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Advancing Sustainable Development: How
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Chieko Tokuyama and J. Ram Pillarisetti

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**Measuring Human Wellbeing and Advancing Sustainable Development: How Credible
are the UNDP's Human Development Reports?**

Chieko Tokuyama*

and

J. Ram Pillarisetti**

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*Department of Economics, Faculty of Business, Economics and Policy Studies, Universiti Brunei Darussalam, BE1410 Brunei Darussalam; ** Department of Economics, Faculty of Business, Economics and Policy Studies, Universiti Brunei Darussalam, BE1410 Brunei Darussalam and Department of Economics, Faculty of Business and Economics, Monash University, Victoria, Australia.

Correspondence to Dr. J. Ram Pillarisetti Tel: 673-2460929, Fax: 673-2463017, Email: rammp@fbeps.ubd.edu.bn. The authors wish to thank Roger Lawrey and Mark McGillivray for valuable comments. The authors are responsible for all errors.

Abstract

The broad objectives of the Human Development Report (HDR) and the estimates of human wellbeing are to identify policies that reduce poverty, economic and gender inequalities and increase human wellbeing. Since inception in 1990, the HDR and the methodological and measurement issues relating to the now well known Human Development Index (HDI) have undergone several transformations. This paper empirically looks at reliability of databases from HDRs with a special focus on the estimations methodology and data revisions of the HDI, recent growth trend in HDI and real income. It also looks selectively at major shift in policy directions for sustainable development in the HDRs. This paper notes that the databases in the HDRs exhibit significant measurement errors and inadequacies. The measurement errors are more conspicuous in case of data pertaining to low-income developing countries. This paper also notes that besides database problems, issues relating to policy revisions in the recent Reports raise serious questions of credibility with the Reports.

1 Introduction

The United Nations Development Program (UNDP) proposed a composite index of development known as the Human Development Index (HDI) in the Human Development Report (HDR) of 1990. The Reports and the Index though well known now, have been subject of critical analysis (see, e.g., McGillivray (1991), McGillivray and White (1992, 1993), Srinivasan (1994), Gormely (1995) et al). The Reports and the HDIs have contributed to the debate on measurement of wellbeing and a phenomenal growth of regional and national Human Development Reports across the world. Several other composite indexes such as Gender-related Development Index (GDI) and Gender Empowerment Measure (GEM) have been subsequently proposed and the values of all these indexes are annually estimated and given in HDRs. The purpose of this paper is to examine if the index values given in HDRs are reliable and comparable and whether selected policy revisions are consistent with the objectives of the HDRs. This paper is organized as follows. Section 2 discusses the composition and revisions in construction of the HDI. Section 3 describes the revisions of HDI values. Section 4 critically examines the revisions and reliability. Section 5 puts forth the questions of credibility, and section 6 gives the concluding remarks.

2. The Human Development Index: original formula and subsequent revisions

2.1 Version 1: Original formula of HDI (HDR1990)

When the HDI was first published in HDR 1990, the HDI was defined as follows:

$$HDI_i = 1 - I_i$$

where I_i is the deprivation indicator for country i . I_i is composed of three key variables, I_{1j} as life expectancy index, I_{2j} as literacy index and I_{3j} as income index. $I_{i,j}$ represents how country i suffers in j th variable. I_{1j} is measured by life expectancy at birth as the single unadjusted indicator, and I_{2j} is measured by adult literacy rate. I_{3j} is measured by

the logarithm of real GDP per capita, calculated not at exchange rates but at the real purchasing power. For the income variable, the HDR consider diminishing marginal utility of income using the following Atkinson-type formula:

$$W(y) = \frac{1}{1-\epsilon} y^{1-\epsilon}$$

where $W(y)$ is the utility derived from income, and ϵ measures the extent of diminishing utility. It is the elasticity of the marginal utility of income. There is no diminishing utility when ϵ is equal to 0 and $W(y)$ becomes $\log y$ as ϵ gets close to 1. The treatment for income is based on the idea that people do not need excessive income to purchase goods and services for a decent standard of living. In HDR 1990, income under the international poverty line has a full weight and income above the poverty line has a zero weight using the following formula:

$$x_{3,i} = W(y_i) = \log y_i, \text{ for } 0 < y_i \leq y^* \text{ and} \\ = \log y^*, \text{ for } y^* < y_i$$

where y_i is income of country i and y^* is income value of the international poverty line. In HDR 1990, y^* is equaled to PPP\$4,861 per annum.

Each of the three components has minimum and maximum values. The deprivation indicator of a country ranges between zero and one defined by the difference between the maximum and the minimum as follows:

$$I_{j,i} = \frac{x_j^{\max} - x_{j,i}}{x_j^{\max} - x_j^{\min}}$$

where $I_{j,i}$ is the j th component index of HDI for country i , $x_{j,i}$ is the j th actual value of country i , x_j^{\max} is the maximum value and x_j^{\min} is the minimum value of $x_{j,i}$ in the world.

The maximum and minimum values were set by taking the highest and lowest national actual values of 1987 for each indicator. For example, the minimum value of income indicator was set at PPP\$220 per annum as the lowest income country of Zaire and the maximum value of the life expectancy was set at 78 years reflecting longevity in Japan in 1987. I_1 is derived by averaging the sum of these three indices:

$$I_1 = \sum_{j=1}^3 I_{1,j}$$

Finally, HDI is calculated by one minus the average deprivation index. The HDI was created for 130 countries in HDR 1990.

2.2 Version 2: Revised formula (HDR 1991-93)

UNDP changed the way of measuring $I_{2,j}$ in HDR 1991. In HDR 1990, $I_{2,j}$ was only measured by adult literacy measures. Since HDR 1991, $I_{2,j}$ has been measured by two components; adult literacy rate (0 to 100%) and mean years of schooling. The two measures are combined to produce a comprehensive measure of educational attainment by using the following formula.

$$x_{2,j} = \frac{2}{3} X_{2,1,j} + \frac{1}{3} X_{2,2,j}$$

Where $X_{2,1,j}$ is adult literacy rate and $X_{2,2,j}$ is mean years of schooling. Adult literacy is given heavier weights as adult literacy is more representative of conventional component for educational achievement.

In HDR 1991, any income beyond the world poverty line level is discounted using a new formulation based on Atkinson's formula for the utility of incomes as follows:

$$\begin{aligned} x_{3,i} = W(y_i) &= y_i && \text{for } 0 < y_i \leq y^* \\ &= y^* + 2(y - y^*)^{\frac{1}{2}}, && \text{for } y^* \leq y_i \leq 2y^* \\ &= y^* + 2(y^*)^{\frac{1}{2}} + 3(y - 2y^*)^{\frac{1}{3}}, && \text{for } 2y^* \leq y_i \leq 3y^* \text{ and} \end{aligned}$$

$$= y' + 2(y')^{\frac{1}{2}} + 3(y - 2y')^{\frac{1}{2}} + n \left\{ \left[1 - (n-1)y' \right]^{\frac{1}{n}} \right\}, \text{ for } (n-1)y' \leq y, \leq ny'$$

where $x_{3j} = W(y_j)$ is the utility/well-being derived from income (or adjusted GDP per capita) and y_j is income of country i . y' represents the international poverty line set at PPP\$4,829 during 1991-93². In the new formula, the value of ϵ rises gradually as income increases, while the value of ϵ was given a zero weight to income above the threshold line in the previous formula. The higher the income, the more the diminishing utilities of income affect.

2.3 Version 3: Revised formula (HDR 1994)

In HDR 1994, the major change seems to be measuring human development in terms of 'achievement' rather than in terms of 'deprivation'. Hence, the new formula for HDI is defined as follows:

$$HDI_i = \frac{1}{3} \sum_{j=1}^3 I_{j,i}$$

where $I_{j,i}$ is the j th component index of HDI and denotes a specific aspect of human development in country i .

A maximum and a minimum value have been also fixed for each of the four key variables since HDR 1994, while observed ones have been used during HDR 1990-93. The observed maximum and minimum values have been taken from the actual values of the best performing and the worst performing countries. The changes in the observed ones may have affected the changes in the HDI value of a country. The changes in the observed ones also may not be possible to compare the HDI data across time as the observed ones may change every year. Hence, the values should be fixed to know that the changes in the HDI of a country are solely because of its improved performance, not because of the changes in the goal posts.

$$I_{j,t} = \frac{x_{j,t} - x_j^{\min}}{x_j^{\max} - x_j^{\min}}$$

where $I_{j,t}$ is the j th component index of HDI for country i , $x_{j,t}$ is the j th actual value of country i . Each of the indicators is defined by the difference between the fixed maximum and minimum values. $I_{1,t}$ is measured by life expectancy at birth as the same above (the range is from 25.0 to 85.0 years). $I_{2,t}$ is measured by two components; adult literacy rate(0% to 100%) and mean years of schooling (0 to 15 years). $I_{3,t}$ is measured by real GDP per capita(PPP\$200 to \$40,000). The discounted value of the maximum income of PPP\$40,000 is \$5,385. In HDR 1994, the world average real GDP per capita of PPP\$5,120 is taken as the new threshold value y^* , while the threshold value was called as the poverty line set at the average income of the nine developed countries until HDR 1994. That's because the poverty line derived from the developed countries was not suitable for an income target for developing countries. The world average income indicates that everyone in the world should have this income level to build human basic capabilities.

2.4 Version 4: Revised formula (HDR 1995-98)

Since HDR 1995, the variable of mean years of schooling has been replaced by the combined primary, secondary and tertiary gross enrolment ratios as one of the measures for educational achievement. $I_{2,t}$ has been measured by two components; adult literacy rate(0 to 100%) and combined primary, secondary and tertiary gross enrolment ratio (0 to 100%). The mean years of schooling was calculated through highly complicated methods applying immense data not derived from any UN agency and it sometimes resulted in using inadequate estimates. The combined enrollment ratio has improved the problem by using the easier methods and the data based on the work of UNESCO.

Secondly, the minimum value for income variable, $I_{3,i}$, has been changed from PPP\$200 to PPP\$100. The range is between PPP\$100 and \$40,000. This revision was made to maintain the comparability and consistency between HDI and the gender-related development index (GDI). The minimum observed value of female income was PPP\$100 when GDI was formulated. The discounted value of the maximum income of PPP\$40,000 is PPP\$6154. The world average income of PPP\$5,835 is taken as the threshold value in HDR1997.

2.5 Version5: Recent formula (HDR1999-2005)

Since HDR 1999, the income index ($I_{3,i}$) has been calculated by using the logarithm of gross GDP per capita in PPP (y_i). In the new methodology, income above the threshold value of world average per capita income is more gradually discounted than the way of using the formulation based on Atkinson's formula for the utility of incomes. The previous formula for income has discounted income of middle income countries excessively. The new formula for income index is as follows:

$$I_{3,i} = W(y_i) = \frac{\log y_i - \log y_{\min}}{\log y_{\max} - \log y_{\min}}$$

where y_{\max} and y_{\min} are set at PPP\$40,000 and PPP\$100, respectively.

3. HDRs and data and policy revisions

The HDRs have made changes to estimation methodology of selected indicators and policies. The HDR suggests that the HDI values are not strictly comparable year by year. In order to counter this problem, HDRs give revised estimates of the HDI values which they claim are more accurate for comparability. These revisions are given in the first instance in the succeeding HDRs. The estimates of the HDI are further revised and given with 5-year intervals, which the HDRs claim are comparable across nations and time. Thus comparable estimates if the indexes are not available on a year-to-year basis.

However, revised comparable estimates for selected years 1985, 1990, 1995 etc are given in succeeding HDRs. Since inception, HDRs gave HDI values with a 3 year gap. That is, HDR1994 contains HDI for reference year 1991, and HDR1995 contains HDIs for reference year 1992 and so on. However, UNDP wanted to reduce the gap and the HDR1999 contains HDI for reference year 1997 (instead of 1996). Thus HDI for reference year 1996 are not officially reported in the HDR1999. The HDRs seem to be weighed down by errors of negligence and measurement errors^{3, 4}. In this paper, we look closely at the values HDI for reference year 2000. To start with, the HDR 2002 gives the HDI for the reference year 2000. Subsequently HDR 2004 gave new revised estimates for HDI for 2000. The HDR 2005, yet again gives further revised estimates for HDI for 2000. Thus we have so far 3 different estimates for HDI for the year 2000, from HDR 2002 (original), HDR 2004 (first revised) and HDR 2005 (second revised)⁵. However, there exist several missing values in the revised series. We have taken HDI 2000 values for a list of 169 countries from HDR 2002. When we looked at the revised estimates of HDI 2000, we have only 116 revised estimates in HDR 2004. Out of the 53 missing HDI values, 7 are values for High Income Countries (HIC), 8 Upper Middle Income Countries (UMIC), 19 Lower Middle Income Countries (LMIC) and 19 for Low Income Countries (LIC)⁶. The latter 38 countries account for nearly 1/3rd of all LMIC and LIC values. Thus, we do not have comparable estimates of human development for a disproportionately large number of developing countries in lower middle and low income categories.

Regarding the Gender-related Development Index (GDI) and Gender Empowerment Measure (GEM), no such revisions were given in succeeding HDRs, even though the issues pertaining to HDI revisions are equally applicable to the GDI and GEM. Even though UNDP produced these gender related indexes with valid concerns about gender

inequalities especially in developing countries, there seems to be a lack of will in developing comparable estimates and improving accuracy in these gender-based measures.

4. Empirical analysis of the HDI revisions:

This section looks at the magnitude of the revisions and its implications by examining the HDI 2000 values from HDR 2002, HDR 2004 and HDR 2005. Table 1 gives descriptive statistics of the percentage differences among the HDI 2000 values from different HDRs. Comparing HDI 2000 (from HDR 2004) with HDI 2000 (from HDR 2002), it can be seen that the differences vary from -10.16% to 10.62%. The differences increase when we compare HDI 2000 (from HDR 2005) with HDI 2000 (from HDR 2002) with differences varying from -14.51% to 12.84%. Ignoring the negative values and viewing at the magnitude of differences, it can be seen that percentage differences between HDI 2000 (from HDR 2005) and HDI 2000 (from HDR 2002) are about 2.32% across all countries, but much higher at 3.78% for LICs. Figures 1 and 2 scatter plots consider data for LICs only and note that differences between original and revised estimates (and re-revised estimates) are substantial in case of LICs and low human development countries, especially from Africa ⁷. Figure 3 box plot shows the percentage differences by income classification.

Next, we have also looked at growth rates of income and the HDI during 1997-2002. We started with 1997 because that is the year the final reformulation till now of HDI formula occurred. As none of the HDRs attempted to calculate backwards the HDI values applying new formula to previous years, the HDI values prior to reference year given in earlier HDRs are not comparable with HDI1997 and later year HDI values. Figure 4 shows that the growth rate of per capita income and that of the HDI during 1997-2002. Figure 5 plots the growth differentials showing the extremely high and seemingly

suspicious growth differentials for countries such as Azerbaijan, Lithuania, Seychelles and others.

Viewing the cautionary note from HDRs regarding comparisons based on HDI data, we have also attempted comparison based on the revised data set on HDIs (which UNDP considers are comparable across time) as given in HDR 2004. The 'comparable data' on HDIs is available for only 115 out of the 169 countries we started with. Figures 6 and 7 show that growth rates of income and the HDI during 1995-2000 (comparable data set according to UNDP) exhibit similar trend to that of 1997-2002 (non-comparable data sets according to UNDP), though the sample sizes are different. An interesting result is that while the growth of income and the HDI during 1995-2000 are correlated significantly with a Pearson coefficient of correlation of 0.47, the rank correlations turned out to be insignificant. While the Kendall tau-b was 0.01, the Spearman's coefficient of rank correlation was -0.001. Given that income index has a one-third weight in the composition of the HDI, the lack of robust correlations suggests that the other two components, the life expectancy and education indexes move in the opposite direction. However, as these variables are more stable than income and expected to vary in the long-run, the data set on HDI and its components raise questions of reliability.

5. Credibility questions on data and policy:

Analysis in previous sections show serious measurement issues associated with composite indexes developed in HDRs. It can be suggested the UNDP should not be blamed for data revisions, as the data are perhaps the best available to UNDP from its sources. However, this paper has noted considerable errors of measurement and imprudence on the part of UNDP.

While database problems are one aspect of deficiency in HDRs, another serious concern is associated with highly controversial policy prescriptions and policy reversals in HDRs. HDR 2001, entitled "Making New Technologies Work for Human Development" claims

that genetically modified foods and crops would increase yield and provide solution to complex problem of poverty and food security. This naïve approach has met with strong criticism from several quarters not only because it ignores the concerns of scientific community on the long-term ecological and health risks, but also the issues of monopoly control, and ethical, cultural and religious issues (see, also, Kothari (2001), Pillarisetti and Radel (2004), Sharma (2001), Vidal and Aglionby (2001)). Oxfam, Greenpeace International, Actionaid, the Intermediate Technology Development Group and more than 290 grassroots groups around the world objected strongly to the HDR 2001 conclusions (Vidal and Aglionby (2001)). The HDR 1999 itself has noted that mergers and acquisitions in biotechnology industry has jumped from \$9.3 billion in 1988 to \$172.4 billion in 1998, with the top 5 biotechnology companies controlling more than 95% of patents and gene technology transfers. Seed varieties from Monsanto account for about 94% of global transgenic crop area. Von Hernandez of Greenpeace South-east Asia has noted it "would do UNDP good to learn that the anti-GE debate is also driven by civil society in the Third World, which is concerned about corporate concentration in our food system, loss of livelihoods as corporations gain control of our biodiversity and seeds, and that several of our countries, including Sri Lanka, Thailand, Brazil, Mexico, among others, have taken national action and imposed a moratorium on some or all GE crops" (Greenpeace South East (2001)).

Several research papers came out prior to the HDR 2001 questioning the unsubstantiated claims of the genetically modified agriculture, and the economic and environmental benefits of sustainable eco-friendly agriculture in reducing poverty (see, e.g., Ho and Ching (2003), Muir and Howard (1996), Rissler and Mellon (1996), Shiva (1999 and 2000), and Simms (1999)). "The UNDP of all agencies should know that complex problems of hunger and agricultural development will not be solved by technological 'silver bullets'. The real crisis is the obvious neglect of research and investment in the

further development and spread of sustainable and ecological agriculture technologies," added Hernandez (Greenpeace South East (2001)).

Since the inception and for a few years, the HDRs have become a voice for advocating greater justice, freedom, and equity within and among nations. HDR 2000 explicitly heightened that the role of globalization and global forces, including the World Trade Organizations and its many agreements, are in violation of basic human rights and ecological sustainability (Kothari (2001)). The UNDP which argued in favor of gender balanced and sustainable development all along has reversed its directions and has begun justifying the multinational monopolies who are pushing products and technologies, the long term safety of which has never been established. Such pro-multinational monopolies and anti-poor and anti-environment policies reflect loss of direction of the UNDP. It raises the question as to whose interests the recent HDRs are serving. Robert Vint of Genetic Food Alert, speaking on behalf of 290 groups in 54 developing countries which disagree with the HDR 2001 recommendations and do not want to see GM crops in their countries, said that the report "contains frightening echoes of recent biotechnology industry propaganda." (Vidal and Aglionby (2001)).

6 Concluding remarks

The Human Development Reports and the construction of wellbeing indexes such as the HDI, the GDI and the GEM in particular, have started with a worthy objective of measuring wellbeing and promoting gender balanced and environmentally sustainable development and poverty reduction. However, while all HDRs exhibit data errors and inferential inadequacies, the HDR 2001 clearly forms a watershed by its promotion of questionable and highly controversial policies associated with agricultural biotechnology. Several questions arise from the analysis in this paper: i) that when a new HDR is released, can we consider the values of the composite indexes such as the HDI, GDI and GEM, especially those pertaining to low-income developing nations, as reliable and

dependable?; ii) are the indexes evolving towards better quality or deteriorating towards redundancy?; iii) can we trust that the policy prescriptions of the HDRs as pro-developing nations, pro-poor and environmentally sustainable?; and iv) whose interests are the recent HDRs serving; poor developing nations or international monopolies promoting disputed and unsafe technologies?. The disturbing conclusion is that while the composite indexes seem to be turning into redundant statistical artifacts because of negligence, inaccuracies and frequent methodological changes, a serious concern is associated with controversial policy prescriptions.

The UNDP and the HDRs have originally established themselves as voices of the weak and disadvantaged and for the economic rights, justice, gender equality and sustainable development. By "naively advocating the export of ill-devised and unsafe GE technology in the South", the UNDP has made a volte-face from its original agenda. HDR 2001 made very little attempt to examine ecological and sustainable farming methods. Many argue that what is needed is not high tech fixes but good governance and productive employment that generate incomes for the poor. This can better be achieved through rural technologies and farming methods which are labor intensive and ecologically friendly (see, New Scientist (2001) and Pearce (2001)).

Given the prestige the HDRs have acquired in the early years and the international dissemination of their contents, a high ethical and professional responsibility is placed on the UNDP and HDR not only to reduce errors of measurement and enhance accuracy and comparability but also advocate the right mix of policies for betterment of low income economies, balanced development and uplift of poorer sections. The crafty manipulation of the HDRs to push the interests of monopolies "will cast an ominous shadow over the credibility of the future UN programmes for human development" (Sharma (2001b)).

It is disquieting to note that recent HDRs are failing both in the tasks of developing reliable and comparable databases on wellbeing measures, and in identifying appropriate policy prescriptions for betterment of the weak and disadvantaged. A complete overhaul of the HDR team and focus seems to be required not only to reduce the credibility gap and arrest the degeneration but also to set forth a new direction for HDRs for providing a voice for economic justice, equality and sustainable development. A serious re-examination of issues relating to data and policy are required if the HDRs would like to claim credibility and to fairly address the real issues of human development.

Endnote

1 It should be noted that the term $3(y - 2y^*)^{\frac{1}{3}}$ is mistakenly placed for $x_{3,} = W(y_1)$ in the range of $y \leq y_1 \leq 2y^*$ in the technical note of HDR 1992.

2. The international poverty line (y^*) is given as PPP\$4,829 for reference years 1988, 1989 and 1990 (i.e., in HDRs for 1991, 1992 and 1993). Fixing poverty line for three consecutive years seems unrealistic and likely to cause bias in the results.

3. The HDR1997 for instance gives the population of many small countries as 'zeros'. This presumably seems to have resulted from negligence in formatting spreadsheet of data, wherein zero decimal places were considered for population data given in 'millions of people'. This resulted in zero population for all countries with less than half a million people as the numbers are rounded with no decimals (UNDP (1997)).

4. The population for Bhutan, for instance, is given as over 2 million consistently in all HDRs. However, the World Bank gives the population estimate for Bhutan as 0.8 million and places Bhutan in the list of small economies (that is, economies with population of 1.5 million or less). The Royal Bhutan Government itself gives the current population of Bhutan as 0.65 million (World Bank (1999-2002)).

5. For the HDI values for reference year 1995, we have until now as many as 6 different estimates from HDRs of 1998, 2001, 2002, 2003, 2004 and 2005.

6. Low-income countries (LICs) are those with per capita income of \$785 or less. Lower middle income countries (LMICs) and upper middle income countries (UMICs) have per capita incomes between \$786 and \$3,115 and between \$3,116 and \$9,635 respectively. High-income countries (HICs) are those with per capita income \$9,636 and above (see World Bank (2000)).

7. Equatorial Guinea has registered a very high growth of Income per capita of 1558% during 1997-2002. For graphical clarity, Equatorial Guinea is not included in the figures, though the data is used for statistical analysis.

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Table 1

HDI 2000 from HDR 2002, HDR 2004 and HDR 2005:
Descriptive Statistics of Percentage Differences

HDI 2000 Revisions	Minimum	Maximum	Average (All)	Average (LIC)	σ (All)	σ (LIC)
HDR2004 and HDR2002	-10.16 (N=116)	10.62 (N=116)	1.76 (N=116)	3.03 (N=39)	2.75 (N=116)	4.15 (N=39)
HDR2005 and HDR2002	-14.51 (N=115)	12.84 (N=115)	2.32 (N=115)	3.78 (N=40)	3.47 (N=115)	5.19 (N=40)
HDR2005 and HDR2004	-4.33 (N=109)	7.74 (N=109)	1.33 (N=109)	2.39 (N=35)	1.95 (N=109)	2.69 (N=35)

Figure 1

HDI 2000 (HDR 2004) and HDI 2000 (HDR 2002) for Low Income Countries

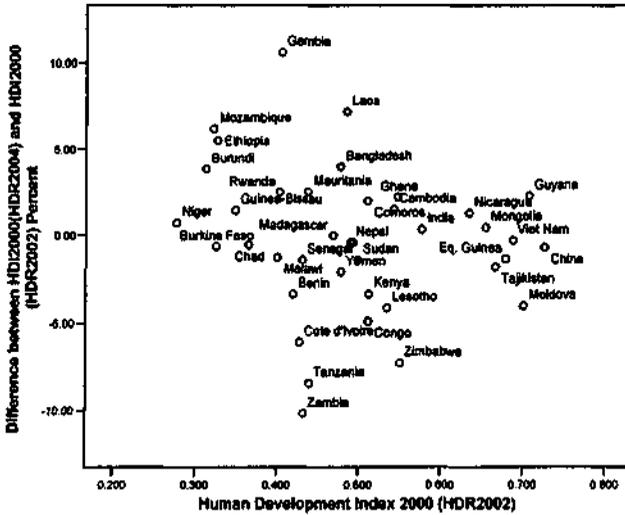


Figure 4
Growth of Income and the HDI 1997-2002

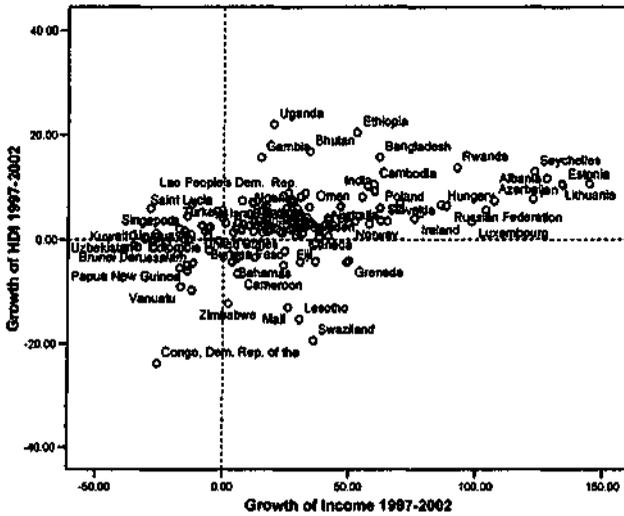


Figure 5
Difference in growth rate of Income and the HDI 1997-2002

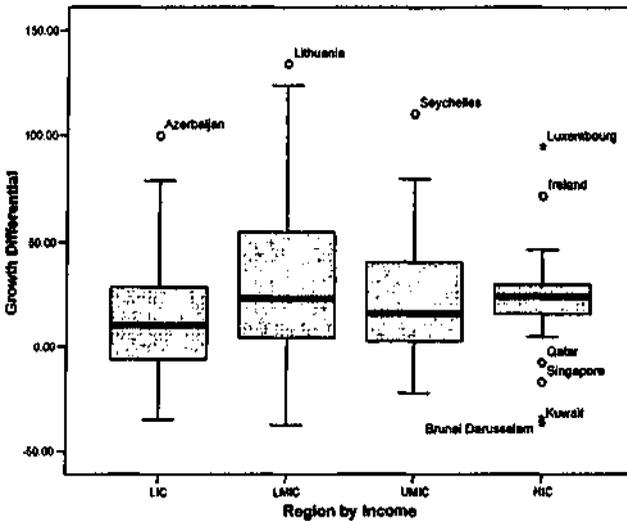


Figure 6
 Growths of Income and the HDI 1995-2000
 (HDI 2000 and HDI 1995 data from HDR 2004)

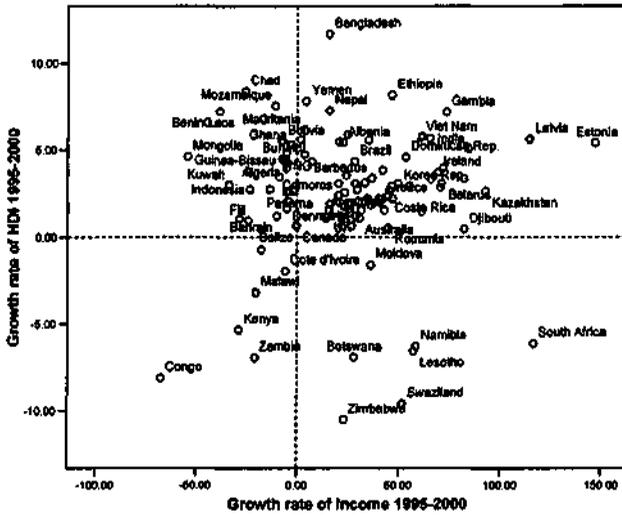
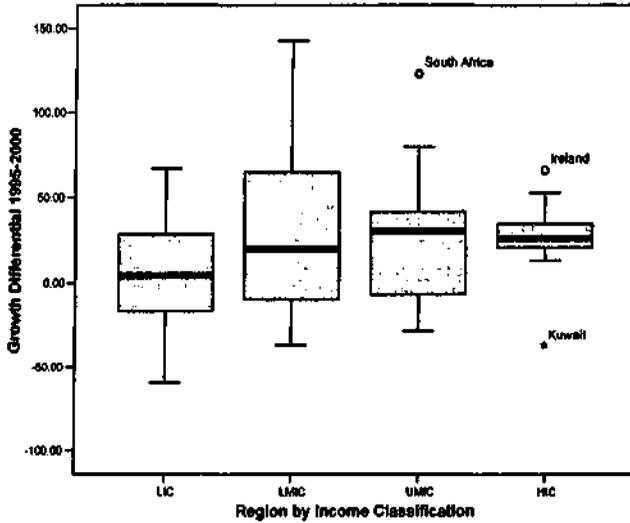


Figure 7
 Difference in growth rate of Income and the HDI 1995-2000



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