

AN ALTERNATIVE APPROACH TO THE MEASUREMENT OF THE HUMAN CAPITAL INDEX

by

Roland Craigwell

and

Denny Lewis

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An alternative approach to the measurement of human capital can be found in the work of Tallman and Wang (1994). The writers formulated this measure in the context of an economic growth model for Taiwan, in which it is suggested that endogenously accumulated human capital has a direct impact on the productivity of labour. Tallman and Wang (1994) employed a standard Cobb Douglas production function which they extended to account for human capital.

The extended Cobb-Douglas production function, including human capital

$$Y_t = A_t K_t^\alpha (H_t L_t)^\beta \quad \text{Equation (1)}$$

where Y is real output, K is physical capital stock, L is raw labour input, A is an exogenous knowledge and technological factor, H is the level of human capital, and α and β are the capital and labour shares, respectively.

The writers found that the incorporation of a labour quality index into the labour input improved the performance of the growth model in Taiwan. In the Tallman and Wang study, like some previous studies, human-capital accumulation was measured as the percentage of the working-age population that had completed primary, secondary and or tertiary education (see Mankiw, Romer and Weil, 1992). For Barbados, as for many countries actual data on the educational attainment levels of the labour force on a continuous basis is unavailable. This study follows the majority of previous researchers (for example, Barro, 1991; De Gregorio, 1992) utilizing

the initial primary, secondary and tertiary school enrolment as a proxy measure of human capital accumulation.

The technique employed by Tallman and Wang (1994) involved calculating two indices of educational achievement using two different sets of weights. The weighting scheme employed is typical in the literature of the economics of growth and education (see Maddison, 1987; Pencavel, 1991). The two indexes of educational achievement/human-capital accumulation are calculated by aggregating the educational attainment levels of the working population (assuming that enrolment can proxy attainment). The increased productivity of additional education is approximated by weighting the educational levels assuming that more educated workers are more productive. Educational achievement index 1 is an aggregate educational attainment measure with weights of 1, 1.4 and 2 assigned to primary, secondary and higher educated workers, respectively. Educational achievement index 2 is an aggregate educational attainment with weight of 1, 2 and 4 assigned to primary, secondary and higher educated workers, respectively.

In Table 1, primary, secondary and tertiary education enrolments, column (5), (6) and (7), are expressed as a percentage of the population 5 years and over. The appropriate weights are then applied to give the educational achievement index 1 (see column (9)) and education achievement index 2 (see column (10)).

These measures of educational achievement are then used to augment raw labour to give a measure of human capital or effective labour input. This is measured as follows:

$$LH = LE^{\delta} \text{ and } H = E^{\delta}$$

$$\text{Equation (2)}$$

	(11) In Education Index 1	(12) In Education Index 2	(13) $\frac{LH}{L}$	(14) $\frac{H}{L}$	(15) Capital Index (1)	(16) Capital Index (2)	(17) Effective Labour Index (1)	(18) Effective Labour Index (2)	(19) $\frac{LH}{L}$	(20) $\frac{H}{L}$
1960	-1.465	-1.465	6.829	-3.513	0.001	0.120	0.000	0.011	22.57	10.20
1961	-1.407	-1.357	-6.512	-3.393	0.001	0.124	0.000	0.012	-1.86	-1.90
1962	-1.406	-1.355	-6.509	-3.388	0.001	0.124	0.000	0.012	-1.86	-1.90
1963	-1.370	-1.321	-6.441	-3.322	0.002	0.127	0.001	0.013	16.15	7.94
1964	-1.382	-1.331	-6.353	-3.252	0.002	0.129	0.001	0.013	7.83	3.17
1965	-1.382	-1.328	-6.356	-3.256	0.002	0.145	0.001	0.015	-1.74	15.11
1966	-1.320	-1.199	-6.126	-2.995	0.002	0.160	0.001	0.016	28.14	9.03
1967	-1.293	-1.183	-6.078	-2.957	0.002	0.162	0.001	0.017	7.15	6.18
1968	-1.281	-1.161	-6.021	-2.903	0.002	0.165	0.001	0.019	7.90	7.98
1969	-1.279	-1.154	-6.012	-2.866	0.002	0.165	0.001	0.020	3.21	3.96
1970	-1.255	-1.078	-5.663	-2.695	0.003	0.164	0.001	0.023	39.48	19.13
1971	-1.232	-1.033	-5.790	-2.757	0.003	0.164	0.001	0.022	-10.97	-4.94
1972	-1.232	-1.091	-5.731	-2.727	0.003	0.165	0.001	0.023	1.26	4.37
1973	-1.250	-1.102	-5.873	-2.755	0.003	0.164	0.001	0.022	-7.77	-2.63
1974	-1.268	-1.114	-5.960	-2.785	0.003	0.162	0.001	0.022	-8.91	-3.59
1975	-1.265	-1.106	-5.945	-2.766	0.003	0.163	0.001	0.021	-3.51	-3.06
1976	-1.259	-1.091	-5.919	-2.728	0.003	0.165	0.001	0.023	6.98	8.20
1977	-1.257	-1.090	-5.910	-2.725	0.003	0.166	0.001	0.024	5.86	5.23
1978	-1.246	-1.075	-5.888	-2.690	0.003	0.168	0.001	0.025	6.71	4.91
1979	-1.255	-1.084	-5.900	-2.709	0.003	0.167	0.001	0.026	-9.37	1.97
1980	-1.223	-1.039	-5.276	-2.147	0.005	0.117	0.002	0.047	95.79	94.03
1981	-1.153	-0.890	-5.418	-2.225	0.004	0.106	0.002	0.043	-13.67	-8.19
1982	-1.145	-0.877	-5.379	-2.193	0.005	0.112	0.002	0.043	6.35	-0.29
1983	-1.101	-0.805	-5.549	-2.273	0.004	0.103	0.001	0.043	-17.23	-9.53
1984	-1.201	-0.925	-5.643	-2.315	0.004	0.299	0.001	0.299	-12.39	-7.65
1985	-1.215	-0.935	-5.713	-2.339	0.003	0.297	0.001	0.295	-8.14	-3.77
1986	-1.220	-0.934	-5.725	-2.335	0.003	0.297	0.001	0.295	-1.73	4.41
1987	-1.242	-0.947	-5.879	-2.367	0.003	0.294	0.001	0.295	-8.57	-1.74
1988	-1.227	-0.946	-5.812	-2.366	0.003	0.294	0.001	0.296	4.88	-2.15
1989	-1.250	-0.961	-5.887	-2.403	0.003	0.290	0.001	0.296	-4.76	-1.09
1990	-1.294	-0.991	-6.081	-2.479	0.002	0.284	0.001	0.304	-16.32	-5.75
1991	-1.270	-0.966	-5.967	-2.414	0.003	0.289	0.001	0.305	7.57	2.37
Average									4.7	4.7

	Per Capita Real GDP				Education Enrollment			Aggregate Educational Attainment Measure		
	(1) Per Capita Real GDP (Growth Rate)	(2) Per Capita Real GDP (Growth Rate)	(3) Per Capita Real GDP (Growth Rate)	(4) Per Capita Real GDP (Growth Rate)	(5) Primary	(6) Secondary	(7) Tertiary	(8) Population ('000 Persons)	(9) Weighted (1, 1, 2, 8, 4, 0)	(10) Weighted (1, 2, 8, 4, 0)
1960	2097.4	13.6	3256.15	15.0	41,012	3,581		199.5	0.231	0.245
1961	2201.5	6.3	3743.20	7.1	42,733	4,135		188.2	0.245	0.257
1962	2533.9	-3.3	4099.63	9.0	43,658	4,132		202.8	0.245	0.258
1963	2827.0	1.2	4399.31	6.5	46,095	4,434		203.9	0.254	0.267
1964	2654.2	-5.3	4654.54	4.9	47,801	4,715		210.2	0.255	0.272
1965	2396.4	-7.9	4882.30	7.1	39,634	11,119		212.6	0.259	0.298
1966	2298.2	3.1	5203.80	7.1	43,095	10,899		217.1	0.272	0.302
1967	2276.1	-7.4	5600.94	9.3	44,665	11.0		220.8	0.274	0.306
1968	2100.5	5.5	6124.24	9.7	43,759	13,241		224.3	0.278	0.313
1969	2275.8	1.2	6716.57	17.9	43,448	13,928		226.2	0.278	0.315
1970	2252.4	16.3	7915.94	6.2	42,957	14,169		229.5	0.280	0.340
1971	2620.5	-0.3	8403.31	5.1	42,665	14,409		214.7	0.282	0.332
1972	2632.2	0.5	8833.92	5.4	40,732	15,257		218.2	0.282	0.335
1973	2655.6	2.4	9304.35	3.5	39,148	16,508		217.2	0.287	0.332
1974	2688.4	-2.9	9633.15	0.9	37,667	17,059		218.4	0.281	0.328
1975	2611.7	-2.5	9723.00	5.3	37,047	17,734		219.2	0.282	0.331
1976	2946.3	4.1	10256.09	1.2	35,708	19,042		219.7	0.284	0.336
1977	2650.6	3.3	10574.62	3.2	35,992	19,064		220.4	0.284	0.336
1978	2733.0	4.5	10909.22	4.2	36,037	19,466		221.0	0.288	0.341
1979	2882.6	7.5	11356.34	5.8	35,555	19,711		221.6	0.285	0.339
1980	3081.2	4.4	11706.59	6.3	34,672	20,073		223.3	0.285	0.343
1981	3216.9	-2.2	12323.17	1.4	34,038	20,56		228.6	0.286	0.411
1982	3147.2	-5.7	12700.10	0.4	33,395	21,062		229.5	0.287	0.403
1983	2957.1	0.1	12746.82	-1.7	32,561	21,095		231.5	0.287	0.403
1984	2969.2	2.5	12853.14	-1.5	31,046	21,375		233.9	0.287	0.395
1985	3043.4	0.6	12930.80	-0.2	29,382	21,474		232.1	0.287	0.393
1986	3061.9	4.7	12913.74	0.3	28,75	22,28		236.1	0.285	0.393
1987	3277.0	3.2	12848.95	1.4	27,919	21,154		238.8	0.289	0.389
1988	3277.0	3.2	12848.95	2.5	28,77	21,183		239.2	0.290	0.389
1989	3382.0	3.2	12865.56	1.6	28,113	21,172		239.2	0.286	0.382
1990	3462.1	-3.7	12803.84	-0.2	28,87	21,055		240.9	0.274	0.371
1991	3381.8	-4.3	12433.40	-4.6	27,211	20,541		242.7	0.261	0.361
Average				4.7						

Where: L is raw labour input, H is the level of human capital, E is the measure of education, level, and δ is the return to education relative to raw labour inputs.

A value for δ is chosen which makes the average growth rate of the effective labour input, LE^δ , equal to the average annual growth rate for the capital input, over the period 1960 to 1991. This is consistent with achievement of a long run steady state of growth in an economy with a Cobb-Douglas production function as specified in equation (1). The growth rates in capital and labour should roughly equal along a balanced growth path (see King, Plosser, and Rebelo, 1988). Column (4) gives the average annual growth rate for capital input over the review period 1960 - 1991 as 4.7%. A value for δ is generated such that LE^δ is equal to the average annual growth rate of capital input of 4.7%.

The results based on the use of enrolment levels gives an appropriate value of δ for index (1) of 4.7 and for index (2) of 2.5 (see Table(1)). These return levels are relatively high, suggesting high returns to education relative to raw labour input assuming that human capital adds significantly to the explanatory power of the growth model for Barbados.

Unfortunately, this was not found to be the case, according to findings of a study by Craigwell and Lewis (1996) on the determinants of growth in a small open economy, Barbados, which utilised this measure of human capital based on enrolment levels. A number of other studies which utilized enrolment levels, have obtained results which do not however lend any support to the view that the accumulation of labour skill improvements omitted from the measured labour input, was responsible for the apparent incompatibility between the input growth rates and the output growth rates. Those findings should not be interpreted as indicative of the unimportance

of human-capital accumulation in (Barbados) economic growth. Both Romer(1989) and De Gregorio (1992) suggest that the lack of significance may be due to the collinearity of enrolment indices with physical capital accumulation. In addition, as Levine and Renelt (1992) pointed out the lack of any significant difference in the results when using raw labour and human-capital enhanced labour input, may reflect measurement problems. Enrolment rates do not measure accurately investment in human capital and do not allow for differences in quality. Benhabib and Spiegel(1994) noted that at best, enrolment ratios represent investment levels in human capital.

As was noted previously educational attainment levels constitute a better measure of human capital than enrolments. Measures based on educational attainment levels have performed better in empirical studies. The use of educational attainment levels for the labour force generation in the previous measure of human capital does not however yield any better results. The results while suggesting higher returns to education versus raw labour are counter intuitive - suggesting that the inclusion of human capital takes away from the explanatory power of the model when compared with raw labour. It is likely that technique of filling in the missing data using a trend equation introduced non-stationarity.

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