International Convergence and Inequality of Human Development: 1975-2001

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Abstract

The concept of convergence is extended to non-income components of human development index and the index itself. Evidence of weak absolute convergence is found over 1975-2001. The results are robust and verified by various conditional β-convergence models and also supported by the evidence of weak σ-convergence. Population weighted analyses provide support for polarisation amongst developing countries but a slight reduction in world inequality. The dynamics of regional analysis reveals a movement of sub-Saharan Africa towards the low band of human development with Asia and Latin America making progress. High immobility of the early part of the period is followed by considerable upward and downward mobility in the latter part indicating a possible case of the "twin peaks" type of polarisation.

Key words: Human development, HDI, convergence, inequality

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I. Introduction

This paper is about the dynamics of inequality in human development between countries. The issues of inequality along with poverty are firmly back on the agenda of most international development agencies. The Millennium Development Goals and targets were set at the turn of the century against a background of decades of failure in human development in order to reverse the declining trends. After a few years the hopes for reversing the trends, at least in a large number of sub-Saharan African countries, are receding significantly (Sahn and Stifel 2003). Lack of achieving a basic threshold for education and health has been regarded as a structural impediment, amongst others, to sustained economic growth and human welfare in poorer countries. Despite this the levels of health, education and economic growth are declining in a number of these countries mostly in sub-Saharan Africa. During the decade of 1990s some 54 countries became poorer, 34 countries experienced a drop in life expectancy and the incidence of under five-mortality rate increased in 14 countries (UNDP 2003). In the table of healthy life expectancy the bottom 10 countries, mostly in sub-Saharan Africa, have a healthy life expectancy of below to just above 30 years, half of that of the top 10 countries (WHO 2002). The most recent WHO report indicates that the increasing child mortality and decreasing life expectancy in a number of poorer countries in recent years has widened the global gap between the poor countries and the rest of the world. It seems that the large gap in life expectancy between developed and developing countries of 50 years ago has been replaced in recent years by a large gap between a group of very poor countries, mainly in sub-Saharan Africa, and the rest of the world (WHO 2003).

In contrast progress in health, education and economic growth in a number of countries, mainly from South East Asia and Latin America, has been impressive. In between were countries which made little progress, mainly from Asia and the Commonwealth of Independent States (UNDP 2003). In brief the experience of developing countries have been mixed at best. The growth rates in particular have been a mixture of takeoffs,

stagnation and decline. Between 1960 to 1990 less developed countries had wide variability in their growth rate ranging from –2.7 to +6.9 per cent (Pritchett 1997). This begs the question of whether the world is becoming more polarised.

The research on income differences amongst countries in recent years has taken two closely related approaches: testing the hypothesis of convergence and measuring inequality and its dynamics. These are basically two sides of the same coin, both investigating whether the distribution between richer and poorer countries is moving towards equalisation or more polarisation.

Some studies argue that in the long run the per capita income of countries would converge and the inequality would be reduced.[1] More recent research has focused on world income inequality for a number of reasons including the important links between inequality, growth, political economy and conflict. Progress in international trade and globalisation has also focused the attention on international inequality. Globalisation has been linked to having an effect on inequality within countries and amongst countries though there is little agreement on whether such effects have been positive or negative[2]. In general the outcome of research on world income (expenditure) inequality is controversial apparently due to the adaptation of different methodology by researchers (UNDP 2003).

A number of studies conclude that the world distribution of income has worsened over the past three or four decades. Korzeniewicz and Moran (1997) conclude that the gap between richer and poorer nations has grown steadily between 1965 and 1990 and in particular intensified during the recession years of 1980s. The UNDP (1999) indicates that the ratio of income in the richer countries with 20% of world population to the poorest nations with 20% of world population had risen from 30 times in1960 to 74 times

[1] See for example Barro and Sala-i-Martin 1995 and a number of other studies referred to in next section on convergence.
[2] See for example Dollar and Kraay 2002a and 2002b and Milanovic 2003.

in 1977. Over a longer period the ratio of per capita income of the richest country to the poorest between 1870 and 1990 increased by almost a factor of five (Pritchett 1997).

Other studies focus on between countries inequality as well as within country inequalities by also taking into account income distribution within countries. In some cases this is done by estimating the entire distribution of income from the Gini coefficient for the country (Chotikapanich et al.1997 and Schultz 1998). More recently Sala-i-Martin (2002) concludes that between 1980 and 1998 the world income inequality shows a decline. Dollar and Kraay (2002a and 2002b) argue that global inequality increased significantly over the past two centuries stabilising in 1980 and somewhat declining in more recent years. Bourguignon and Morrisson (2002) study the distribution of income amongst the world citizens by looking at the distribution amongst 11 quantiles for each country in the sample. The time span of this study is spread over two centuries concluding that in the early 19th century the main contributor to inequality was the differences within countries while in more recent years the main source was the inequality between countries. Milanovic (2002) uses country household surveys for deriving the income and expenditure distribution within countries and concludes that the world income inequality increased from 1988 to 1993 from a very high base. The Gini coefficient of 63 in 1988 increased at a rather fast annual rate of 0.6 to 66 in 1993.

In brief there is little agreement on where the world inequality is heading for in the future. However, the above studies, though controversial in their results, have two common features. First they agree that most of the world inequality is driven by between country inequality while the within country inequality is a low contributor to the overall inequality. Second that they all concentrate on the inequality or convergence of income or expenditure and use no other indicator of welfare.[3]

[3] The only partial exception to the second point is Bourguignon and Morrison (2002) which also considers the inequality in life expectancy as a wider measure of welfare, however, this measure in their study is only employed for obtaining income over the expected life of population and not as a measure of welfare in its own right.

To the best of our knowledge there is no study which extends the concept of convergence to non-income indicators. Given the spread of mass communications devices in recent decades it seems equally likely, if not more, that convergence amongst countries could happen with respect to the level of education and health as compared to income. This paper attempts to fill up this gap by studying international convergence of, and inequality in, human development

The rest of this paper is organised as follows. Section II briefly discusses the approaches to the concept of convergence. Section III relates and tests the relevance of this concept to HDI and its none-income components. Section IV testes the hypothesis of convergence for HDI. Section V takes into account the population concentration in deriving the measures of inequality, discusses the dynamics of change in distribution of human development and the extent of upward and downward mobility. Section VI concludes.

II. Convergence

According to the neoclassical growth model, given the fully competitive markets and the availability of similar technology, for the same rate of investment every economy would grow at a similar rate determined by the exogenous technical progress and population growth. Assuming a production function with constant returns to scale and the diminishing returns of capital, economies with lower levels of initial productivity enjoy a higher rate of growth in productivity and as such will *catch up* with the more developed economies. The more recent work on explaining the process of *catching up* is extensive and advocates three possible, and sometimes related, forms of convergence: β-convergence, conditional β-convergence and σ-convergence.

β-convergence postulates that poorer countries will tend to grow faster than the richer countries. This is because of the diminishing marginal returns to capital in the richer countries, as the level of capital per labour is relatively high in these countries. Moreover, the further down a country is below its balanced growth path and the higher the lags in access to new technology the higher would be the expected growth when the country

gains access to such technology (Romer 1986). In the empirical literature, running a cross-section regression of the time-averaged per capita income growth rate on the level of per capita income in the initial period tests this. A negative sign for the respective coefficient reflects the existence of convergence.

Most of the relevant empirical literatures have attempted to test cross-country β-convergence and measure the speed of convergence (see for example Baumol 1986, Romer 1986, Baumol and Wolff 1988, Mankiw, Romer and Weil 1992, Barro and Sala-i-Martin 1995, Sala-i-Martin 1996 and de la Fuente 1997). The general consensus is that there exists an evidence of convergence only amongst the richer countries. There is little evidence of convergence on the part of low-income countries (Zind 1991). Some researchers go further by stating that, while the growth rates of income amongst richer countries show a historical convergence, the picture for less developed countries vis-à-vis the richer countries tells a story of divergence (Pritchett 1997). Such results provide support for the idea of *convergence clubs* in the sense that convergence may apply to groups of countries which have similar initial conditions and structures. One such club may be the richer countries and another could be developing countries or the least developed countries. Indeed the inequality amongst such clubs may persist and may even result in further divergence (Martin and Sunley 1998, Quah 1993 and 1996b). The literature considers a number of possible reasons for the lack of convergence amongst poor and rich countries. One such reason is mainly related to the proposition that the nature and process of convergence requires that the institutions in the poorer countries to be supportive of inward flows of foreign capital and technology. Another explanation is based on the fact that human capital is initially higher in the richer countries resulting in a higher output and hence higher saving and investment in these countries enabling them to maintain their lead over poorer countries indefinitely[4] (Romer 1986, 1990, Sachs and Larrain 1993 and Hossain 2000).

[4] These have been incorporated in the new endogenous growth models, which consider the human capital and technology to be endogenous.

The second type of convergence, conditional β-convergence, mainly takes into consideration the steady-state growth path of the country.[5] If the structural conditions of countries were different the respective long-run growth rates would be different which may result in divergence or at best a very weak convergence. This type of convergence may be tested in the same way except that the regression should also include a set of explanatory variables which would define the steady-state growth path for per capita income (Barro 1991, Barro and Sala-i-Martin 1992). A negative coefficient for the per capita income in the initial period, in the presence of the extra *conditional variables*, suggests the existence of conditional β-convergence.

The third type, σ-convergence, envisages that the cross-country dispersion of per capita income levels across economies would tend to decrease over time implying a tendency amongst countries to equalization of per capita income in the long-run. That is, over time the dispersion around the steady-state value decreases (increases) if its initial value is above (below) the steady-state value. β-convergence is a necessary condition for σ-convergence but not a sufficient condition (Barro and Sala-i-Martin 1995). To put this differently, whether σ-convergence is because of the relatively higher growth rates of poorer countries or not can be studied by testing for the existence of β-convergence in its different forms (Hossain 2000).

III. Convergence of Human Development Index

The concept of convergence is mainly discussed in the literature in the context of output per capita usually measured in terms of GDP per capita. This concept was developed from the Solow model and one of its main arguments relates to the diminishing returns to capital. As the Human Development Index (HDI) also has none income components, it may be useful to explore the relevance of convergence to this index. For this purpose a brief description of HDI may be helpful.

The HDI is a composite index of four indicators. Its components are to reflect three major dimensions of human development: longevity, knowledge and access to resources. These are to represent three of the essential choices in life (UNDP 1990) and are derived from the notion of human *capabilities* as proposed by Amartya Sen. Although this index has been criticised on a number of grounds[6], it has been suggested that the components of the HDI together seem to provide an almost acceptable package of indicators of the level of living at an aggregate level (Dasgupta et al.1992) and has been adopted frequently in recent literature.[7]

The dimension of longevity is directly measured by life expectancy at birth. Knowledge is presented by a measure of educational achievement based on a weighted sum of adult literacy rate and the combined first, second and third level gross enrolment ratio. Access to resources is represented by the logarithm of real per capita income (purchasing power parity).

The concept of diminishing returns would apply to the income component of HDI. It would also apply to component of education, as the early "units" of educational attainments are relatively easier and less costly to attain. Diminishing returns are equally applicable to the component of life expectancy as it would be much more difficult and costly to attain a higher level of life expectancy from an initially high level than a low level.

The main difference with income component is that while income in the context of diminishing returns to capital is linked to the mobility of capital, at international level for

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[5] Some literature regards conditional β-convergence as a form of β-convergence and classifies with the latter. However, the extent of empirical work on the former may warrant such typology (see Hossain 2000 for example).
[6] For some of the criticisms see McGillivray 1991, Mc Gillivray and White 1993, Srinivasan 1994 and Noorbakhsh 1998.
[7] See for example Noorbakhsh 1999, Neumayer 2001 and Kosack 2003.

non-income components, this does not apply fully. However, the concept of diminishing returns may be linked to the point that the returns to investment in education and health diminish as the level of investment in health and education increases. Two indicators of adult literacy and combined enrolment ratios measure the dimension of education in HDI. The returns to investment in education, for improving adult literacy and increasing the combined enrolment ratio, will be higher in countries that are relatively at a lower level of initial education as measured by these indicators. Similarly the returns to investment in health, for improving life expectancy, will be higher in countries which have a lower life expectancy as compared to those with a higher level of life expectancy. In brief countries with lower level of education and health will *grow* faster over time, in terms of education and health, than countries which initially enjoy a higher level of education and health.

More specifically in a country which has reached a very high level of primary and secondary enrolment, only the relatively more expensive investment in tertiary education could improve the level of educational attainment used in HDI. Similarly for an equal amount of investment in health facilities in two countries with similar conditions but with low and high levels of life expectancy, relatively more life expectancy could be gained in the country with the low initial level of life expectancy.

The concept of steady state rate of growth would be equally, if not more, applicable to education and life expectancy. Given that literacy and enrolment ratios are both defined in the context of countries and the question of comparative quality is not addressed and also taking into account the upper limit of 100% for these indicators, it seems more plausible to suggest that the steady state *growth rates* of countries for these indicators are relatively more homogenous and closer than those for output and income in the neoclassical model of growth. Similar arguments may be developed for life expectancy indicator. More importantly access to *technology* relevant to education and health for improving the level of adult literacy, combined enrolment and life expectancy in countries which are at a lower level of these indicators is relatively more plausible as

compared to access to technology required for obtaining a higher level of production in the standard neoclassical model.

We tested these suggestions empirically by estimating the parameters of the following equation, which is mainly the growth regression equation for adult literacy and life expectancy.

$$(\frac{1}{T})\log(\frac{x_{it+T}}{x_{it}}) = \alpha + \beta \log(x_{it}) + u_{it} \qquad (1)$$

where $x_{it} = \frac{x_{it}}{x_t}$ is the ratio of *x* (adult literacy or life expectancy) in the i[th] country to the average for the sample of countries under consideration. $(\frac{1}{T})\log(\frac{x_{it+T}}{x_{it}})$ is the annualised growth of the variable *x* in the i[th] country over the period of t and t+T. A negative value of β would be an evidence of β-convergence. Table 1 shows the results for the annualised adult literacy growth (1975-98) and life expectancy (1977-98) for a sample of 93 developing countries.

Table 1. Convergence results for adult literacy and life expectancy.

Indicators	Adult Literacy	Life Expectancy
Constant	0.001 (3.15)***	-0.000 (-0.23)
Log x_t	-0.020 (-25.44)***	-0.009 (-3.00)***
Adjusted R^2	0.88	0.08
F Statistic	647.28***	8.97***

*** Significant at the 1% level.

The results in Table 1 provide support for the suggestion that the diminishing returns to investment in education and health are indeed the case in developing countries. The β coefficient for both indicators is negative and highly significant indicating that countries with a lower initial level of adult literacy (life expectancy) grow faster in terms of these indicators.

Briefly we may conclude that it is plausible to extend the concept of diminishing returns to investment to the non-income components of HDI. Consequently it can be expected that countries with a low level of human development in the initial period would have a higher rate of growth in HDI in the long-run than those with a high level human development in the initial period.

We test for the existence of β-convergence in HDI by employing the following K models

$$(\frac{1}{T})\log(\frac{hdi_{it+T}}{hdi_{it}}) = \alpha + \beta\log(hdi_{it}) + \sum_{j=1}^{J_k}\lambda_{ij}S_{ij} + u_{it} \qquad \text{for k=0, 1,2,…,K} \qquad (2)$$

where $hdi_{it} = \frac{HDI_{it}}{\overline{HDI_t}}$ is the ratio of HDI in the i[th] country to the average for the sample of countries under consideration. $(\frac{1}{T})\log(\frac{hdi_{it+T}}{hdi_{it}})$ is the annualised growth of the variable HDI in the i[th] country over the period of t and t+T. A value of β in the range of $-1\langle\beta\langle 0$ would be an evidence of β-convergence. That is, the nearer the value of β to –1, the higher the speed of convergence and the nearer to zero the lower the speed of convergence.[8] By implication zero means no convergence and a positive value for β indicates a divergence. S_{ij} is the j[th] structural condition variable and λ_{ij} is the respective parameter to be estimated. There are K different models where the structural conditional variables change and for k=0 all S_{ij} are zeros i.e. the absolute convergence model.

The data for HDI for the period of 1975 to 2001 (at intervals of 5 years up to 1995 and 6 years for the last period) has been taken from the UNDP 2003. As for some countries time series start at the middle of this period; adjustment in the length of the period in equation (2) are made to reflect this for the respective countries.

The variables included for reflecting conditional convergence are selected on the grounds of contributing to the components of HDI. There are two types of variables which may

take account of the external and domestic contributions to HDI. In the conditional beta-convergence model it is postulated that the institutions in poorer countries should be supportive of inward flows of foreign capital and technology. While a certain amount of technology is transferred with foreign direct investment, the openness of the country to international trade also may be responsible for such a transfer. We have selected both these variables: foreign direct investment as a percentage of GDP (FDI) and trade as a percentage of GDP (TRD). Foreign aid as a percentage of GDP (AID) has also been included as a substantial amount of aid is geared to improving the health and educational status of the recipient country. These variables reflect the external sources of contribution to HDI.

We have selected three variables to reflect the domestic contributions to HDI: gross domestic investment as a percentage of GDP (GDI), public sector expenditure on education and health as a percentage of GDP (PEEH) and the number of telephone lines per population (TEL) to reflect the level of infrastructure.[9]

Our initial sample of 93 countries includes 62 medium and 31 low human development countries. We have not included the high human development countries in the β-convergence models on the grounds of the general consensus, in the literature of growth, on the possible existence of wide apart convergence clubs for rich and developing countries. In addition the variables selected to represent the structural conditions would be widely different for the high human development countries.[10]

[8] Chaterji (1992) and Chaterji and Dewhurst (1996) distinguish between weak convergence where $\beta<0$, and strong convergence where $-2<\beta<0$.
[9] The data for FDI, AID, GDI and TRD are the totals over 1973-98, for PEEH average annual for 1990-98 and TEL for 1990. The source for all is the World Development Indicators STAR disk.
[10] For example AID or TEL would not be suitable variables the high human development group of countries.

IV. Empirical results for conversion hypotheses

We tested the hypothesis of β-convergence, in its absolute and conditional forms, through a number of models for different samples. Table 2 shows the results for the sample of medium and low human development countries.

Table 2. β-convergence models of HDI for medium and low human development countries.

Models/ Variables	1	2	3	4	5	6	7
Constant	-0.000 (-2.06)**	0.004 (1.38)	-0.004 (-1.23)	-0.005 (-1.50)	-0.002 (-0.44)	-0.002 (-0.50)	-0.002 (-0.61)
Log hdi_t	-0.009 (-5.59)***	-0.010 (-4.71)***	-0.008 (-4.54)***	-0.012 (-4.46)***	-0.009 (-4.11)***	-0.013 (-4.65)***	-0.010 (-4.64)***
Log AID		-0.000 (-1.04)			-0.000 (-0.20)	0.000 (0.66)	
Log FDI		0.001 (1.90)*			0.001 (1.02)	0.001 (1.38)	0.001 (1.15)
Log TRD		-0.002 (-1.39)			-0.003 (-2.21)**	-0.003 (-2.63)***	-0.003 (-2.51)***
Log GDI			0.003 (1.98)**	0.003 (2.07)**	0.005 (3.01)***	0.005 (3.15)***	0.005 (3.17)***
Log PEEH			-0.004 (-3.17)***	-0.005 (-3.67)***	-0.003 (-2.06)**	-0.004 (-2.78)***	-0.003 (-2.22)***
Log TEL				0.001 (1.99)**		0.001 (2.13)**	0.000 (0.79)
Adjusted R^2	0.25	0.28	0.35	0.37	0.38	0.41	0.38
F Statistic	31.21***	9.44***	16.26***	13.21***	9.24***	8.94***	9.40***

*** Significant at the 1% level.
** Significant at the 5% level.
* Significant at the 10% level.

Model 1 reflects the absolute convergence hypothesis. The negative sign of hdi_t is as expected and it is significant at the 1% level indicating a clear tendency to convergence amongst the countries in the sample. However, the magnitude of the coefficient is very low reflecting a very slow speed of convergence over the period.

Model 2 introduces the conditional β-convergence. The conditions employed are mainly of external origin and at the same time containing some domestic substance. Theoretically, convergence is conditional on governments being supportive of foreign

capital transfer and technology. Often the literature argues that the transfer of technology and capital is through foreign direct investment, openness and sometimes aid. These variables are normally regarded as reflecting the degree of globalisation in a country. The first point to mention about model 2 is that in the presence of these global variables the coefficient of hdi_t has remained negative and significant with almost the same magnitude. The coefficients of AID and TRD are not significant and both have negative signs. However, the same for FDI is positive and significant at the 10% level.

Model 3 introduces conditions which are more directly of domestic origin. The gross domestic investment as a percentage of GDP is relevant to the income component of HDI, while public sector expenditure on education and health as a percentage of GDP are directly relevant to the education and longevity components of HDI. The coefficient of hdi_t has remained negative and highly significant. GDI has a positive coefficient significant at the 5% level indicating that the growth differential in HDI is a positive function of investment which most probably works through the income component of the index. Public sector expenditure on education and health has a surprisingly negative sign and is significant at the 1% level. The break down of the sample into medium human development and low human development sub-samples may throw more light on the negative sign of PEEH, which we will discuss below.

In model 4 we have also included the number of telephone lines per population as a proxy for infrastructure. The overall results remain similar to the previous model and the new variable TEL has a positive sign and is significant at the 5% level. Once again the depiction of conditional convergence remains intact.

Model 5 includes all variables of external and internal origin without TEL.[11] The coefficient of TRD has become significant and at the same time the coefficient of hdi_t has

[11] We may be interested to have the results with and without TEL being included as this variable has been used in the literature to reflect conditions of internal and external origins alternately.

remained negative and highly significant. Model 6 includes TEL and there is little change to the overall picture except that the coefficient of TEL is also significant at the 5% level.

In model 7 AID is excluded from the equation on the basis of a possible argument that aid may have been more provided to countries which have had a lower level of human development, hence the question of endogeniety may arise. The results do not change and the coefficient of hdi_t remains negative and highly significant.

Overall the results are extremely robust indicating strongly that there has been a conditional convergence in HDI close to absolute convergence though in all cases the speed of convergence has been very slow.

A fundamental idea behind the concept of absolute convergence is that the structural conditions in countries are similar. The literature of growth argues that there may be clubs of convergence where the members of such specific clubs have a tendency to converge. With this in mind we split the sample into medium human development and low human development countries to see if the results would be different.

Table 3 provides the results for the same models for medium human development countries.

Table 3. β-convergence models of HDI for medium human development countries.

Models/ Variables	1	2	3	4	5	6	7
Constant	0.000 (1.75)*	0.003 (1.38)	0.000 (0.01)	-0.001 (-0.23)	0.001 (0.38)	0.001 (0.33)	0.000 (0.08)
Log hdi_t	-0.016 (-6.36)***	-0.015 (-5.46)***	-0.013 (-5.05)***	-0.018 (-5.09)***	-0.013 (-4.48)***	-0.017 (-5.26)***	-0.015 (-5.36)***
Log AID		-0.000 (-0.08)			0.000 (0.72)	0.001 (1.42)	
Log FDI		0.000 (0.57)			-0.000 (-0.33)	0.000 (0.26)	0.000 (0.02)
Log TRD		-0.001 (-1.07)			-0.001 (-0.97)	-0.002 (-1.48)	-0.001 (-0.72)
Log GDI			0.002 (1.33)	0.002 (1.48)	0.002 (1.67)*	0.002 (1.89)*	0.002 (1.68)*
Log PEEH			-0.004 (-4.17)***	-0.005 (-4.74)***	-0.004 (-3.63)***	-0.005 (-4.45)***	-0.004 (-3.68)***
Log TEL				0.001 (2.03)**		0.001 (2.49)***	0.000 (0.73)
Adjusted R^2	0.39	0.46	0.53	0.55	0.58	0.62	0.58
F Statistic	40.46***	13.67***	22.22***	18.66***	13.85***	14.02***	13.85***

*** Significant at the 1% level.
** Significant at the 5% level.
* Significant at the 10% level.

The most interesting feature is that the same picture for absolute and conditional convergence emerges, as the coefficient of hdi_t remains negative and highly significant in all models. The magnitude of this coefficient once again reveals a very slow speed of convergence. In this respect the results are very robust. The globalisation variables of AID, FDI and TRD are not significant in any of the models indicating that in this group of countries they played no role in the growth differential of HDI. The domestic investment variable, GDI, is only significant in the last three models at the 10% level. PEEH has interestingly remained negative and highly significant indicating that the level of public expenditure has been lower in countries which have enjoyed higher growth differentials in HDI. TEL is significant in models 4 and 6. Overall model 6 seems to provide sensible results with a rather high adjusted R^2 of 0.62.

Table 4 shows the results for the same models of absolute and conditional β-convergence for low human development countries.

Table 4. β-convergence models of HDI for low human development countries.

Models/ Variables	1	2	3	4	5	6	7
Constant	-0.003 (-4.25)***	0.002 (0.22)	-0.005 (-0.54)	-0.004 (-0.44)	-0.002 (-0.19)	0.001 (0.07)	-0.004 (-0.40)
Log hdi_t	-0.022 (-5.00)***	-0.026 (-5.26)***	-0.020 (-3.98)***	-0.029 (-4.64)***	-0.025 (-4.41)***	-0.030 (-4.43)***	-0.026 (-3.88)***
Log AID		-0.002 (-1.74)*			-0.003 (-1.84)*	-0.002 (-1.39)	
Log FDI		0.001 (0.44)			-0.000 (-0.08)	-0.001 (-0.43)	0.000 (0.16)
Log TRD		-0.000 (-0.12)			-0.001 (-0.18)	0.000 (0.03)	-0.003 (-0.75)
Log GDI			0.001 (0.34)	-0.000 (-0.07)	0.003 (0.54)	-0.000 (-0.04)	0.003 (0.69)
Log PEEH			-0.002 (-0.66)	-0.003 (-1.24)	0.002 (0.55)	-0.001 (-0.23)	-0.003 (-0.87)
Log TEL				0.004 (2.09)**		0.003 (1.28)	0.000 (1.43)
Adjusted R^2	0.44	0.48	0.36	0.46	0.43	0.45	0.39
F Statistic	24.97***	7.60***	5.96***	6.32***	4.16***	3.92***	3.71***

*** Significant at the 1% level.
** Significant at the 5% level.
* Significant at the 10% level.

Once again the models are very robust as the coefficient of hdi_t remains negative and highly significant in all models. The magnitude of this coefficient is nearly twice as much as what we had for other samples but still indicating a slow speed of convergence. Most other variables reflecting the external and internal conditions are not significant. The exceptions are AID in models 2 and 5, but with negative signs and only significant at the 10% level and also TEL in model 4. The other interesting point is that PEEH is not significant in any of the models. It seems that the medium human development countries mainly drive the significance of the parameter of this variable in the full sample. Overall the results are robust in all models for all samples indicating a weak convergence in HDI over time.

The last type of convergence, σ-convergence, hypothesizes that the deviations from the long-run cross-country mean have a tendency to converge towards the mean over time (Barro 1991, Barro and Sala-i-Martin 1992). The underlying assumption for this type of convergence is that the steady-state value of the variable concerned and its time trends

are the same for all countries as the constant term in equation (2) conceptually includes the steady-state value of the HDI variable (Barro and Sala-i-Martin 1995). In the empirical literature the standard deviation of the logarithm of the variable concerned is commonly used for investigating if this type of convergence has taken place.

Table 5 shows the results for three different measures of dispersion of HDI amongst countries over time. The first column presents the standard deviation of log (hdi). The second column depicts the results for the coefficient of variation (CV) which is the ratio of the standard deviation to the mean of distribution. The last column shows the gini coefficient (GiniC) as a measure of dispersion amongst countries.[12]

Table 5. Measures of σ-convergence for HDI

Year	SD $\log(hdi_{it})$	CV	GiniC
1975	0.1371	0.2941	0.1674
1980	0.1330	0.2792	0.1602
1985	0.1300	0.2698	0.1542
1990	0.1269	0.2643	0.1507
1995	0.1243	0.2588	0.1465
2001	0.1194	0.2519	0.1426

All measures show a convergence amongst middle and low human development countries. However, considering the length of the period, the pace of convergence seems to be very slow confirming our previous results for β-convergence.

V. Population-weighted measures of inequality and dynamics of mobility

The measures considered so far were for investigating the possible occurrence of convergence as this particular strand of literature on inequality and convergence postulates. However, these measures assess the degree of concentration between

[12] The GiniC coefficient has been computed without taking the size of the population into account. It is a measure of the concentration (dispersion) of indicator HDI amongst countries regardless of their population size (see Pyatt et al. 1980, Milanovic 1997 and Noorbakhsh 2003).

countries without taking into account the population of the countries concerned. Furthermore as convergence is basically about poor countries catching up with rich countries, it is argued that, it should be more relevant to the cross sectional of the distribution of the phenomena under consideration and not to the convergence of individual economies to their own individual steady state (Quah 1996a). This is to do with the dynamics of mobility in distribution.

To start with we have employed two measures of inequality, which take into account the population share of each country, for investigating the extent and dynamics of inequality amongst countries. These measures are the gini coefficient (Gini) and the Theil index.[13] As the concept of inequality is not constrained by the argument of clubs of convergence it would be interesting to measure both these measures for two separate samples: the medium and low human development sample (ML) and for all countries including the high human development countries. Furthermore we limit our study to measuring between-country inequalities as most recent literature, which have used the decomposed measures for including the within country sources of inequality as well, conclude that the main source of inequality is the between-country component (see for example Schultz, 1998, Milanovic 2002 and Bourguignon and Morrison 2002).[14] Table 6 shows the results for our two samples.

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[13] For Gini coefficient:

$$Gini = \frac{1}{\mu}\sum_{i=1}^{N}\sum_{j=1}^{N} f(y_i) f(y_j) \left| y_i - y_j \right|$$

where for N countries y_i is the value of HDI in country i, $f(y_i)$ is the population share of country i in total population and μ is the mean value for HDI. For Theil index :

$$T = \sum_{i=1}^{N} Y_i \log \frac{Y_i}{X_i}$$

where Y_i and X_i are the HDI and population shares of country i respectively.

[14] Furthermore there is a controversy in the procedure used for finding the within country distribution and hence the within country inequality for income. In addition the extension of such procedures for deriving the within country distribution of the non-income components of HDI may be even more controversial. Lastly because education and health are more public goods in most developing countries it is more likely that their distributions within countries are, relatively speaking, more even than that of income.

Table 6. Population weighted measures of inequality.

Time	**GiniP ML**	**Theil index ML**	**GiniP All countries**	**Theil index All countries**
1975	0.1001	0.6962	0.1887	0.6708
1980	0.1198	0.7355	0.1878	0.7059
1985	0.1220	0.7285	0.1805	0.7008
1990	0.1235	0.6827	0.1745	0.6594
1995	0.1220	0.6781	0.1678	0.6616
2001	0.1230	0.6666	0.1636	0.6576

For the ML human development sample the Gini coefficient has increased from 1975 to 1990 with a drop in 1995 before resuming its upward trend. This indeed is showing a picture of divergence amongst ML human development countries. Theil index for these countries shows an initial increase before coming down; its decline over the entire period is hardly considerable. This is in line with the results of weak convergence in the previous section. As for the full sample Gini shows a steady but relatively weak decline over 26 years while the Thiel index depicts an initial increase before coming down in 2001 to just below its level in 1975. The overall picture for both samples does not show a considerable decrease in equality in human development amongst countries.

Another way of looking at the international distribution of HDI is to focus on the degree of mobility of various regions in the world over time. Table 7 shows the regional composition of various quantiles of the international distribution of HDI for the period of our sample for all countries.

Table 7. Dynamics of regional composition of HDI for selected quantiles. (Percents)

World	quantiles	Africa	Asia and Pacific	Japan, Hong Kong and Korea	Latin America	Eastern Europe	Europe and its offshoots	Total
1975	Total	33.0	18.0	3.0	21.0	1.0	24.0	100.0
	Bottom 20%	85.0	15.0	0.0	0.0	0.0	0.0	100.0
	Middle 60%	26.7	25.0	3.3	35.0	1.7	8.3	100.0
	Top 20%	0.0	0.0	5.0	0.0	0.0	95.0	100.0
1980	Total	30.1	18.6	2.7	20.4	6.2	22.1	100
	Bottom 20%	82.6	17.4	0.0	0.0	0.0	0.0	100
	Middle 60%	22.4	25.4	3.0	32.8	10.4	6.0	100
	Top 20%	0.0	0.0	4.3	4.3	0.0	91.3	100
1985	Total	32.8	19.7	2.5	18.9	5.7	20.5	100
	Bottom 20%	88.0	12.0	0.0	0.0	0.0	0.0	100
	Middle 60%	25.0	29.2	1.4	30.6	9.7	4.2	100
	Top 20%	0.0	0.0	8.0	4.0	0.0	88.0	100
1990	Total	28.7	22.8	2.2	16.2	11.8	18.4	100
	Bottom 20%	77.8	22.2	0.0	0.0	0.0	0.0	100
	Middle 60%	22.0	30.5	1.2	25.6	19.5	1.2	100
	Top 20%	0.0	0.0	7.4	3.7	0.0	88.9	100
1995	Total	30.0	22.9	2.1	15.7	11.4	17.9	100
	Bottom 20%	85.7	14.3	0.0	0.0	0.0	0.0	100
	Middle 60%	21.4	32.1	1.2	25.0	19.0	1.2	100
	Top 20%	0.0	3.6	7.1	3.6	0.0	85.7	100
2001	Total	30.0	22.9	2.1	15.7	11.4	17.9	100
	Bottom 20%	92.9	7.1	0.0	0.0	0.0	0.0	100
	Middle 60%	19.0	34.5	1.2	25.0	19.0	1.2	100
	Top 20%	0.0	3.6	7.1	3.6	0.0	85.7	100

For 1975 the first row of Table 7 shows the distribution of countries in various regions of the world. 85% of countries in the bottom 20% of HDI value were in Africa with Asia and Pacific accounting for 15%. The top 20% band is exclusive to European countries and their offshoots (95%) and Japan. Latin American countries dominate the middle 60% band with relatively lesser presence from other regions. There is very little change in the bottom 20% band in 1980 which is again dominated primarily by African and to a lesser extent by Asian countries. This is coupled with relatively little change in the middle band composition. As for the top band the dominance of Europe and its offshoots is not challenged but a relatively small presence of Latin American countries in this band is notable. 1985 shows a worsening of the position of African countries and an

improvement in the case of Asian countries in the bottom 20% band with little notable change in other bands. Fewer African and more Asian countries appear in the bottom 20% band in 1990 before the worsening trend for Africa resumes to its path in 1995 and 2001. For the last two periods the share of African (Asian) countries in the lower band has increased (decreased) notably. The entry of some Asian countries into the top 20% band is interesting. However, despite the presence of countries from all regions (except Africa) in the top band in 2001, the European countries and their offshoots dominate this band.

The overall picture for the dynamics of human development over the period of 1975 to 2001 reveals little upward mobility for the poor countries of the world. The relative situation for sub-Saharan African countries worsened, for some Asian countries improved with the top band being dominated by European countries and their offshoots.

A complementary way of reviewing the dynamics of human development inequality is to find out how countries change position over time. This approach, adopted in recent literature investigates the degree of mobility of countries (with the size of their population taken into account) moving from one band of HDI to another over time.[15] Table 8 shows the results for four HDI bands relative to the mean of the sample and for various sub-periods.

[15] See Quah 1996a and Bourguignon and Morrisson 2002 for its application to income.

Table 8. Relative populated HDI mobility matrix and mobility ratios. (Percents)

HDI in final year relative to mean	HDI in initial year relative to mean: More than 4/3 mean	1 to 4/3 mean	2/3 to 1 mean	Less than 2/3 mean	Total population share	Mobility ratio
1975-1980						
More than 4/3 mean	*99.6*	*0.0*	*0.0*	*0.0*	**19.9**	
1 to 4/3 mean	*0.4*	*100.0*	*0.0*	*0.0*	**17.7**	
2/3 to 1 mean	*0.0*	*0.0*	*99.6*	*5.5*	**53.8**	
Less than 2/3 mean	*0.0*	*0.0*	*0.4*	*94.5*	**8.6**	
Total population share	**20.0**	**17.7**	**53.4**	**8.9**	**100.0**	
Immobility ratio						98.4
Upward mobility						1.4
Downward mobility						0.2
1980-1985						
More than 4/3 mean	*76.9*	*0.0*	*0.0*	*0.0*	**14.5**	
1 to 4/3 mean	*23.1*	*100.0*	*0.0*	*0.0*	**22.7**	
2/3 to 1 mean	*0.0*	*0.0*	*98.3*	*0.0*	**53.1**	
Less than 2/3 mean	*0.0*	*0.0*	*1.7*	*100.0*	**9.7**	
Total population share	**18.9**	**18.3**	**54.0**	**8.8**	**100.0**	
Immobility ratio						93.8
Upward mobility						0.0
Downward mobility						6.2
1985-1990						
More than 4/3 mean	*95.0*	*0.0*	*0.0*	*0.0*	**11.3**	
1 to 4/3 mean	*5.0*	*100.0*	*2.2*	*0.0*	**26.0**	
2/3 to 1 mean	*0.0*	*0.0*	*97.8*	*0.0*	**52.4**	
Less than 2/3 mean	*0.0*	*0.0*	*0.0*	*100.0*	**10.3**	
Total population share	**11.9**	**24.2**	**53.6**	**10.3**	**100.0**	
Immobility ratio						98.2
Upward mobility						0.5
Downward mobility						1.3
1990-1995						
More than 4/3 mean	*85.4*	*7.1*	*0.0*	*0.0*	**11.0**	
1 to 4/3 mean	*14.6*	*92.8*	*2.8*	*0.0*	**26.8**	
2/3 to 1 mean	*0.0*	*0.1*	*96.6*	*26.3*	**53.9**	
Less than 2/3 mean	*0.0*	*0.0*	*0.6*	*73.7*	**8.3**	
Total population share	**10.8**	**25.6**	**52.8**	**10.8**	**100.0**	
Immobility ratio						87.1
Upward mobility						9.1
Downward mobility						3.8
1995-2001						
More than 4/3 mean	*100.0*	*8.0*	*0.0*	*0.0*	**12.8**	
1 to 4/3 mean	*0.0*	*88.7*	*44.4*	*0.0*	**47.5**	
2/3 to 1 mean	*0.0*	*3.3*	*55.6*	*32.5*	**33.8**	
Less than 2/3 mean	*0.0*	*0.0*	*0.0*	*67.5*	**5.9**	
Total population share	**10.7**	**26.4**	**54.2**	**8.7**	**100.0**	
Immobility ratio						78.0
Upward mobility						21.2
Downward mobility						0.8
1975-2001						
More than 4/3 mean	*67.5*	*0.0*	*0.0*	*0.0*	**13.5**	
1 to 4/3 mean	*32.5*	*96.1*	*52.6*	*0.0*	**51.6**	
2/3 to 1 mean	*0.0*	*3.9*	*45.7*	*54.4*	**29.9**	
Less than 2/3 mean	*0.0*	*0.0*	*1.7*	*45.6*	**5.0**	
Total population share	**20.0**	**17.7**	**53.4**	**8.9**	**100.0**	
Immobility ratio						63.7
Upward mobility						26.8
Downward mobility						9.5

For each period interval the percentage population in HDI bands in the initial year which have moved to various bands in the final year are shown. The bands are selected such that they are spread around the mean evenly. The row entitled “total population share” shows the percentage of population in each band at the beginning of the period and the column with the same title shows the same at the end of the period. A comparison of this row and column reveals the change in inequality over the relevant period. The details of such mobility are shown in the transition matrix (figures in *italics*). The immobility ratio is computed as the percentage of population not changing band by the final year (the diagonal of the transition matrix). The upward and downward mobility are the shares of population moving to upper or lower bands (the upper and lower off diagonal elements of the transition matrix respectively).

There is little evidence of change in distribution for the period of 1975-80. More than 98% of population remained in the same bands as the initial year. There is a little more downward mobility for the period of 1980-85, though essentially there is a high degree of immobility for this period. The degree of immobility for 1985-90 is very high again. It is during the period of 1990-95 that some upward mobility takes place. This is mainly due to some populated countries moving to a higher band (amongst them Pakistan, Iran, Sudan and Tunis). The downward mobility for this period is mainly due to some European countries or their offshoots dropping out of the top band due to this band not being wide enough to accommodate them all. The relatively big move takes place for the period of 1995-2001. During this period more than 21% of population moved upwards. Almost all this transition is in the middle part of the distribution and is explained by the upward movement of two highly populated countries: China and Bangladesh. The change in distribution is evident in the transition matrix as well as the changes in the overall distribution at the final period as compared to the initial period (column and row of “total population share”). For this period, and to some extent for the 1990-95, we see a movement towards the “twin peaks” in distribution as suggested by Quah (1996a) and observed for income data in the long run by Jones (1997) and Bourguignon and Morrisson (2002).

The final section of Table 8 shows the mobility for the entire period of our sample, 1975-2001. The "twin peak" effect is clearer in this longer interval. There are clear upward and downward movements in human development over the period of 26 years. The upward mobility has resulted in 26 percent of population in the sample to move from the bottom two bands to the upper middle bands. There is a 54% movement from the bottom band to the next band coupled by nearly 53% movement from the 2/3 to 1 mean band to the next upper band. The downward movement is mostly due to some European countries and their offshoots dropping to a lower band coupled with some relatively small downward movement from the second top band to the third. The overall changes in the distribution of human development in 2001 as compared to 1975 (column and row of "total population share") depict a clear picture of movement from the bottom to the lower-middle band, from the lower-middle to the upper-middle band and also from the top band towards the middle-upper band. The mobility ratios indicate that nearly 27% of population moved upward as compared to a downward mobility of 9.5% and an immobility ratio of nearly 64% during this period.

VI. Conclusion and Policy Implications

The concepts of convergence and inequality could be usefully employed in studying the evolvement of human development over time. The extension of conversion hypothesis to the non-income components of HDI could be validated conceptually and empirically. The growth regression for the medium and low human development countries shows an evidence of weak absolute convergence in human development over 26 years. These findings are robust and remain the same for various models of conditional convergence. The same is established for sub-samples of medium and also low human development countries. The measures of σ-convergence are in line with those for weak β-convergence.

When the population size of countries are taken into account the results differ. The gini coefficient for medium and low human development countries shows a worsening of inequality while in the case of all countries sample we see little change in inequality over

the 26 year time span of this study. A regional breakdown of the sample over time clearly showed that in 2001 almost all countries in the bottom 20% of HDI are sub-Saharan African countries - a situation worse than that of 1975 for these countries. During the 1975 to 2001 period, the Asian and Latin American countries experienced considerable progress in human development.

Regarding population mobility between mean-relative HDI bands there is little movement for the first three five-year periods from 1975 to 1990. It is during 1990-95 that we see some upward and downward mobility with the former being higher. This is mainly driven by a number of medium populations size countries such as Pakistan and Iran moving one HDI band up and some less populated countries moving down. During the 1995-2001 period, there is more upward mobility mainly caused by the highly populated China and Bangladesh moving up one band. This resulted in a considerable change in the middle sections of distribution. The change in distribution for the entire period of 1975-2001 shows considerable mobility again in the middle part of distribution depicting a case of "twin peaks" with the previously dominant lower middle band peak in the beginning of the period being replaced by an upper middle peak at the end of the period.

All this illustrates that there have been some signs of equalisation in the distribution of HDI but a few populated countries mainly drive this. There are also signs of polarisation particularly amongst the developing countries. While some countries, mainly in Asia and Latin America, have progressed considerably, the sub-Saharan Africa seems to have been caught in a deep trap of low human development with no signs of getting out of it. These countries are not moving in the direction of MDG as expected and, if the current trends continue, by 2015 they would be worse off in some aspects such as poverty and nowhere near the goals for the remaining MDG. To ensure improvements in human development in poorer countries, who need this most, and a reduction in inequality far more efforts than what has been done so far under MDG is needed. Given that poorer countries on their own lack the required resources for this purpose, as recognised by a number of

reports (such as WHO 2003 and UNDP 2003), far more rigorous efforts are required by international aid agencies and donor countries in order to change the current trends.

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