

Measuring Relative Social Progress among Nations*

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Data from the World Bank for 85 countries are used to assess the progress or decline in their quality of life over a 25-year period. The computation of a metric index with the constituents: infant mortality, literacy, and life expectancy, helps in inter-country and inter-temporal comparisons. The results support the conclusion that significant relative improvements in the quality of life were observed at the scale of the four major economies (low, lower-middle, upper-middle, high) as classified by the World Bank. Specific countries that performed better or worse than expected are also identified.

I. Introduction

The limitations of gross national product (GNP) per capita as a measure of well-being have been widely discussed, and are especially acute in cross-country comparisons. An example of such a limitation according to Fields (1980) is that the distribution of GNP among the population in a country and the share in the benefits of its growth by the poorest are not taken into account, although such criteria are essential in assessing economic performance and progress toward development. MacBean and Balasubramanyam (1976: 27-31) list many weaknesses and pitfalls of GNP per capita for comparison purposes and suggest as substitutes the use of a number of socio-economic indicators that are reasonably measurable. Three main issues arise in using such indicators. The first issue is the selection of relevant indicators; the second issue is

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whether to use the raw data or use them as ingredients in a composite index; and finally, the actual construction of such an index.

Estes (1988) refers to various works undertaken by organizations and individuals since the mid-1940s which focus on attempts to quantify the subjective perceptions of well-being. Among the well known works by organizations are those contributed by the United Nations (UN), the Organization for Economic Cooperation and Development (OECD) and the Overseas Development Council (ODC). Estes himself constructed an index to assess human welfare, which he calls the "Index of Social Progress." Many more examples can be cited.

A common feature among these indexes is the inclusion of socio-economic indicators as components. Difficulties arise when deciding on the set of variables for inclusion. Variation in cultures makes the selection of variables critical as pointed out by Desai and Shah (1988). For instance, the ODC index (Morris (1979)) called "Physical Quality-of-Life Index," (PQLI) which contains life expectancy at age one, infant mortality rates, and literacy rates, is one of the simplest among the models discussed above. The focus is measuring the accomplishment of nations in the three variables considered basic for living, irrespective of the level of development or the wealth of a nation.

But even this simple index is contested for its level-of-living relevance. Dasgupta (1988: 96-117) discusses in a detailed manner the justification of the indicators and provides answers to some of the objections raised against their use. It is argued, for instance, that literacy is not necessary for economic growth in that most factory work does not require it. An opposite argument is that literacy and education are essential both for their usefulness in disciplining the young to obey authority (social control), thus making them productive in industrial setting, and for their usefulness in jobs requiring skills. Yet, such views value literacy for their utility rather than as a basic need. In order for literacy to qualify as a basic need, one must show that it is as essential for survival as are food, clothing, and shelter. In response, one may show that literacy is essential for the potential development of a person as a human being, thus making literacy qualify as a basic need. In a similar manner, there are arguments against the inclusion in the index the demographic variables "life expectancy at birth" and "infant mortality at age one." The objections are based on the premise that a lengthy life may be associated with a decline in its quality, especially among the poorest people. A reasonable response is that the noticeable decline in mortality rates in recent years was achieved through improvement in the delivery of public goods such as health facilities, clean water, sanitation, and food supplies and nutrition. In

other words, length in life is accomplished through a rise in the standard of living, an aspect which makes longevity desirable and therefore dictates its inclusion as an integral part in the make-up of a quality-of-life index.

This brief synopsis of the pros and cons for the three social indicators as components in the quality-of-life index suggest that a bare minimum of such indicators is desirable. Even the inclusion of an indicator such as nutrition can pose some problems because of the complexity of establishing an internationally acceptable standard diet (Stein 1989). With this in mind, this paper is intended to deal with the construction of an index which measures quality of life using life expectancy at birth, infant mortality at age one per 1,000 live births, and literacy as its components. Such an index would be useful in evaluating trends through time as well as differences between countries.

II. The Measure of Quality of Life

The use of a composite index for quality of life as a yardstick for comparisons rather than dealing with a multiplicity of single indicators is well defeded by Ram (1982). What reamins is the search for appropriate yardsticks by which to measure the differences and the inequalities. The subject of measurement has received a great deal of attention from economists and statisticians, with works by Atkinson (1970, 1987), San (1973, 1981), Kolm (1977), Bourguignon (1979), Maasoumi (1986), Theil (1989), and Ray (1989) representing a partial list in this endeavour.

In particular, the PQLI according to Todaro (1985) ranks each country on the three indicators (life expectancy at age one, infant mortality rates per 1,000 live births, and literacy rates) on a scale with limits of 1 for the "worst" performance and 100 for the "best" performance, then averages the ranks. For this study, an index based on the concept of distance is developed. First, due to the variability of measurement of raw data, the component factors of the index are transformed into a uniform scale by the equation

$$(1) \quad u_i = (X_i - \bar{X} + 3S_x) / 6S_x$$

where X_i is a raw score of a given indicator for country, i , and \bar{X} and S_x are its mean and the standard deviation. By an appeal to the law of large numbers, the values for u_i with a probability approaching 1 will be between zero and one.¹

¹ By the law of large numbers, for a random variable X with mean μ_x and standard devia-

The proposed measure $d(u_{ij}, u_{0j})$ is expressed by the relation

$$(2) \quad d(u_{ij}, u_{0j}) = \left[\sum_{j=1}^3 (u_{ij} - u_{0j})^2 \right]^{1/2}, \quad i = 1, \dots, n;$$

where u_{ij} is the transformed data for country i and indicator j from equation (1), and u_{0j} is the best score in the group of n countries for the three factors. Thus, the distance "d" for each country is compared to a three-dimensional anchor point which represents an ideal. The ideal point $u_0 = (u_{01}, u_{02}, u_{03})$ is the transformation by equation (1) of best record in the n observed data for each indicator. For life expectancy and literacy, the score of the country with the highest life expectancy and the highest rate of literacy are used. For infant mortality, the candidate is the country with the lowest score. The resulting composite measure for a specific country is, therefore, its distance from the ideal point.²

The index "d" differs from the popularly used indexes such as the PQLI and the "standard score," otherwise known as "standard deviates," in fundamental ways. The PQLI as explained earlier is computed as an average of ordinal scales, and these take into account only the ranking of the individuals. The difference between an individual ranked first and an individual ranked second may not be the same magnitude as the difference between the third and the fourth. Here the position of each in the group is known but not their distances from each other. As an example, assume that the scores on a test of the top four candidates are 95, 94, 83, and 64. These are ranked respectively as 1, 2, 3, and 4. Yet as can easily be seen, the magnitudes of differences between them are not the same.

tion σ_x

$$P(-3\sigma_x < X_i - \mu_x < 3\sigma_x) \approx 1.$$

Adding $3\sigma_x$ to each side of the inequality, the result is

$$P(0 < (X_i - \mu_x + 3\sigma_x) < 6\sigma_x) \approx 1.$$

Dividing each side by $6\sigma_x$, then,

$$P(0 < (K_i - \mu_x + 3\sigma_x) / 6\sigma_x < 1) \approx 1.$$

Finally, replacing μ_x and σ_x by their sample values \bar{X} and S_x gives for u_i as defined in (1),

$$P(0 < u_i < 1) \approx 1.$$

² Distance, being an interval scale, considers the size of the interval between measurements. An interval scale requires a zero point and a unit distance (Conover, 1980:65). The ideal point u_0 serves as zero because the distance of a point to itself by equation (2) is zero. The proposed measure $d(u_{ij}, u_{0j})$ can be defined as a function by which the single number d is determined by two three-dimensional points. Thus, for country i , the distance of its score for the three indicators $u_i = (u_{i1}, u_{i2}, u_{i3})$ from the ideal $u_0 = (u_{01}, u_{02}, u_{03})$ is

$$d(u_i, u_0) = [(u_{i1} - u_{01})^2 + (u_{i2} - u_{02})^2 + (u_{i3} - u_{03})^2]^{1/2}$$

This measure satisfies the four axioms of metric space (See Green and Heller (1988)).

The index based on "standard deviates," measures the departure of individual observations from the average expressed in units of the standard deviation. Each score is a linear transformation of the original data which may take negative or positive values. The index itself may be negative or positive since it involves the summation of individual deviations. This index, therefore, is somewhat difficult to deal with arithmetically and conceptually. Furthermore, the point of reference is the average of the distribution. Each observation is compared with the average.

The index "d," on the other hand, is a metric measure as explained earlier which takes into account the magnitudes of the observations unlike the ordinal index (PQLI). It uses as a point of reference the "ideal" or the "best score" in contrast to "standard deviates" which use the average. Finally, because "d" is metric, computational operations and statistical inferences can be made.

III. Data and Empirical Results

Data for 85 countries were obtained for the years 1960 and 1987 primarily from the World Bank (1983, 1989). The countries are classified as (a) low-income, (b) lower-middle-income, (c) upper-middle-income, and, (d) high-income with these classifications used as a basis of comparison.

A principal concern is the distribution of the three factors, and how they compare between the two periods. The summaries are shown in Table 1. A striking observation from a casual glance is the dispersion between the top and the bottom of the distributions as witnessed from the values of the range (maximum minus minimum), even though there were relative improvements between 1960 and 1987. The improvements in each indicator for all the groups of countries are evident from the means, the standard deviations, the range, and the coefficients of variation. The means and the range in 1987 are somewhat better than 1960; the standard deviations for the majority of cases are smaller. The decrease in the coefficients of variation indicates less disparity in all distributions with the exception of infant mortality for the groups of countries other than high-income.

Table 2 displays the number of observations (n), the mean (d), the standard deviation (S), and the coefficient of variation (cv) of the index of the four major groups of countries for 1960 and 1987. Because the smaller the magnitude of the index the better is the performance, the averages in

Table 1
SUMMARY DESCRIPTIVE STATISTICS^a

Economics	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
	Mean	Standard Deviation	Minimum	Maximum	Range	CV (s/x̄)	CV (s/x̄)	CV (s/x̄)	CV (s/x̄)	CV (s/x̄)	CV (s/x̄)	CV (s/x̄)
	60	87	60	87	60	87	60	87	60	87	60	87
Infant mortality ^b												
Low	155	117	35	35	63	35	220	175	157	140	.23	.30
Low-middle	133	86	38	32	49	20	200	154	151	134	.29	.37
Upper-middle	82	43	37	26	28	9	157	111	129	102	.45	.60
High	27	9	9	2	17	6	50	11	33	5	.33	.22
All countries	107	70	50	35	6	1	230	175	224	174	.47	.50
Literacy ^c												
Low	19	38	18	21	1	10	75	85	74	75	.95	.55
Lower-middle	37	54	25	24	3	10	82	90	79	80	.68	.44
Upper-middle	58	76	24	17	10	35	93	95	83	60	.41	.22
High	97	99	3	1	87	98	99	100	12	2	.03	.01
All countries	49	63	35	30	1	10	99	100	98	90	.71	.48
Life Expectancy ^d												
Low	42	50	7	7	23	40	64	70	41	30	.17	.14
Lower-middle	49	58	7	7	37	45	65	73	28	28	.14	.12
Upper-middle	59	68	6	4	50	60	67	76	17	16	.10	.06
High	70	76	2	1	68	73	73	78	5	5	.03	.01
All countries	54	61	12	11	23	40	73	78	50	38	.22	.18

^a Values are rounded.

^b Infant Mortality: per 1,000 live births.

^c Literacy: out of 100.

^d Life expectancy: number of years.

^e Source: World Bank (1983, 1989), and calculations by the author.

Table 2
AVERAGE, STANDARD DEVIATION, AND COEFFICIENT OF VARIATION
OF INDEX AMONG GROUPS OF NATIONS, 1960 AND 1987

Economics	n	1960 ^a			1987 ^a			t
		\bar{d}_1	S	cv	\bar{d}_2	S	cv	
Low-income	25	0.690	0.149	.216	0.656	0.177	.270	-2.26*
Lower-middle-income	26	0.557	0.175	.314	0.480	0.188	.392	-1.83*
Upper-middle-income	15	0.335	0.165	.493	0.241	0.131	.543	-3.24*
High-income	19	0.050	0.031	.620	0.034	0.020	.588	-2.21*
All countries	85	0.440	0.280	.636	0.390	0.170	.436	-5.51*

^a The mean ' \bar{d}_i ' is the average of distances of the countries in each group from the ideal point (infant mortality, literacy, life expectancy). For 1960 the ideal is (17, 99, 73) while for 1987 it is (6, 100, 78).
 Source: World Bank (1983, 1985) and calculation from equation (2).

the table indicate that low-income economies were farther from the ideal in quality of life as depicted by the index than the other groups of countries. Furthermore, the major gains between the two periods were by lower-middle and upper-middle-income countries, as there was a noticeable reduction in their mean distance. The increase in the standard deviation and the coefficient of variation in 1987 for some groups indicate that reductions in the means reflect better scores in one or more of the components for selected countries.

The reduction in the means observed in Table 2 can be checked for statistical significance using t-tests for paired comparison. The purpose is to compare the means of differences in magnitude of the index of the two periods. For the four groups of economies, the null hypothesis is $H_0: \mu d_2 - \mu d_1 = 0$ against $H_a: \mu d_2 - \mu d_1 < 0$, where μd_2 and μd_1 are the population index means for 1987 and 1960 respectively of the four groups of countries. For superiority of performance, the null hypothesis is rejected if the calculated t-ratio given by $t = \sqrt{n} \bar{d} / S_d$ is less than $[-t_{\alpha}(n-1)]$ where \bar{d} and S_d are the sample mean and standard deviation of paired differences, α is the significance level of the test, and n is the number of countries included in each group. All the calculated t-ratios shown in the last column of Table 2 reveal that the observed differences in sample means ($\bar{d} = \bar{d}_2 - \bar{d}_1$) of the index are statistically significant at the 5 percent level. In other words, each of the four groups of countries performed better in the later period (1987) than in the former period (1960). This, however, does not give assurance that the differences between the groups are narrowing or diverging. The next section addresses this question as well as the question of the behavior of individual countries.

The above analysis was based on aggregation of countries by per capita income as depicted by the World Bank, and, thus, may ignore the wide disparity among countries within each group. For instance, even though the low-income economies did not perform as well by comparison to the other groups, it is conceivable that some individual countries performed better in the later period than expected and others performed worse. To address this issue, analysis is undertaken following procedures suggested by Congdon and Shepherd (1988). The model is based on simple linear regression which can provide information regarding performance over time. Given comparable index data for two periods, the model can: (1) determine whether trends exist toward convergence or divergence; and (2) decompose change over a period of time into a component which applies to all countries and a component which reflects localized effects.

For ease of presentation, let X_i and Y_i be the values of the index for a country i in 1960 and 1987 respectively. The latter year values are regress-

ed on their corresponding early year values. The regression equation is $Y'_i = a + bX_i$. By substituting for $a = \bar{Y} - b\bar{X}$ and rearranging terms, the equation becomes

$$(3) \quad Y'_i - \bar{Y} = b(X_i - \bar{X}),$$

where Y'_i , \bar{Y} are the predicted values and the average in the later period, \bar{X} is the average in the initial period, and "a" and "b" are the intercept and the slope of the regression line. A divergence is implied if $b > 1$, because the deviations of Y'_i from their mean \bar{Y} exceed the deviations of \bar{X}_i from their mean \bar{X} . Index scores above the mean in the former period will be even higher above the mean in the later period. The reverse is true when $b < 1$.

The actual difference between the terminal and the initial values of the index ($Y_i - X_i$) can be written as an identity

$$(4) \quad Y_i - X_i = (Y'_i - X_i) + (Y_i - Y'_i).$$

The first term on the right hand side of Equation (4) is the effect which applies to all countries arising from world-wide changing structure called "structural change." Furthermore, from Equation (3), this structural effect can be broken down into

$$(5) \quad Y'_i - X_i = \bar{Y} + b(X_i - \bar{X}) - X_i \\ = (\bar{Y} - \bar{X}) + (b-1)(X_i - \bar{X})$$

which is the sum of change in world-wide average and the influence of world trends. The second term on the right hand side of Equation (4) gives the change in the relative position of a particular country reflecting local dynamism, called "deviational change." If the change is negative, a country has performed better than expected and has improved its position relative to the other countries. The reverse is true if the change is positive. The test for significance with $(n-2)$ degrees of freedom is

$$(6) \quad t = (Y_i - Y'_i) / [S_y^2 (1-r^2)]^{1/2}$$

where S_y^2 is the variance of the index in the later period and r^2 is the square of the correlation coefficient.

A collective measure which can pinpoint the relative importance of structural and deviational changes is the partition of the sum of the squares of the differences ($Y_i - X_i$) to

$$(7) \quad (1/n) [\Sigma(Y_i - X_i)^2] = (\bar{Y} - \bar{X})^2 + (b-1)^2 S_x^2 + (1-r^2) S_y^2.$$

The three terms on the right hand side give the respective total variations due to means, trends, and deviation, usually computed as percentages.

Table 3 shows the results of Equation (3) by regressing index values (Y) of 1987 on the index values (X) of 1960 for each of the four income groups as well as for all the countries. Given in the table are the intercept a, the slope b, the t-values for testing for significance of the slopes, and r which is the correlation coefficient. The slopes gradually decrease from 1.12 for low-income countries to .20 for high-income countries. This is an indication of trends of divergence in low-income ($b = 1.12$) and lower-middle-income ($b = 1.03$) economies and convergence for upper-middle ($b = .75$) and high-income ($b = .20$). The interpretation is that in low and lower-middle economies, those countries which were doing better than average in their groups in 1960 ($X_i - \bar{X} < 0$) performed even better in 1987. The reverse is true if ($X_i - \bar{X} > 0$). For the upper-middle and high-income economies, there was a tendency toward convergence. The slope for all countries is $b = 0.97 \approx 1$, meaning on the whole that there was a tendency toward maintaining the prevailing status. The correlation coefficient r is the inverse measure of scatter of observations about the regression line. It is related to the mobility of the countries up or down as well as the extent of permanence. In Column 4 of Table 3, the coefficient r is very high for all economies with the exception of high-income countries, a sign of permanence and rigidity.

Table 3
SUMMARY RESULTS OF REGRESSION COMPUTATIONS

Group of Economies Classification	(1)	(2)	(3)	(4)
	a	b	t	r
Low-income	-0.11	1.12	12.9*	0.93
Lower-middle-income	-0.09	1.03	17.2*	0.96
Upper-middle-income	-0.01	0.75	9.4*	0.94
High-income	-0.02	0.20	1.3	0.32
All countries	-0.04	0.97	48.5*	0.97

* $p \leq .05$.

Source: World Bank (1983, 1989) and calculations from equation (3).

Table 4 presents the distance measure and rank for each country for 1960 and 1987 according to the four World Bank groups. It is expected that the values in 1987 for a particular country to be smaller than in 1960. The rationale is that most countries will move closer to the ideal in 1987 than in 1960 because of the general improvement world-wide in the quality of life as depicted by the three indicators. Sweden and Japan ranked the highest in 1960 and 1987 respectively, while Sierra Leone occupied the last spot in both years. The final column of Table 4 presents the result of the t-tests for significance of the deviational change ($Y-Y'$) from Equation (6). Negative t-values indicate superiority of performance while positive t-values indicate a deterioration. An "*" indicates statistical significance at the ten percent level.

Table 4
INDEX, RANK AND RELATIVE POSITION OF COUNTRIES
IN THE QUALITY-OF-LIFE INDEX BETWEEN 1960 AND 1987

Countries	1960		1987		t
	d1	R1	d2	R2	
Low-income					
Bangladesh	0.664	62	0.693	70	1.45*
Benin	0.751	72	0.691	69	0.04
Burma	0.504	42	0.404	46	-0.73
Burundi	0.670	65	0.716	74	1.74*
Central Afr. Rep.	0.763	75	0.717	75	0.29
Chad	0.788	80	0.808	80	1.36*
China	0.462	40	0.238	32	-2.75*
Guinea	0.848	83	0.866	83	1.35*
Haiti	0.668	63	0.679	66	1.16
India	0.637	58	0.555	55	-0.35
Kenya	0.610	51	0.540	54	-0.18
Laos PDR	0.758	73	0.752	76	0.91
Mali	0.844	82	0.887	84	1.77
Mozambique	0.788	79	0.706	71	-0.30
Nepal	0.782	77	0.768	77	0.82
Niger	0.821	81	0.837	82	1.32*
Pakistan	0.669	64	0.685	68	1.25
Rwanda	0.623	54	0.658	64	1.54*
Sierra Leone	0.995	85	0.924	85	-0.04

Table 4 (Continued)

Countries	1960		1987		t
	d1	R1	d2	R2	
Somalia	0.787	78	0.711	72	-0.19
Sri Lanka	0.213	25	0.175	28	0.16
Tanzania	0.683	66	0.528	53	-1.53*
Togo	0.713	67	0.677	65	0.42
Uganda	0.598	50	0.606	61	1.09
Zaire	0.621	53	0.567	59	0.09
Lower-middle-income					
Bolivia	0.637	59	0.562	57	-0.25
Colombia	0.371	35	0.259	34	-0.98
Dominican Rep.	0.389	38	0.349	40	0.19
Ecuador	0.385	37	0.289	36	-0.72
Egypt	0.649	60	0.494	49	-1.55*
El Salvador	0.458	39	0.355	42	-0.79
Honduras	0.522	45	0.399	44	-1.09
Low-middle-income					
Indonesia	0.597	49	0.498	50	-0.66
Ivory Coast	0.749	71	0.623	62	-1.03
Jamaica	0.163	22	0.103	21	-0.23
Liberia	0.744	69	0.712	73	0.49
Mauritania	0.770	76	0.773	78	1.09
Morocco	0.635	57	0.564	58	-0.19
Nigeria	0.747	70	0.650	63	-0.56
Papua New Guinea	0.625	55	0.577	60	0.18
Paraguay	0.265	28	0.232	30	0.27
Low-income					
Senegal	0.761	74	0.806	79	1.77*
Sudan	0.732	68	0.680	67	0.16
Thailand	0.350	34	0.252	33	-0.78
Tunisia	0.615	52	0.388	43	-2.74*
Turkey	0.553	47	0.399	45	-1.57*
Yemen Arab Rep.	0.849	84	0.820	81	0.59
Zambia	0.596	48	0.557	56	0.31
Zimbabwe	0.508	43	0.425	48	-0.45
Upper-middle-income					
Algeria	0.655	61	0.507	51	-1.44*
Argentina	0.155	21	0.155	27	0.73

Table 4 (Continued)

Countries	1960		1987		t
	d1	R1	d2	R2	
Brazil	0.376	36	0.309	39	-0.24
Hong Kong	0.164	23	0.064	18	-0.88
Iran	0.630	56	0.520	52	-0.82
Jordan	0.527	46	0.291	37	-2.93*
Korea Rep.	0.298	30	0.154	26	-1.53*
Malaysia	0.319	33	0.277	35	0.14
Mexico	0.311	31	0.237	31	-0.38
Panama	0.215	26	0.137	22	-0.50
Portugal	0.245	27	0.143	24	-0.87
Syria	0.516	44	0.350	41	-1.78*
Trinidad & Tobago	0.133	20	0.145	25	0.92
Venezuela	0.266	29	0.186	29	-0.51
Yugoslavia	0.211	24	0.140	23	-0.38
High-income					
Australia	0.029	4	0.020	8	0.53
Austria	0.081	17	0.075	19	0.61
Belgium	0.057	13	0.046	16	0.52
Canada	0.039	8	0.031	10	0.54
Denmark	0.019	3	0.008	2	0.50
Finland	0.069	15	0.029	9	0.06
France	0.051	11	0.017	6	0.15
Germ. Fed. Rep.	0.063	14	0.045	15	0.41
Ireland	0.054	12	0.075	20	1.03
Italy	0.101	18	0.035	12	-0.36
Japan	0.078	16	0.006	1	-0.46
Netherlands	0.029	5	0.017	5	0.49
New Zealand	0.029	6	0.061	17	1.21
Norway	0.007	2	0.018	7	0.85
Spain	0.129	19	0.035	11	-0.79
Sweden	0.000	1	0.016	3	0.92
Switzerland	0.029	7	0.016	4	0.47
U.K.	0.043	9	0.045	14	0.73
U.S.A.	0.048	10	0.045	13	0.65

* $P \leq 10$.

Source: World Bank (1983, 1989) and calculation from equation (3).

Only two countries in the low-income economies, China and Tanzania, showed statistically significant improvement. Those that showed a statistically significant deterioration are: Bangladesh, Burund, Chad, Guinea, Mali, Niger, and Rwanda. In the lower-middle income group, Egypt, Tunisia, and Turkey showed significant improvement, while Senegal showed a worsening in position. In the uppermiddle-income group, Algeria, Jordan, Korea, and Syria had statistically significant improvement. No country in this group showed a statistically significant worsening of position. In the high-income group, none of the changes were statistically significant. This is understandable, because this group of countries is very close to the ideal points of the indicators in both periods.

Table 5 presents the components of variation in the index between 1960 and 1987 according to equation (7). The results provide evidence that for the low-income countries, the largest portion of change, accounting for 72%, was due to innate superiority or the lack thereof of the countries involved. The values decrease as one moves up in the income levels which are 32%, 16%, and 0% for the lower, lower-middle, and high-income countries respectively. Change due to total structure on the other hand moved in the opposite direction, lowest for low-income countries and highest for high-income countries.

IV. Concluding Observations

This paper has illustrated the construction of a composite index which measures an important facet in the quality of life of nations. The index represents the distance from an ideal and incorporates indicators for infant mortality, literacy, and life expectancy. This measure has two obvious advantages. First, the inclusion of more than one indicator allows simultaneous comparisons among and between nations. Secondly, the index possesses a continuous scale which permits the use of traditional statistical procedures.

One notices considerable differences between the means of the indexes according to a grouping by income defined by the World Bank. The higher the income, the lower the values of the index, giving indication that quality of life is related to income. However, each of the groups of countries shared significant improvement in 1987 as compared to 1960 (See Table 2). Rankings of the index in the two time periods in Table 5 reveal the relative progress or decline of an individual country. The regression procedure identified nations that performed significantly better or worse than expected in their quality of life. One also notices that there is some variation across the countries that lie within a group of countries. Sri

Table 5
COMPONENTS OF VARIATION IN INDEX BETWEEN 1960 AND 1987

	\bar{X}	s_x^2	\bar{Y}	s_y^2	r^2	b	Percent total variation due to changes in			
							Structure		Totals	Deviation
							Means	Trends		
Low-income	.690	.022	.656	.031	.88	1.12	.22	.06	.28	.72
Lower-middle-income	.557	.031	.480	.035	.92	1.03	.68	.00	.68	.32
Upper-middle-income	.335	.027	.241	.017	.88	.75	.71	.13	.84	.16
High-income	.050	.001	.034	.000	.92	.20	.29	.71	1.00	.00
All countries	.044	.080	.139	.080	.95	.97	.38	.01	.39	.61

Source: Computations from equation (7).

Lanka in the low-income group; Jamaica in the lower-middle group; Argentina, Hong Kong, and Trinidad and Tobago in the upper-middle group are countries which have index scores in 1960 and 1987 that are relatively much better than the scores of the countries in their group. This can be attributed perhaps to the special programs pursued by these countries to improve the well-being of their people.

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