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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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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 endevour.

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

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

where X_i is a raw score of a given indicator for country, i, and 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 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 2

AVERAGE, STANDARD DEVIATION, AND COEFFICIENT OF VARIVATION OF INDEX AMONG GROUPS OF NATIONS, 1960 AND 1987

Economies	n	1960[a]			1987[a]			$\bar{d}_2-\bar{d}_1$	t
		$\bar{d}_1$	S	cv	$\bar{d}_2$	S	cv		
Low-income	25	0.690	0.149	.216	0.656	0.177	.270	−.034	−2.26*
Lower-middle-income	26	0.557	0.175	.314	0.480	0.188	.392	−.077	−1.83*
Upper-middle-income	15	0.335	0.165	.493	0.241	0.131	.543	−.094	−3.24*
High-income	19	0.050	0.031	.620	0.034	0.020	.588	−.016	−2.21*
All countries	85	0.440	0.280	.636	0.390	0.170	.436	−.050	−5.51*

[a] The mean "$\bar{d}$" 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, 1989) and calculation from equation (2).

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

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

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 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

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

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

$$(5) \qquad \begin{aligned} Y'_i - X_i &= \bar{Y} + b(X_i - \bar{X}) - X_i \\ &= (\bar{Y} - \bar{X}) + (b-1)(X_i - \bar{X}) \end{aligned}$$

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

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

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

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 cloumn 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		
	d1	R1	d2	R2	t
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 d1	1960 R1	1987 d2	1987 R2	t
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
Venezula	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

*$P \leqslant .10$.

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

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			Deviation
							Means	Trends	Totals	
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).

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