countries into three classifications and investigated the question of changes between and within these groups. The investigation included contrasts between HDI and per capita income for convergence or divergence. In the process, countries exceeding or falling short of expectation were identified.

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NISSAN: TRENDS IN HUMAN AND ECONOMIC DEVELOPMENT ACROSS COUNTRIES

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**Table 5 Countries for Significant Change in HDI and Income by HDI Classification**

Classification	80 vs. 75		85 vs. 80		90 vs. 85		98 vs. 90	
	HDI	Income	HDI	Income	HDI	Income	HDI	Income
HIGH	(+)Japan (+)Hong Kong	(+)Iceland (+)Hong Kong (-)UAE	(+)Canada (+)Korea	(-)UAE	(+)Hong Kong (+)Korea (-)Argentina	(+)Japan (+)Luxembourg (-)UAE	(+)Singapore (-)UAE	(-)UAE (-)Switzerland (+)Luxembourg (+)Ireland (+)Singapore (+)Malta
MEDIUM	(+)Saudi Arabia (-)Guyana	(+)Saudi Arabia (+)Trinidad (-)Venezuela	(-)Guyana (+)Botswana	(+)Trinidad (+)Mexico	(-)Romania (-)Zimbabwe	(-)Trinidad (+)Malaysia	(+)China (-)Botswana	(+)Malaysia (+)Mauritius
	(-)Iran (-)El Salvador	(-)Iran (-)Jamaica	(-)Ghana (+)Zimbabwe	(+)Botswana (-)Saudi Arabia	(-)Congo	(+)Mauritius (+)Thailand	(-)Zimbabwe (-)Kenya	(-)Saudi Arabia
	(-)Guatemala (+)Botswana	(-)S. Africa (-)Botswana	(-)Papua NG			(+)Botswana		
LOW	(+)Nigeria (-)Chad (-)Guinea B.	(+)Indonesia (-)Congo (+)Cote d'Ivoire (-)Chad (-)Zambia	(+)Nepal (-)Niger	(+)Senegal (-)Nigeria (-)Niger	(+)Nepal (-)Zambia	(-)Congo (+)Senegal (-)Niger	(+)Sudan (-)Zambia (-)Burundi	(+)Sudan (-)Congo
ALL	(+)Saudi Arabia (+)Tunisia (-)El Salvador (+)Indonesia (-)Guatemala (+)Botswana (+)Nigeria	(+)Norway (+)Iceland (-)Sweden (+)Japan (-)New Zealand (+)Singapore (+)Hong Kong	(+)Korea (-)Guyana (+)Algeria (+)Indonesia (+)Egypt (+)Botswana (+)Zimbabwe	(+)Norway (+)Japan (+)Denmark (-)UAE (-)Saudi Arabia	(+)Korea (-)Romania (+)Switzerland (-)Zimbabwe (-)Congo (+)Nepal (-)Zambia	(+)Japan (+)Luxembourg (-)N Zealand (+)Singapore (+)Hong Kong (+)Korea (-)UAE	(+)China (-)S. Africa (-)Botswana (-)Zimbabwe (-)Kenya (+)Sudan (-)Congo	(+)Norway (-)Switzerland (+)Luxembourg (+)Ireland (+)Singapore (+)Malta (-)UAE

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(-)Chad  
(-)Guinea B.

(-)UAE

(+)Cameroon  
(-)Togo  
(-)Niger

(-)Zambia  
(-)Burundi

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Source: Human Development Report (2000).