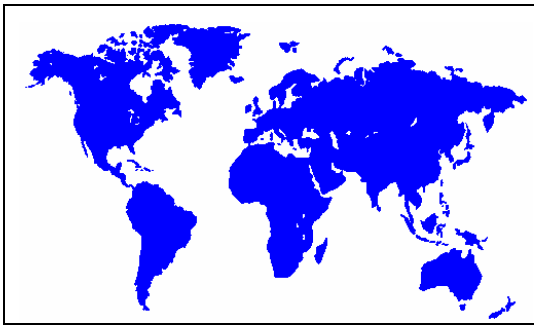

Forecasting the Human Development Index (HDI)

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Boston University

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Abstract

This paper introduces an approach to forecasting the Human Development Index (HDI) for any or all of 164 countries and for any grouping of those countries.

The approach uses a computer simulation that forecasts each of the three basic components of the HDI and computes the index forecast from those components. Specifically, it uses the IFs for RAND Pardee simulation with an extensive historic database and with a representation of demographic systems (using cohort-component methods), economic systems (using multi-sector general equilibrium modeling in a social accounting matrix framework), and specialized socio-political representations (including a submodel of formal education at three levels).

The computer forecasting system can be used with alternative formulations of the HDI and two alternatives have been added.

The system also facilitates the investigation of alternative scenarios, including different patterns of human intervention. This paper shows the HDI for the base case of the model and for two alternative scenarios, the first involving a more pessimistic unfolding of the HIV/AIDS epidemic and the second involving a more optimistic global movement towards sustainable development.

1. Introduction[1]

The first *Human Development Report* appeared in 1990. Among the great many contributions of those reports, over what is little more than a decade since their beginning, has been the introduction of the human development index (HDI), an alternative to individual, mostly economic measures of human well-being. Although its founding father, Mahbubul Haq, and his collaborator, Amartya Sen, were very much aware of the weaknesses of any single measure, the HDI has proven its value in focusing attention on quality of the human condition.[2] Among other applications, well over 100 countries have produced specialized human development reports heavily using the HDI, often focusing on local municipalities and regions as well as country-level values.

Much less common than use of the HDI for analysis of historic patterns and trends, or for examination of regional and local variations in achievement, are attempts to forecast the Human Development Index. Again, some of the country-specific reports have done so.

The challenges to forecasting are significant, but not overwhelming. To begin, it would not be highly complex to use traditional time-series extrapolations of patterns of change, although variations in the calculation of the HDI over time make extrapolations less meaningful. The historic base of HDI calculations now extends back at least to 1975. At Boston University, the Frederick S. Pardee Center for the Study of the Longer-Range Future has initiated a Project on Human Development that, with the support of an extensive database, allows interactive calculation of indices like the HDI. The project intends to add the capability for extrapolations on single measures and flexibly-defined indices, a unique tool.

At a more complex level, however, it would be very useful for analysts to have a forecasting capability that did not simply extrapolate the Human Development Index, but that produced forecasts of its underlying components and calculated future values for HDI based on those forecasts. Even further, it would be ideal if the forecasts of the underlying components could be based on a simulation that produced them in a manner that allowed the analyst to investigate alternative scenarios dependent on differing assumptions of various long-term processes (such as the unfolding of the HIV/AIDS epidemic) or human interventions (such as efforts to achieve the UN Millennium Development Goals).

The purpose of this working paper is to introduce such a forecasting capability. The simulation is the International Futures (IFs) system, specifically the IFs for RAND

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[1] Suggestions/feedback from James Dewar, Frederick Pardee, and James Thomson have improved this draft, which uses IFs for RAND Pardee v4.40. The author remains fully responsible.

[2] Selim Jahan (www.umass.edu/peri/pdfs/glw_jahan.pdf), one of the UNDP authors for most of a decade, reviewed the origins, evolution, and character of the HDI.

Pardee elaboration of that system.[3] In brief IFs for RAND Pardee combines an extensive historic database with a simulation of demographic systems (using cohort-component methods), economic systems (using multi-sector general equilibrium modeling in a social accounting matrix framework), and specialized socio-political representations (including an early version of a model of formal education at primary, secondary, and tertiary levels[4]).

The rest of this paper will present some initial results from use of the IFs for RAND Pardee system to forecast the Human Development Index. The next section provides numbers from the base case of the model. The third section uses two scenarios to show some possible broad ranges in forecasts that might be reasonable. The fourth section illustrates the capability of the system for providing alternative scaling of the HDI. The fifth and final section demonstrates very briefly the capability of the system to drill-down into the examination of different development patterns than underlie alternative possible futures for HDI in different parts of the developing world.

[3]That elaboration has been sponsored by the RAND Pardee Center. For information on the simulation see Barry B. Hughes, *International Futures: Choices in the Face of Uncertainty*, 3rd edition. Boulder, CO: Westview Press, 1999. A brief summary of IFs can also be found in "Choices in the Face of Uncertainty: The International Futures (IFs) Model, *Futures* 33 (2001): 55-62. A more extended one is forthcoming in "International Futures (IFs) Model," UNESCO Enclyclopedia of Life Support Systems. See also http://www.du.edu/~bhughes/ifswelcome.html for considerably more detail on the system.

[4] Mohammod T. Irfan is developing that model in his Ph.D. dissertation work at the University of Denver, Graduate School of International Studies.

2. Base Case Using Standard HDI Formulation: History and Forecasts

How might levels of the HDI unfold over the coming century? There are obviously a great many possible paths, and that is a topic to which we return in the next section. Figure 1 suggests one possible path, provided by the Base Case of IFs for RAND Pardee. It shows the actual values of the HDI from 1975 through the end of the twentieth century and the forecast thereafter. Clearly there is a saturation effect occurring in the forecast that is related in part to the character of the index (literacy, for instance, cannot exceed 100% and GDP per capita at PPP is logged), as well as a movement of the HDI for OECD countries slightly above 1.0 in the long run. Section 4 returns to both of these issues.[5]

It also appears, however, that the near-term forecast of IFs may be a little pessimistic relative to past patterns. Part of the reason for that in non-OECD countries is the impact that HIV/AIDS will have in many African countries over the coming decade or more, and part is increasing saturation of the index for China and other countries. We will elaborate those issues and alternative forecasts throughout the paper.

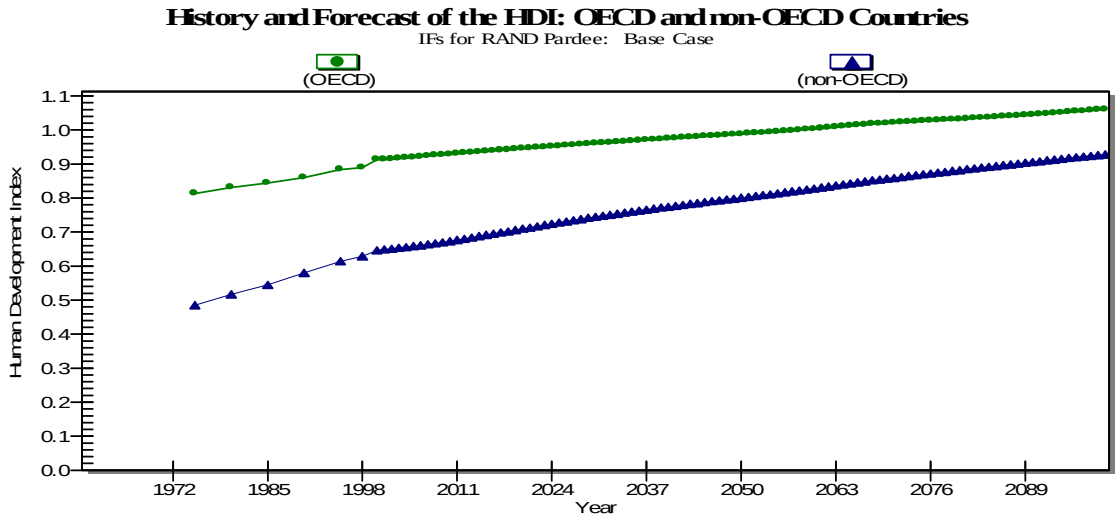

Figure 1. History and Forecast of the HDI: OECD and non-OECD

Figure 2 focuses on the non-OECD countries, showing a history and base-case forecast for four developing regions of the world. Note that the problem area, not surprisingly, is Sub-Saharan Africa. HDI growth in that region has already slowed down because of declines in life expectancy for citizens of some countries.

[5] There are small transients in 2000 as model computations begin to extend the historic series. These are introduced by the use within IFs of slightly different historic series for one or more of the underlying components of the HDI than those used by the UNDP. As this work proceeds, there should be an effort to reconcile those series as fully as possible.

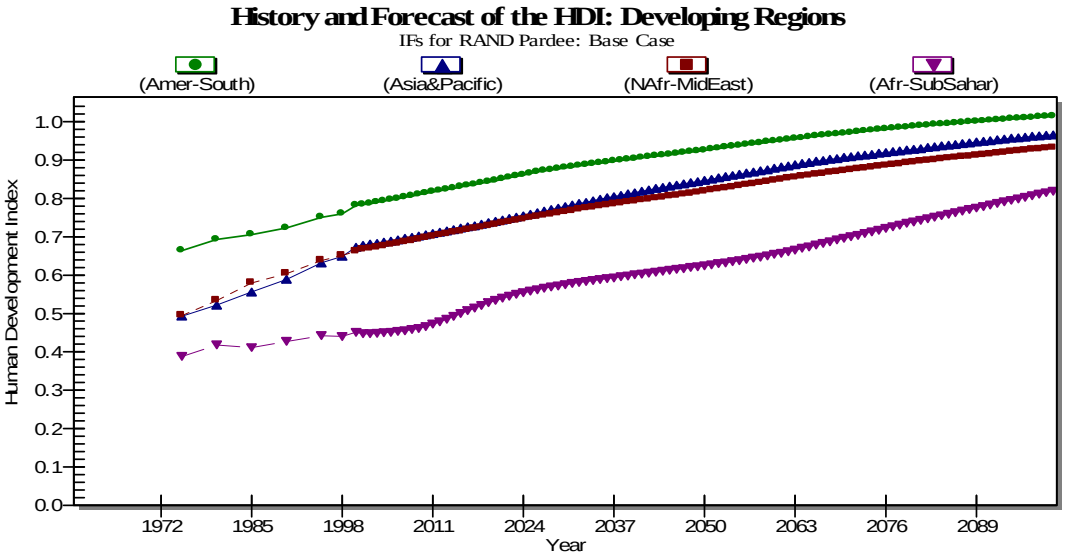

Figure 2. History and Forecast of the HDI: Developing Regions

Figures 3-5 provide more detail for Africa, Asia, and the Americas. Figure 3 shows that Southern Africa will likely exhibit a substantial decline in the HDI over the next decade.[6] Recovery thereafter depends on assumptions about success against HIV/AIDS to which Section 3 returns. But it is not only Southern Africa that faces very substantial challenges in the effort to advance human development. Except for Northern Africa (the countries of the Sahel), all African regions have experienced a highly uneven pattern of development in recent decades and that pattern appears unlikely to change dramatically. For additional information, please look below this and subsequent figures for numerical values of the HDI at decade intervals through mid-century.

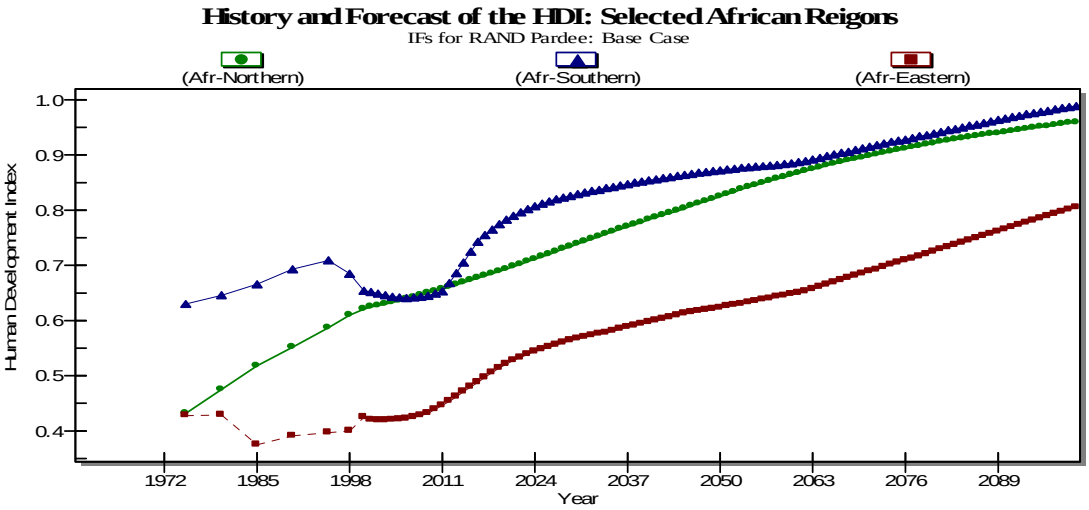

Figure 3. History and Forecast of the HDI: Selected African Regions

[6] Following Figure 3 and many subsequent figures is a table with numeric values for all African regions for selected years through 2040. The Appendix of this paper provides forecasts for all country members of each developing region, thereby also identifying region members.

	1980	1990	2000	2010	2020	2030	2040
Afr-Northern	0.475	0.552	0.621	0.653	0.693	0.739	0.783
Afr-Southern	0.645	0.693	0.654	0.649	0.783	0.829	0.854
Afr-Eastern	0.429	0.391	0.425	0.439	0.521	0.567	0.597
Afr-Middle	0.388	0.448	0.454	0.456	0.501	0.525	0.546
Afr-Western	0.362	0.398	0.439	0.473	0.53	0.579	0.608

Figure 4 shows one of the reasons, in addition to prevalence of HIV/AIDS, that advance of the HDI in developing regions may actually slow in coming years. East Asia includes China, where rapid growth in the last three decades has dramatically increased the level of HDI. Although the base case expects a continuation of rapid economic growth, literacy and life expectancy have reached levels where further advance is likely to be slower. The model calculates values of HDI for country groupings as a *population-weighted* sum of values in the member countries. Clearly, increasing saturation of HDI in China will greatly influence global patterns. Over time, the same saturation phenomenon is likely to characterize India (see the fast growth of the HDI in South-Central Asia), again with substantial impact on global patterns.

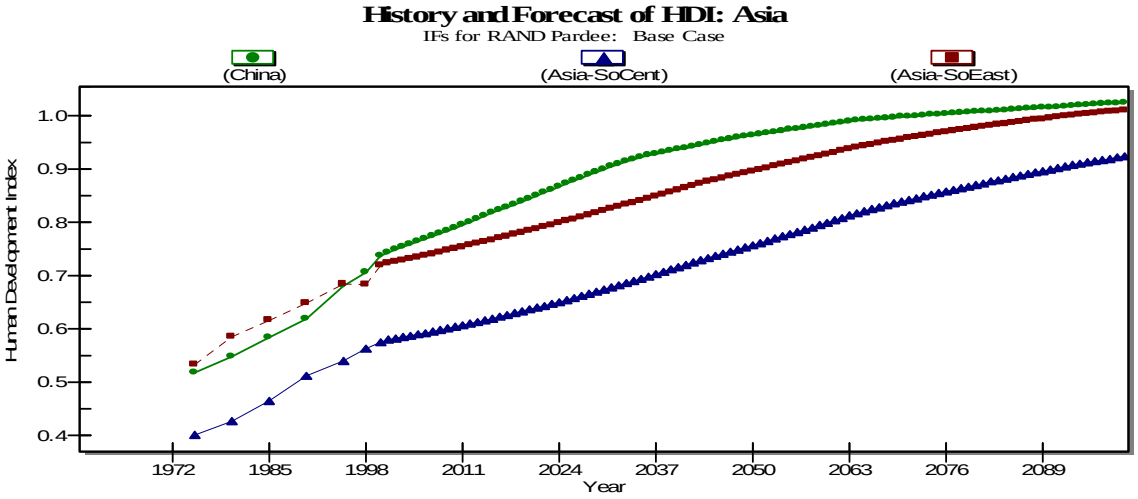

Figure 4. History and Forecast of the HDI: Selected Asian Regions

	1980	1990	2000	2010	2020	2030	2040
China	0.548	0.619	0.737	0.79	0.844	0.899	0.937
Asia-SoCent	0.427	0.512	0.575	0.604	0.636	0.674	0.716
Asia-SoEast	0.585	0.648	0.719	0.75	0.784	0.821	0.86
Asia-East	0.588	0.653	0.76	0.807	0.856	0.904	0.938
Asia-West	0.627	0.661	0.707	0.729	0.753	0.775	0.796

Figure 5 shows that, in the Americas, the sub-region of greatest concern is the Caribbean. Again, HIV/AIDS is one of the reasons, but a complex mixture of environmental degradation and socio-political disruptions have contributed.

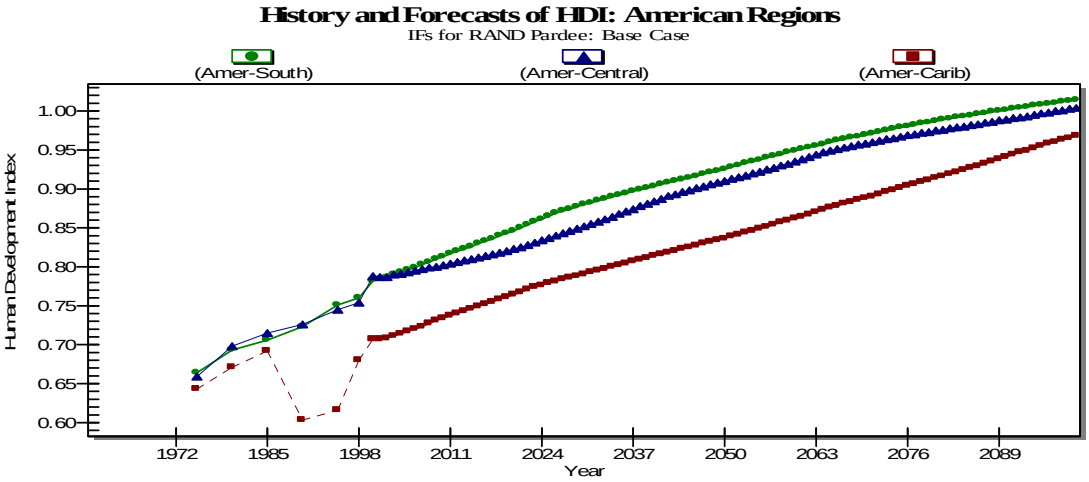

Figure 5. History and Forecast of the HDI: Selected American Regions

	1980	1990	2000	2010	2020	2030	2040
Amer-South	0.694	0.723	0.782	0.813	0.846	0.88	0.903
Amer-Central	0.698	0.726	0.788	0.802	0.823	0.852	0.884
Amer-Carib	0.671	0.603	0.707	0.734	0.764	0.79	0.814
Amer-North	0.882	0.911	0.948	0.96	0.974	0.987	0.997

3. Alternative Scenarios

There are, of course, an essentially infinite number of alternative scenarios that can affect forecasts of the HDI and of all aspects of human development.[7] Some scenarios, like an imminent reversal of the Gulf Stream (the North Atlantic thermal conveyer), are largely beyond human control. Others, like the failure of humanity to control the HIV/AIDS epidemic in the next two decades represent a possible mixture of factors, some of which are responsive to human action and some, like viral mutations, that are not. Still others, like a concerted effort to achieve the Millennium Development Goals (MDGs), can be highly responsive to human action. In this working paper we have selected only two scenarios for preliminary exploration. The first and pessimistic intervention into the base case is a large-scale failure to control HIV/AIDS. The second and optimistic intervention is a very substantial program to advance human development, something like those that have been proposed for the MDGs.

1. A Failure to Control HIV/AIDS

Figure 6 shows three extremely different scenarios concerning the unfolding of the HIV/AIDS epidemic. The base case of IFs follows the typical pattern of UN and other forecasts in showing that the epidemic peaks and begins to subside near the beginning of the next decade.[8] In addition to the base case forecast, the IFs system makes available other "packaged" scenarios. Three of these are scenarios for "intermediate" and "severe" HIV/AIDS epidemic futures, corresponding roughly to those that the U.S. National Intelligence Council developed and Nicholas Eberstadt described in *Foreign Affairs*,[9] as well as an HIV control failure scenario that extends the severe scenario to 2075 before beginning to reduce peak prevalence rates. The HIV/AIDS failure scenario is admittedly extreme. The purpose for such scenarios is to show how sensitive HDI might be to very different assumptions, framing the range of HDI with them.

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[7] A lash-up of the Computer Assisted Reasoning System (CARS) of the RAND Pardee Center with IFs for RAND Pardee has been completed, so as to facilitate intelligent searches for patterns and policy strategies across the complex space of alternatives. See Robert J. Lempert, Steven W. Popper, and Steven C. Bankes, *Shaping the Next One Hundred Years: New Methods for Quantitative, Long-Term Policy Analysis*. Santa Monica: RAND Corporation, 2003.

[8] The UN Population Division (2003), in *World Population Prospects: The 2002 Revision*, sets the peak prevalence at about 2010 and estimates a total of 278 million excess deaths by 2050. The Annex to that report identifies peak prevalence years and rates for many of the most severely affected countries. See http://www.un.org/esa/population/publications/wpp2002/wpp2002annextables.PDF. Using those years and rates, IFs calculates a total of about half as many excess deaths in its base case, and has left that lower number in place under the assumption that the intensified campaign against HIV and the increased availability of treatments will cut the UN forecast.

[9] See Nicholas Eberstadt. 2002. "The Future of AIDS: Grim Toll in Russia, China, and India," *Foreign Affairs* 81, no. 6 (November/December): 22-45.

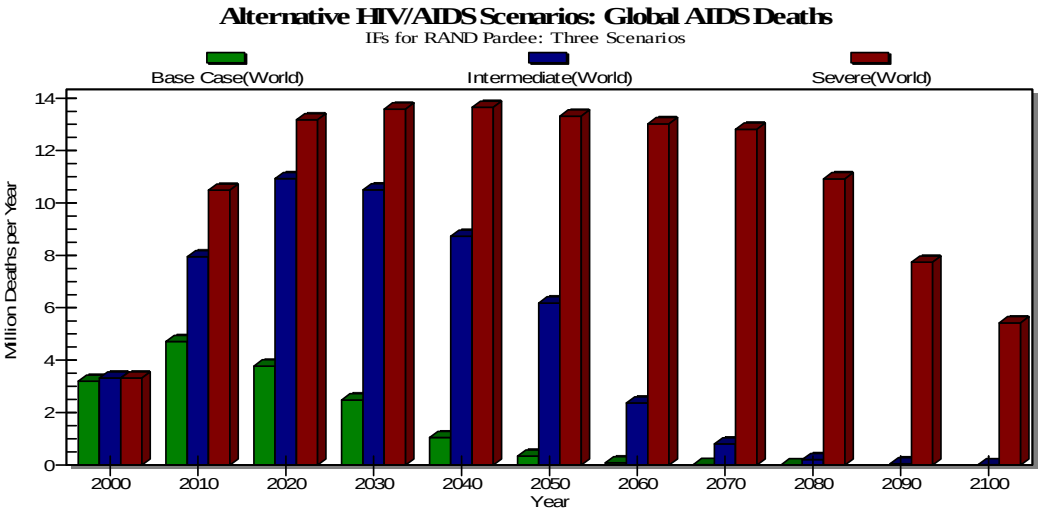

Figure 6. Alternative HIV/AIDS Scenario: Deaths in Failure to Control

Although many of the additional deaths from an HIV/AIDS failure scenario would be, according to Eberstadt, in Russia, China, and India, we continue our focus here primarily on Africa. Figure 7 can be contrasted with Figure 3.

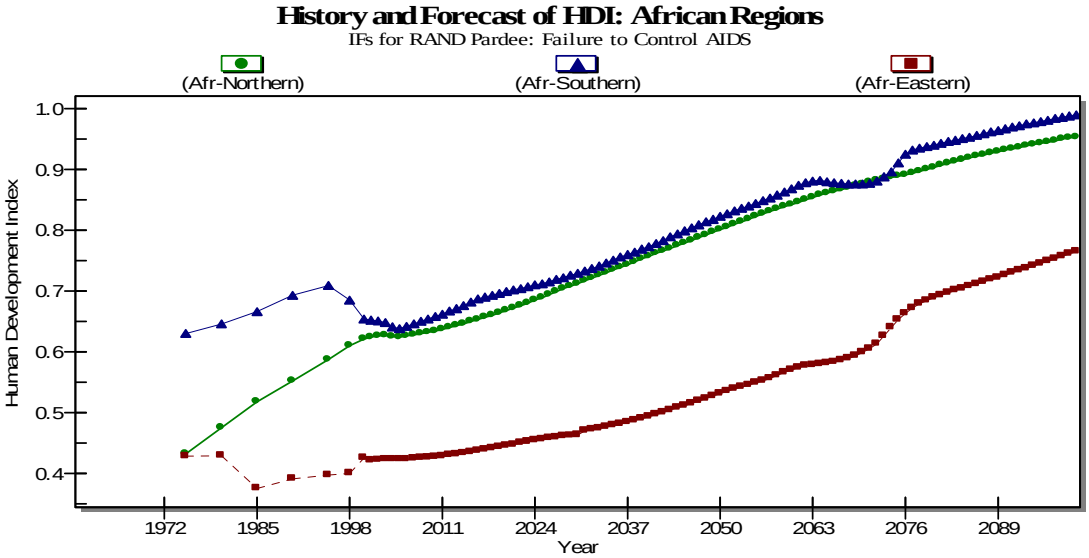

Figure 7. Alternative HIV/AIDS Scenario: African HDI in Failure to Control

	1980	1990	2000	2010	2020	2030	2040
Afr-Northern	0.475	0.552	0.621	0.634	0.668	0.712	0.757
Afr-Southern	0.645	0.693	0.654	0.658	0.699	0.729	0.773
Afr-Eastern	0.429	0.391	0.425	0.427	0.445	0.463	0.493
Afr-Middle	0.388	0.448	0.454	0.438	0.439	0.445	0.464
Afr-Western	0.362	0.398	0.439	0.454	0.485	0.514	0.541

A quick look at Figures 3 and 7 might not indicate the substantial impact of failure to control AIDS. Figure 8 corrects that impression by showing the very large population-weighted impact on all of Sub-Saharan Africa of the HIV/AIDS failure scenario. The HDI history of Africa over the last two decades has in essence, of course, traced the

beginning of the failure scenario. It is the base case that begins to deviate from that history in the next decade, under UN assumptions that the continent will pass peak prevalence rates, while the failure scenario simply continues the past pattern well into the century.

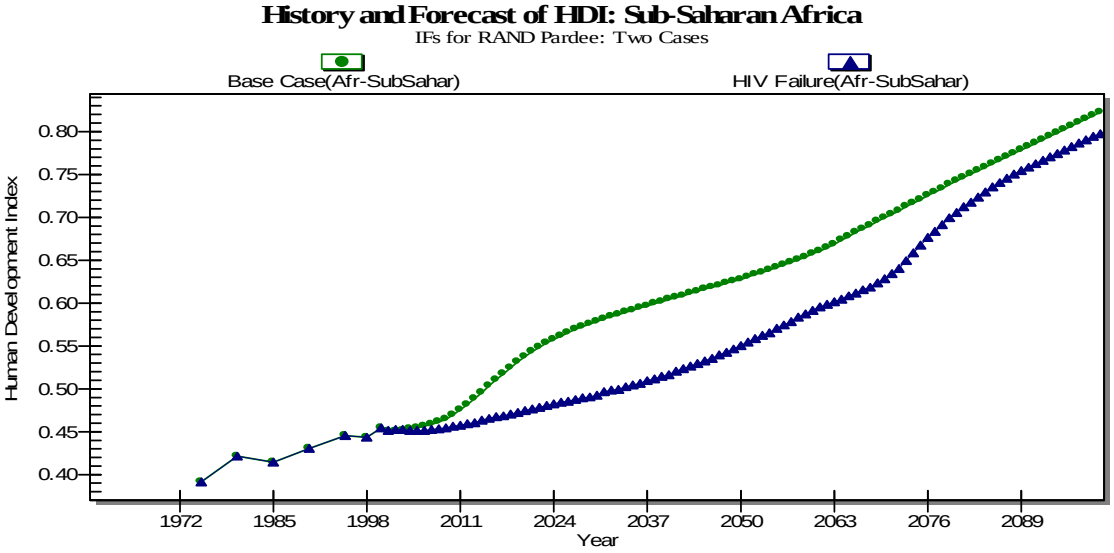

Figure 8. History and Forecast of HDI: Sub-Saharan Africa in Two Scenarios

SS-African HDI	1980	1990	2000	2010	2020	2030	2040
Base Case	0.418	0.427	0.451	0.466	0.534	0.575	0.601
HIV Failure	0.418	0.427	0.451	0.453	0.471	0.489	0.514

2. Sustainable Development Scenario

The International Futures system was used extensively over the last two years in the TERRA project, sponsored by the Information Society Directorate-General of the European Commission under the Fifth Framework for research funding. In the course of that work, a "sustainability scenario" was created that incorporates assumptions of wide-spread and substantial efforts to move humanity towards sustainability across human development, economic, and environmental dimensions. That scenario incorporates many of the initiatives that often appear in suggestions for increasing the likelihood of meeting the MDGs. For the purposes of this analysis, the sustainability scenario, which is also very heavily a human development scenario, was introduced into the IFs for RAND Pardee system. Many if not most of the elements of the scenario, such as increased emphasis by developing countries on health and education, positive connections to the world economy, and family planning, require self-help. But, as Figure 9 shows, the scenario also posits a sharp ramping up of Overseas Development Assistance (ODA) as a percentage of the GDPs of donor countries, in contrast to continued slow erosion of those levels in the base case.[10]

[10] An overview of the sustainability scenario can be found in Barry B. Hughes, "Defining and Pursuing a Multidimensional Sustainability Transformation," prepared for presentation at the Boston University

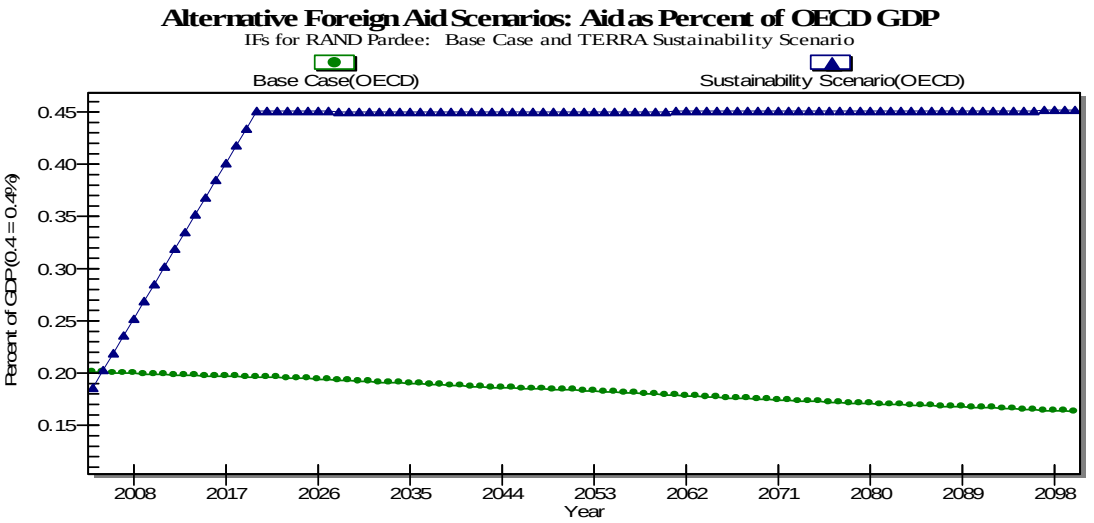

Figure 9. Alternative Foreign Aid Scenarios

Figure 10 shows the impact of the sustainability scenario on African sub-regions and should again be compared with Figures 3 and 7.

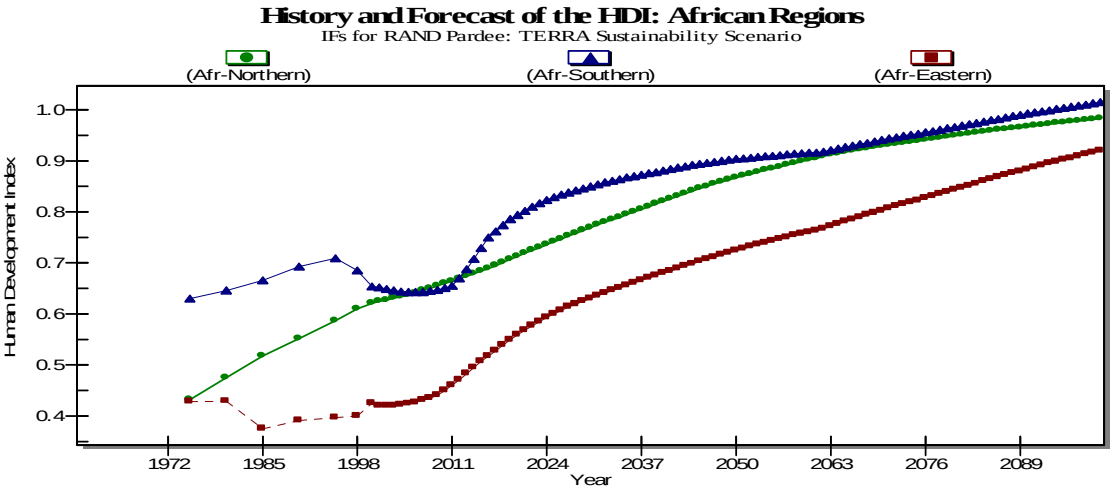

Figure 10. History and Forecast of the HDI: African Regions in Sustainability Scenario

Sustainability Scenario	1980	1990	2000	2010	2020	2030	2040
Afr-Northern	0.475	0.552	0.621	0.66	0.713	0.769	0.821
Afr-Southern	0.645	0.693	0.654	0.651	0.794	0.85	0.881
Afr-Eastern	0.429	0.391	0.425	0.45	0.559	0.63	0.68
Afr-Middle	0.388	0.448	0.454	0.467	0.53	0.576	0.619
Afr-Western	0.362	0.398	0.439	0.478	0.554	0.616	0.661

Pardee Center conference on Making the Great Transformation, November 13-14, 2003. Much greater detail is available in the TERRA project working paper on "Integrated Sustainability Analysis."

Figure 11 shows the full range of HDI forecasts for the three scenarios introduced in this paper. That range is obviously, and intentionally, quite broad. As indicated before, movement within that range is not fully susceptible to human decisions and action, but there is a large role for such action.

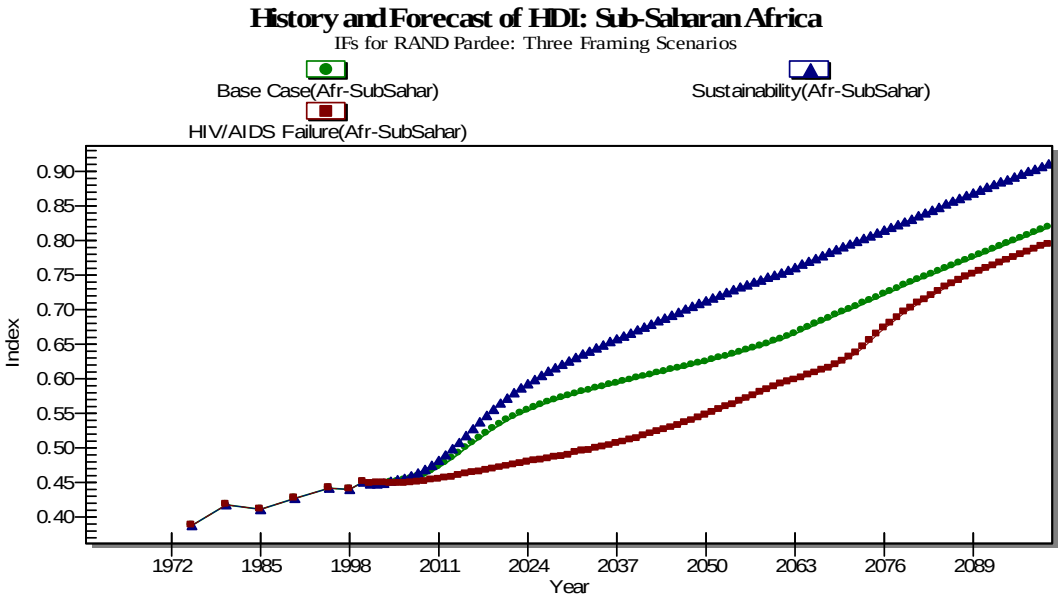

Figure 11. History and Forecast of HDI: Sub-Saharan Africa in Three Scenarios

SS African HDI	1980	1990	2000	2010	2020	2030	2040
HIV Failure	0.418	0.427	0.451	0.453	0.471	0.489	0.514
Base	0.418	0.427	0.451	0.466	0.534	0.575	0.601
Sustainability	0.418	0.427	0.451	0.475	0.565	0.626	0.671

4. Alternative HDI Calculations

The human development index was created at the beginning of the 1990s for analysis of data from that period. As the use of the index continues, and particularly should forecasting of it become more common, some limitations will become even more apparent than they have been. One of those limitations has been noted in the text above, namely the fully saturating character of literacy and enrolment ratio,[11] in contrast to the partially saturating character of life expectancy and the not necessarily-saturating character of GDP per capita (a logarithmic formulation makes it also partially saturating). That mixture makes interpretation of forecast graphs a bit more complicated.

A second limitation for use in longer-term forecasting is that the measure builds in maximums for each of its three sub-dimensions. The limitation of doing that is actually greater for the partially-saturating sub-dimensions of logged GDP per capita (at PPP) and for life expectancy than for the saturating dimension of literacy. Namely, over the coming century we would expect to see some countries exceed the maximum GDP per capita of $40,000 (PPP) and the maximum life expectancy of 85, both of which are built into the basic calculation. In the base case of IFs for RAND Pardee, for example, Finland does so by 2075. Figure 12 shows the implications of both saturation and the fixed limits by focusing on the HDI for the rich countries of the current European Union. The three scenarios that we have examined here, as different as they are, all lead to roughly comparable outcomes with HDI values that appear near or above the index's current "maximum" value of 1.

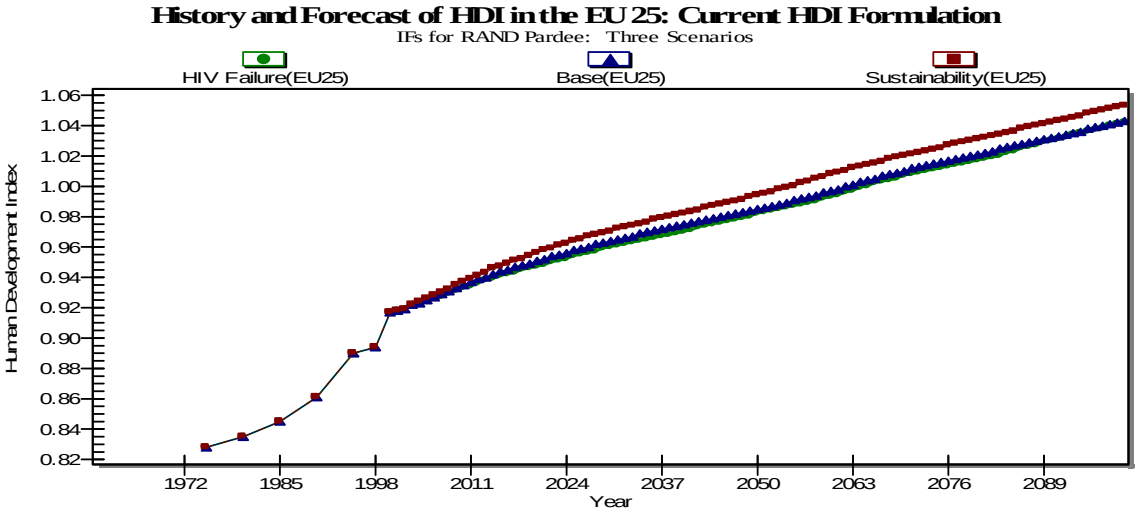

Figure 12. History and Forecast of the HDI in the European Union: Current Formulation of HDI

[11] The one place where the model's representation differs slightly from the formal HDI formulation is in the educational area. IFs for RAND Pardee is now using only a literacy level, not an enrollment ratio. The on-going development of the education module will correct this.

EU25: Current HDI	1980	1990	2000	2010	2020	2030	2040
HIV Failure	0.835	0.861	0.917	0.933	0.947	0.96	0.97
Base	0.835	0.861	0.917	0.935	0.951	0.964	0.975
Sustainability	0.835	0.861	0.917	0.937	0.956	0.97	0.982

Within IFs for RAND Pardee we have begun experimenting with variations on the traditional HDI that will facilitate longer-term forecasting. Figure 13 shows one of those, in which we have increased the maximums on GDP per capita to $100,000. Although we will want to rescale historic values in order to eliminate the transient as forecasting begins, even such a simple variation will allow us to reduce the saturation effect and to eliminate the apparent exceeding of "maximums."

One of the benefits of being able to use the computerized system for forecasting is the ability of introduce alternative formulations quite easily (even, as in Figure 13, via parameter changes). We may also want to experiment with a number of the more substantially altered formations that have been proposed over the years, including the Gini-weighted variation suggested by Amartya Sen.

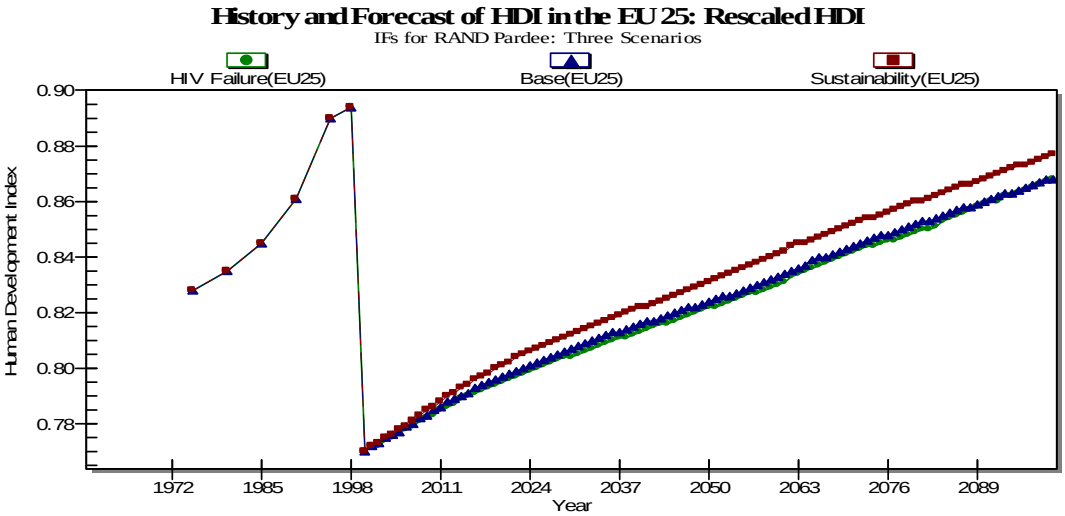

Figure 13. History and Forecast of HDI in the EU: Rescaled HDI Forecast

EU25: Rescaled HDI	1980	1990	2000	2010	2020	2030	2040
HIV Failure	0.835	0.861	0.77	0.783	0.795	0.805	0.813
Base Case	0.835	0.861	0.77	0.785	0.797	0.807	0.816
Sustainability	0.835	0.861	0.77	0.786	0.801	0.812	0.822

5. Additional Detail: Exploring Differences in Development Paths

In addition to being able to explore different scenarios and different formulations, one of the key advantages of using the IFs for RAND Pardee system is the ability to drill down into analysis areas of interest. In this section we demonstrate that very briefly. (The Appendix of this paper provides more detail on individual developing countries from around the world.) Figure 14 shows, once again, the history and base-case forecast of HDI for two subregions of Africa, focusing now on Southern and Northern Africa. The reader is encouraged to look at the tables below the figure, where values for the member countries in each grouping are broken out. Still, the figure itself shows the dramatic difference in patterns of development, with Northern Africa having come from far behind on the HDI measure and being likely to run more nearly parallel over coming decades.

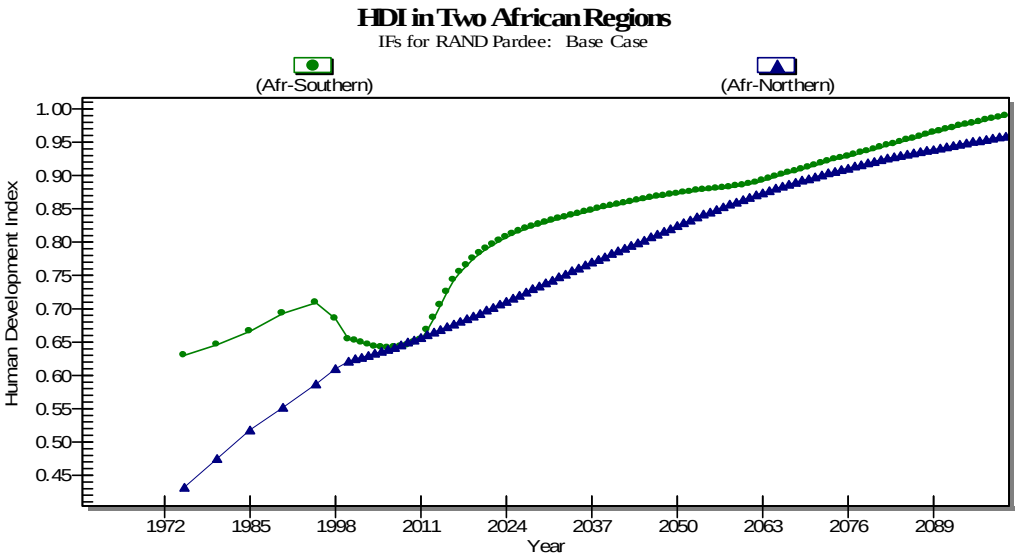

Figure 14. HDI in Two African Regions: Base Case

HDI Base Case	1980	1990	2000	2010	2020	2030
Botswana	0.554	0.651	0.574	0.556	0.722	0.79
Lesotho	0.506	0.561	0.563	0.503	0.655	0.68
Namibia	0.607	0.644	0.629	0.591	0.744	0.797
South Africa	0.659	0.705	0.664	0.666	0.798	0.845
Swaziland	0.536	0.613	0.595	0.515	0.681	0.697
Total Afr-Southern	0.645	0.693	0.654	0.649	0.783	0.829
Algeria	0.556	0.642	0.697	0.734	0.779	0.82
Egypt	0.478	0.57	0.622	0.648	0.675	0.717
Libya	0	0	0.757	0.774	0.795	0.821
Morocco	0.47	0.537	0.596	0.615	0.635	0.665
Sudan	0.368	0.406	0.511	0.568	0.651	0.723
Tunisia	0.563	0.642	0.728	0.768	0.807	0.853
Total Afr-Northern	0.475	0.552	0.621	0.653	0.693	0.739

Figure 15 breaks out one of the sub-dimensions for the HDI, namely life expectancy. Again, the tables following it provide detail for the members of the African groupings.

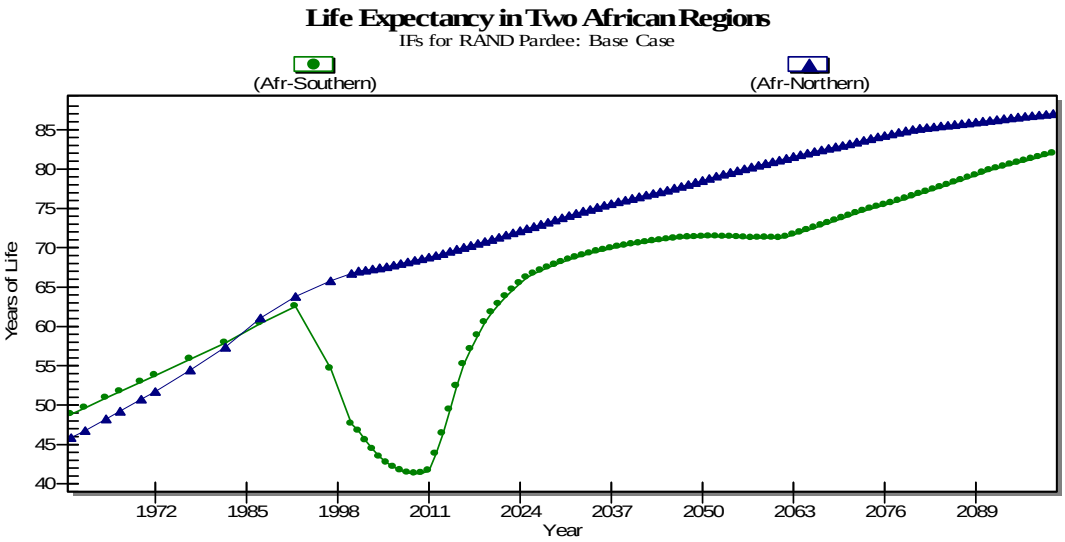

Figure 15. Life Expectancy in Two African Regions: Base Case

Life Expectancy	2000	2010	2020	2030	2040	2050
Botswana	38.97	33.92	62.08	70.48	71.05	70.26
Lesotho	43.96	35.82	67.72	72.95	71.21	69.5
Namibia	47.15	38.06	63.65	70.18	70.83	70.46
South Africa	47.81	41.82	60.65	66.97	69.68	71.07
Swaziland	45.62	36.58	71.54	76.49	76	73.97
Total Afr-Southern	47.28	41.02	61.43	67.81	70.06	71.02
Algeria	71.04	73.42	75.61	77.42	79.49	81.3
Egypt	67.46	69.34	71.18	74.01	76.54	79.28
Libya	71.03	71.88	73.35	75.11	76.36	77.78
Morocco	67.47	69.41	70.88	72.93	75.17	76.69
Sudan	56.17	57.89	63.33	67.79	71.14	73.92
Tunisia	72.1	74.21	76.16	78.76	80.83	82.35
Total Afr-Northern	66.4	68.25	70.71	73.45	75.91	78.2

Figure 16 breaks out a second dimension, GDP per capita at PPP. The growth of GDP per capita in that figure may appear surprisingly large. Yet the compound rates for the entire century are only 1.74% and 2.36%, respectively for Southern and Northern Africa. The rates in the next two decades are even slower and are below those forecast by the World Bank in its *Global Economic Prospects 2004*.[12]

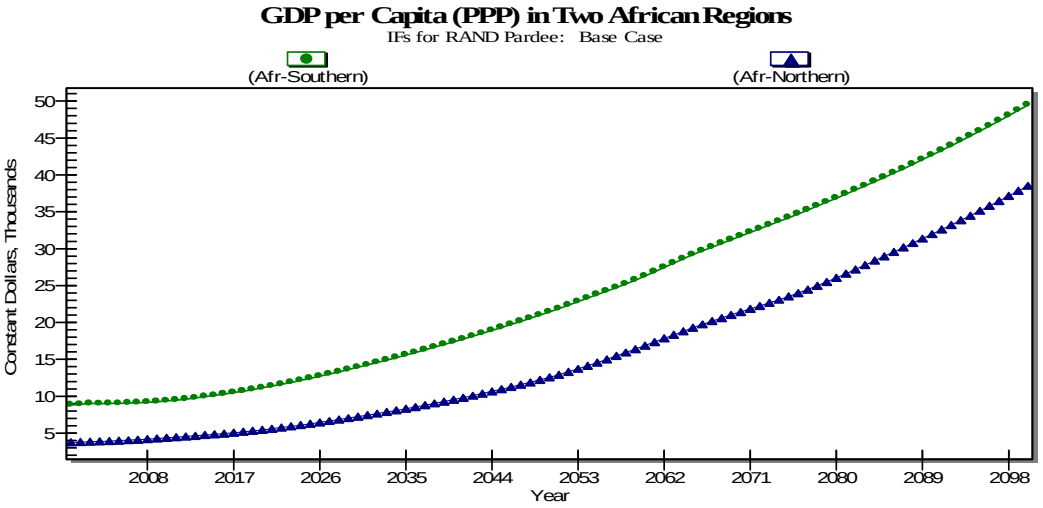

Figure 16. GDP per Capita in Two African Regions: Base Case

GDP per Capita (PPP)	2000	2010	2020	2030	2040	2050
Botswana	7.345	8.747	10.32	13.55	17.9	21.87
Lesotho	2.544	2.622	2.701	3.262	3.827	4.578
Namibia	6.579	7.075	8.158	9.86	12.24	15.32
South Africa	9.378	9.95	11.96	15.05	18.84	23.28
Swaziland	4.771	4.72	5.036	5.844	7.171	9.04
Total Afr-Southern	8.827	9.363	11.14	13.92	17.37	21.42
Algeria	5.144	5.878	7.619	10.08	12.78	16.12
Egypt	3.77	4.383	5.33	7.203	9.833	13.44
Libya	6.746	7.157	8.084	9.829	11.49	13.38
Morocco	3.484	4.081	4.965	6.243	7.865	9.808
Sudan	1.346	1.696	2.413	3.608	5.353	7.825
Tunisia	6.221	7.935	10.21	13.56	17.59	21.96
Total Afr-Northern	3.753	4.368	5.451	7.233	9.539	12.57

[12] World Bank. 2003. *Global Economic Prospects 2004*. Washington, D.C.: World Bank. See http://www.worldbank.org/prospects/gep2004/; January 22, 2004. For a more extensive comparison of the IFs base case with other forecasts see Barry Hughes, "Base Case of International Futures (IFs): Comparison with Other Forecasts," manuscript (February 2004).

Figure 17 breaks out the third dimension, literacy rate. The pattern shown in this figure, of rise and then slight decline for South Africa, does not appear probable. It is a function of the still developing education submodel within IFs. With further development we would expect a steadier pattern of change to appear in South Africa. The pattern for Northern Africa, of steady change with saturation, appears more likely.

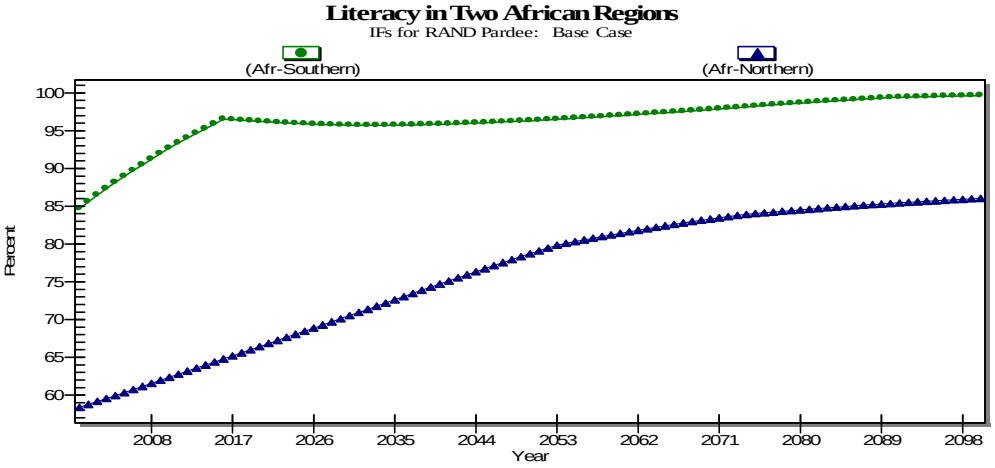

Figure 17. Literacy Rate in Two African Regions: Base Case

Literacy: Base	2000	2010	2020	2030	2040	2050
Botswana	77.24	77.38	77.51	79.39	82.74	86.83
Lesotho	83.36	78.37	70.23	65.98	69.29	73.45
Namibia	81.98	84.4	85.25	87.17	89.37	92.37
South Africa	85.26	94.98	100	100	100	100
Swaziland	79.63	71	61.38	55.31	53.19	54.95
Total Afr-Southern	84.67	92.69	96.23	95.73	95.85	96.32
Algeria	66.7	71.57	76.9	81.72	86.44	91.35
Egypt	55.32	57.43	59.26	62	65.35	67.92
Libya	80	82.79	84.51	86.14	88.08	90.12
Morocco	48.87	48.58	48.97	50.5	52.88	55.9
Sudan	57.81	68.27	78.31	85.8	91.69	97.99
Tunisia	71.02	75.5	79.63	84.48	89.7	94.09
Total Afr-Northern	58.39	62.37	66.42	70.53	74.7	78.72

6. Conclusions and Possible Scenario Analyses

The Human Development Index has proven a wonderful measure for summarizing the state of development around the world. As it has been calculated over longer periods of time, it has increasingly also proven itself a powerful tool for portraying the dynamics of development in the human condition. It is therefore perhaps inevitable that the HDI be used increasingly for thinking about the future. Extrapolation of the HDI alone can be useful, for instance, in helping us understand whether goals like the MDGs are likely to be met in the longer term within those countries not meeting them by 2015.

In an analysis system that is sensitive to changed assumptions about environmental context and human action, however, and that further allows flexibility with respect to measure formulation and drill-down into the details of the sub-indices, the HDI will be even more powerful. Within IFs for RAND Pardee, we have already seen in this exploratory paper that the HDI is sensitive to changes in assumptions about the unfolding of the AIDS epidemic (including a much more pessimistic scenario than that of the base case) and sensitive to the TERRA Project's scenario for a more sustainable future (a considerably more optimistic scenario than that of the base case). A wide range of scenarios is, of course, possible, including those built around single changes in assumptions and those built around integrated framing scenarios.

With respect to single assumptions or interventions, it would be useful to explore such government policies as levels of education spending, extent of transfer payments, and degree of export promotion. Similarly, it would be useful to consider the implications for HDI development of variables such as different levels of economic liberalization/freedom and of different family planning program intensity. As noted earlier, the integration of IFs for RAND Pardee within the Computer Assisted Reasoning System (CARS) of the RAND Pardee Center provides an opportunity for strategic search across assumptions and interventions for policy packages that could accelerate increases in levels of HDI.

With respect to larger patterns of intervention through integrated scenarios, such scenarios have emerged in various projects, including those of the Global Scenario Group (GSG).[13] The scenario creation capability of IFs allows such integrated scenarios to be built up from individual elements (as was done in this paper).

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[13]See, for example, Paul Raskin, et al. 2002. *Great Transition: The Promise and Lure of the Times Ahead*. Boston: Stockholm Environment Institute. See http://www.tellus.org/seib/publications/Great_Transitions.pdf; February 15, 2004

The purpose of this paper has been to begin the process of longer-term, analytically-based forecasting using the HDI. The process will continue.

7. Appendix: More Extensive HDI Tables for Base Case

	2000	2010	2020	2030	2040	2050	2060	2070	2080	2090	2100
Burundi	0.353	0.393	0.462	0.489	0.494	0.501	0.54	0.604	0.686	0.761	0.818
Djibouti	0.505	0.496	0.508	0.525	0.539	0.54	0.543	0.578	0.612	0.657	0.715
Eritrea	0.452	0.482	0.495	0.508	0.519	0.525	0.535	0.558	0.582	0.623	0.661
Ethiopia	0.333	0.34	0.411	0.456	0.491	0.524	0.559	0.601	0.64	0.681	0.725
Kenya	0.527	0.504	0.617	0.651	0.662	0.672	0.688	0.73	0.77	0.797	0.828
Madagascar	0.505	0.523	0.536	0.557	0.59	0.631	0.683	0.735	0.793	0.849	0.884
Mauritania	0.439	0.466	0.484	0.507	0.53	0.555	0.578	0.601	0.623	0.652	0.682
Mozambique	0.362	0.356	0.488	0.557	0.617	0.67	0.707	0.754	0.803	0.852	0.897
Rwanda	0.431	0.486	0.577	0.626	0.657	0.684	0.704	0.741	0.774	0.807	0.839
Somalia	0.357	0.373	0.39	0.4	0.417	0.441	0.473	0.517	0.571	0.639	0.708
Tanzania	0.452	0.468	0.537	0.581	0.632	0.675	0.7	0.737	0.775	0.813	0.853
Uganda	0.46	0.548	0.659	0.765	0.829	0.882	0.913	0.938	0.961	0.98	0.997
Zambia	0.446	0.454	0.58	0.605	0.597	0.584	0.559	0.583	0.626	0.667	0.712
Zimbabwe	0.561	0.541	0.708	0.778	0.798	0.807	0.805	0.831	0.86	0.883	0.911
Total Afr-Eastern	0.425	0.439	0.521	0.567	0.597	0.623	0.648	0.685	0.724	0.765	0.805
Angola	0.441	0.443	0.473	0.513	0.532	0.548	0.567	0.603	0.642	0.681	0.719
Cameroon	0.546	0.523	0.625	0.683	0.718	0.751	0.79	0.826	0.864	0.896	0.929
Central AfR	0.398	0.377	0.46	0.49	0.51	0.536	0.564	0.613	0.667	0.722	0.781
Chad	0.393	0.403	0.446	0.477	0.507	0.543	0.583	0.631	0.682	0.735	0.786
Congo	0.513	0.548	0.572	0.587	0.617	0.653	0.7	0.753	0.807	0.853	0.882
Gabon	0.636	0.649	0.691	0.715	0.751	0.787	0.827	0.873	0.913	0.947	0.978
Zaire	0.436	0.444	0.479	0.492	0.511	0.544	0.602	0.674	0.738	0.796	0.849
Total Afr-Middle	0.454	0.456	0.501	0.525	0.546	0.576	0.622	0.681	0.737	0.789	0.837
Algeria	0.697	0.734	0.779	0.82	0.861	0.9	0.938	0.973	0.994	1.005	1.017
Egypt	0.622	0.648	0.675	0.717	0.759	0.801	0.839	0.869	0.9	0.92	0.937
Libya	0.757	0.774	0.795	0.821	0.843	0.866	0.899	0.93	0.959	0.985	1.001
Morocco	0.596	0.615	0.635	0.665	0.698	0.729	0.768	0.802	0.829	0.854	0.878
Sudan	0.511	0.568	0.651	0.723	0.783	0.841	0.884	0.915	0.939	0.963	0.984
Tunisia	0.728	0.768	0.807	0.853	0.897	0.932	0.964	0.989	0.999	1.008	1.018
Total Afr-Northern	0.621	0.653	0.693	0.739	0.783	0.825	0.864	0.895	0.921	0.941	0.959

	2000	2010	2020	2030	2040	2050	2060	2070	2080	2090	2100
Botswana	0.574	0.556	0.722	0.79	0.82	0.841	0.846	0.881	0.918	0.943	0.968
Lesotho	0.563	0.503	0.655	0.68	0.69	0.705	0.706	0.746	0.802	0.858	0.887
Namibia	0.629	0.591	0.744	0.797	0.82	0.84	0.859	0.89	0.919	0.939	0.96
South Africa	0.664	0.666	0.798	0.845	0.873	0.892	0.906	0.931	0.954	0.979	1
Swaziland	0.595	0.515	0.681	0.697	0.698	0.706	0.713	0.758	0.814	0.868	0.921
Total Afr-Southern	0.654	0.649	0.783	0.829	0.854	0.872	0.885	0.912	0.939	0.966	0.989
Benin	0.408	0.439	0.502	0.55	0.598	0.647	0.695	0.744	0.786	0.826	0.861
Burkina Faso	0.317	0.325	0.388	0.426	0.459	0.496	0.534	0.578	0.617	0.66	0.698
Cote Ivoire	0.424	0.422	0.423	0.505	0.549	0.583	0.623	0.679	0.737	0.784	0.828
Gambia	0.436	0.454	0.474	0.493	0.527	0.555	0.585	0.628	0.661	0.699	0.731
Ghana	0.582	0.617	0.664	0.702	0.738	0.771	0.806	0.842	0.874	0.9	0.927
Guinea	0.488	0.499	0.538	0.58	0.627	0.68	0.737	0.793	0.838	0.882	0.923
GuineaBiss	0.348	0.394	0.427	0.452	0.474	0.501	0.534	0.595	0.675	0.749	0.826
Liberia	0.426	0.384	0.388	0.395	0.401	0.431	0.499	0.575	0.648	0.718	0.781
Mali	0.354	0.506	0.609	0.642	0.681	0.721	0.761	0.802	0.84	0.875	0.905
Mauritania	0.439	0.466	0.484	0.507	0.53	0.555	0.578	0.601	0.623	0.652	0.682
Niger	0.28	0.311	0.336	0.363	0.389	0.433	0.487	0.54	0.593	0.637	0.685
Nigeria	0.451	0.488	0.562	0.619	0.645	0.663	0.693	0.735	0.779	0.811	0.844
Senegal	0.427	0.475	0.512	0.556	0.595	0.637	0.68	0.725	0.77	0.812	0.854
Togo	0.474	0.463	0.509	0.538	0.562	0.592	0.627	0.675	0.724	0.778	0.833
Total Afr-Western	0.439	0.473	0.53	0.579	0.608	0.633	0.667	0.711	0.755	0.791	0.827
Cuba	0.771	0.784	0.803	0.825	0.844	0.863	0.887	0.908	0.931	0.951	0.971
DominicanRep	0.74	0.792	0.851	0.904	0.941	0.965	0.982	0.996	1.01	1.022	1.035
Haiti	0.475	0.516	0.562	0.593	0.626	0.666	0.708	0.755	0.8	0.848	0.896
Jamaica	0.768	0.786	0.813	0.848	0.881	0.902	0.922	0.943	0.961	0.979	0.997
Puerto Rico	0.857	0.891	0.911	0.93	0.946	0.962	0.981	0.994	1.004	1.013	1.023
Trinidad	0.825	0.873	0.895	0.921	0.939	0.953	0.971	0.993	1.009	1.024	1.039
Total Amer-Carib	0.707	0.734	0.764	0.79	0.814	0.836	0.862	0.888	0.913	0.941	0.968
Belize	0.809	0.829	0.855	0.894	0.918	0.937	0.957	0.976	0.991	1.002	1.013
Costa Rica	0.857	0.889	0.911	0.941	0.966	0.984	0.999	1.01	1.021	1.032	1.042
El Salvador	0.725	0.751	0.782	0.828	0.877	0.929	0.958	0.985	1.002	1.014	1.026
Guatemala	0.655	0.677	0.702	0.74	0.794	0.854	0.913	0.958	0.99	1.006	1.02

	2000	2010	2020	2030	2040	2050	2060	2070	2080	2090	2100
Honduras	0.654	0.663	0.678	0.71	0.738	0.773	0.806	0.843	0.884	0.919	0.951
Mexico	0.822	0.837	0.862	0.894	0.927	0.949	0.97	0.991	1.003	1.015	1.029
Nicaragua	0.636	0.633	0.636	0.645	0.649	0.655	0.663	0.674	0.687	0.703	0.721
Panama	0.808	0.819	0.835	0.867	0.896	0.923	0.949	0.968	0.984	0.998	1.009
Total Amer-Central	0.788	0.802	0.823	0.852	0.884	0.91	0.935	0.958	0.975	0.989	1.004
Argentina	0.862	0.885	0.911	0.94	0.968	0.982	0.994	1.006	1.017	1.028	1.038
Bolivia	0.671	0.693	0.709	0.737	0.768	0.796	0.832	0.874	0.897	0.919	0.942
Brazil	0.763	0.803	0.842	0.879	0.9	0.921	0.944	0.964	0.98	0.994	1.006
Chile	0.853	0.885	0.928	0.97	0.992	1.002	1.011	1.021	1.03	1.039	1.049
Columbia	0.791	0.816	0.85	0.878	0.903	0.926	0.95	0.971	0.991	1.003	1.014
Ecuador	0.742	0.767	0.796	0.831	0.856	0.885	0.916	0.945	0.97	0.993	1.01
French Guia	0.613	0.621	0.619	0.635	0.661	0.698	0.736	0.776	0.813	0.847	0.882
Guyana	0.739	0.752	0.791	0.824	0.847	0.868	0.888	0.909	0.933	0.951	0.97
Paraguay	0.775	0.786	0.794	0.813	0.844	0.877	0.908	0.937	0.962	0.985	1.003
Peru	0.761	0.78	0.805	0.838	0.873	0.911	0.942	0.965	0.985	1.001	1.013
Suriname	0.687	0.712	0.745	0.783	0.812	0.843	0.877	0.908	0.939	0.967	0.988
Uruguay	0.851	0.877	0.9	0.926	0.945	0.965	0.985	0.997	1.008	1.018	1.029
Venezuela	0.804	0.839	0.869	0.897	0.916	0.938	0.967	0.996	1.016	1.033	1.045
Total Amer-South	0.782	0.813	0.846	0.88	0.903	0.925	0.949	0.969	0.987	1.001	1.014
China	0.737	0.789	0.844	0.899	0.937	0.963	0.983	0.998	1.007	1.015	1.024
Mongolia	0.721	0.746	0.755	0.767	0.774	0.785	0.798	0.813	0.828	0.842	0.858
North Korea	0.496	0.537	0.569	0.589	0.617	0.652	0.692	0.737	0.777	0.818	0.854
Total Asia-East	0.733	0.785	0.84	0.894	0.931	0.957	0.978	0.993	1.003	1.012	1.021
Afghanistan	0.504	0.553	0.613	0.669	0.723	0.766	0.805	0.846	0.879	0.911	0.943
Bangladesh	0.496	0.534	0.571	0.619	0.666	0.714	0.765	0.814	0.853	0.887	0.914
Bhutan	0.569	0.575	0.584	0.609	0.641	0.677	0.718	0.757	0.794	0.829	0.861
India	0.576	0.603	0.636	0.676	0.724	0.769	0.814	0.854	0.884	0.912	0.934
Iran	0.727	0.8	0.867	0.915	0.938	0.953	0.974	0.99	1.001	1.014	1.027
Kazakhstan	0.71	0.761	0.808	0.843	0.873	0.901	0.935	0.969	0.995	1.014	1.033
Kyrgyz	0.637	0.665	0.695	0.722	0.745	0.769	0.796	0.82	0.842	0.865	0.89
Nepal	0.474	0.499	0.529	0.568	0.617	0.666	0.715	0.762	0.802	0.835	0.865
Pakistan	0.522	0.548	0.566	0.589	0.619	0.655	0.7	0.744	0.786	0.82	0.851
Sri Lanka	0.771	0.802	0.839	0.877	0.906	0.935	0.966	0.991	1.008	1.02	1.03

	2000	2010	2020	2030	2040	2050	2060	2070	2080	2090	2100
Tajikistan	0.706	0.75	0.757	0.776	0.798	0.811	0.836	0.861	0.885	0.91	0.929
Turkmenistan	0.68	0.738	0.789	0.813	0.829	0.85	0.878	0.914	0.945	0.974	0.996
Uzbekistan	0.757	0.776	0.794	0.803	0.804	0.812	0.826	0.85	0.875	0.899	0.925
Total Asia-SoCent	0.575	0.604	0.636	0.674	0.716	0.757	0.799	0.839	0.87	0.899	0.924
Cambodia	0.535	0.562	0.614	0.669	0.728	0.795	0.86	0.915	0.953	0.98	0.998
Indonesia	0.705	0.733	0.768	0.805	0.847	0.88	0.914	0.944	0.968	0.991	1.006
Laos	0.475	0.518	0.566	0.626	0.69	0.747	0.797	0.837	0.872	0.902	0.924
Malaysia	0.803	0.854	0.912	0.953	0.98	0.993	1.004	1.015	1.025	1.034	1.045
Myanmar	0.607	0.633	0.656	0.7	0.741	0.785	0.823	0.856	0.885	0.913	0.938
Philippines	0.773	0.78	0.795	0.821	0.848	0.884	0.921	0.956	0.983	0.998	1.01
Singapore	0.909	0.959	0.976	0.988	0.999	1.008	1.019	1.03	1.04	1.05	1.061
Thailand	0.794	0.832	0.869	0.896	0.925	0.948	0.973	0.991	1.007	1.021	1.036
Vietnam	0.725	0.779	0.825	0.876	0.924	0.965	0.988	1.009	1.018	1.028	1.038
Total Asia-SoEast	0.719	0.75	0.784	0.821	0.86	0.895	0.927	0.955	0.977	0.995	1.01
Armenia	0.78	0.793	0.804	0.818	0.836	0.853	0.873	0.897	0.917	0.936	0.954
Azerbaijan	0.669	0.697	0.721	0.733	0.749	0.774	0.808	0.845	0.883	0.919	0.953
Cyprus	0.911	0.942	0.959	0.973	0.983	0.992	1	1.012	1.022	1.03	1.04
Georgia	0.664	0.692	0.717	0.743	0.773	0.803	0.833	0.866	0.897	0.931	0.96
Iraq	0.57	0.595	0.624	0.65	0.683	0.705	0.734	0.75	0.775	0.799	0.83
Israel	0.906	0.937	0.955	0.973	0.983	0.992	1	1.008	1.017	1.025	1.032
Jordan	0.765	0.785	0.8	0.833	0.865	0.896	0.916	0.933	0.947	0.959	0.972
Kuwait	0.837	0.865	0.912	0.945	0.964	0.978	0.986	0.996	1.007	1.017	1.028
Lebanon	0.753	0.795	0.848	0.906	0.939	0.963	0.982	0.992	1.001	1.009	1.016
Oman	0.771	0.78	0.784	0.794	0.806	0.826	0.849	0.879	0.9	0.919	0.937
Palestine	0.676	0.682	0.691	0.692	0.717	0.757	0.795	0.831	0.851	0.859	0.867
Qatar	0.85	0.885	0.913	0.926	0.936	0.939	0.947	0.958	0.969	0.98	0.993
Saudi Arabia	0.781	0.786	0.812	0.84	0.861	0.879	0.901	0.919	0.937	0.955	0.973
Syria	0.691	0.723	0.761	0.795	0.826	0.854	0.893	0.931	0.962	0.983	1.003
Turkey	0.77	0.798	0.829	0.859	0.89	0.925	0.955	0.979	0.994	1.008	1.022
UAE	0.828	0.856	0.882	0.905	0.921	0.932	0.944	0.959	0.97	0.984	0.997
Yemen	0.445	0.485	0.521	0.543	0.566	0.6	0.632	0.676	0.714	0.756	0.793
Total Asia-West	0.707	0.729	0.753	0.775	0.796	0.819	0.843	0.867	0.888	0.908	0.929