



## **Scenario Analysis with International Futures (IFs)**

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## Table of Contents

1.	Introduction: Scenario and Policy Analysis.....	4
2.	Demography.....	10
2.1	The Pressures of Growth and Youth.....	10
2.2	The Pressure of HIV/AIDS.....	13
2.3	The Pressures of Aging and Decline.....	15
2.4	The Benefits of Demographic Dividend.....	19
2.5	The Pressures of Movement.....	20
3.	Economics.....	23
3.1	The Pressures of Poverty and Slow Growth.....	23
3.2	The Pressures of Unequal Condition, Local and Global.....	25
3.3	The Pressures of Fast Growth (and Possible Reversal).....	29
3.4	The Pressures of Interconnected Growth.....	31
4.	Socio-Political Systems.....	37
4.1	The Pressures of Value Change and Identity:.....	37
4.2	The Pressures of Human Condition.....	45
4.3	The Pressures of Institutional Change.....	51
4.4	The Weight of Bad Governance.....	57
4.5	International Relations: The Pressure of Growing Power upon Global Roles.....	58
4.6	International Relations: The Pressure of Shrinking Power Capabilities.....	59
5.	Biological and Physical Environmental Systems.....	61
5.1	The Pressure of Fossil Oil Demand and of Growing Supply Concentration....	61
5.2	The Pressure of Demand on Water Resources.....	65
5.3	The Pressure of Humans on Forest Area.....	67
5.4	The Pressure of Carbon Emissions.....	69
6.	Considering Uncertainty Explicitly.....	71
6.1	Scenario Typology in IFs.....	71
6.2	Scenario Development Tools in IFs.....	71
6.3	Drawing on Other Scenario Analysis Efforts.....	77
6.4	Key Global Uncertainties in Various Scenario-Building Efforts.....	82
6.	Conclusion.....	85
	Bibliography.....	86

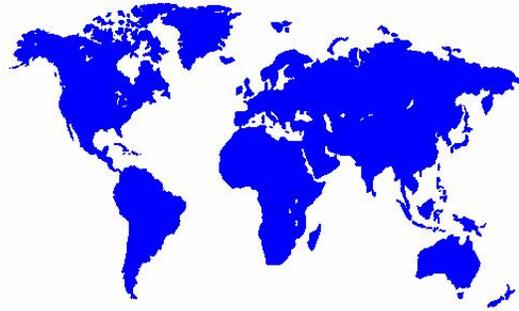
## **Abstract**

This paper provides an introduction to using the International Futures (IFs) modeling system for analysis. It is meant primarily to be a companion piece to a paper describing the base case of IFs in comparison with other forecasts, incorporating some portions of that paper, but building on it.

The intent here is to explain how scenario and policy analysis with IFs can build on and beyond the base case. Scenario analysis often usefully begins with a base case that suggests generally how the future appears to be unfolding. Relatively detailed examination of the base case, going beyond the key aggregate variables often considered, can be the first step to identifying how important curves might be bending and/or pressures for change might be building.

Moving more definitively beyond the base case, scenarios can provide coherent alternative stories of how the future might unfold. There are, however, many alternative understandings of what scenarios are and different ways of creating them. This paper describes how IFs facilitates a “building block” approach to scenario construction, beginning with general framing assumptions and adding elements that outline alternative general patterns of aggregate global, regional or country behavior, adding various more specific actions by key agent-classes, and/or adding a variety of wild cards or surprises.

When modeling tools and scenarios begin to move to the level of agent-class behavior, they begin to also add the capability of undertaking policy analysis — explorations of how strategies of interventions might help achieve important goals. This paper therefore also wraps a discussion of policy analysis around the discussion of scenario analysis.



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Welcome to International Futures (IFs)  
Full Country Set for NIC

Load and Continue

## 1. Introduction: Scenario and Policy Analysis

Because all human action (including inaction) depends on forecasts, it is important to understand how to create forecasts and use them effectively. This paper presents a framework for effective use of forecasts in decision and policy analysis that involves five primary sets of activities:

- Identify values and goals
- Build and use models about how things work
- Analyze where things appear to be going
- Consider uncertainty explicitly
- Explore potential for intervention and leverage

Only a subset of the five is normally involved in scenario analysis, but all five help frame the larger activities, decision and policy analysis, to which scenario analysis is normally meant to contribute. This introduction thus briefly elaborates the full five activities before narrowing its focus back to scenario analysis in the rest of the paper.

### 1. Identify Values and Goals.

Values and goals are the foundation of forecasting and of action based on it. Values and goals can be as disparate as profits, personal reputation, national security, reduction of poverty and movement towards sustainability. Effective use of values and goals requires:

- Clearly defining and understanding them.
- Developing metrics for measuring goals and progress to them (such as has been done with the Millennium Development Goals or MDGs).

### 2. Build and Use Models About How Things Work

Everyone uses models and open minds constantly extend and refine them or build new ones. Most models are mental models, often referred to in forecasting as “domain knowledge.” Strong domain knowledge always involves the causal understandings of mental models, not just facts or data. Mental and computer models help add consistency (e.g. in accounting for flows and changes in stocks), trace through secondary or higher order impacts, and anchor forecasts explicitly in data and theory. Weaknesses in all models often include not being able to anticipate/represent reversals in direction or step changes, the “bending or breaking of the curve.” Undertaking scenario analysis almost invariably leads to further extensions and refinement of models.

### 3. Analyze Where Things Appear to be Going

Forecasting very often benefits from initial analysis of where things seem to be going, what is often called the **base case or reference case**. These first forecasts are often used in two interrelated ways:

- To examine key variables (most often related to our values and goals) and examine how they are likely to unfold. In IFs, we also look at the base case and compare it to forecasts from other sources, partly as a quick read on the “face validity” of the model that produced them.
- To identify and examine key processes and transitions as a useful extension of key-variable analysis. In models like IFs that produce non-linear and highly interactive behavior, this is partly to look for the beginnings of bending of the curve. But there is more. It is also possible, even in the absence of explicit curve bending to look at growing imbalances and growing pressures that may give rise to such bending or breaking. Such imbalances can show up in systems such as:
  - States (for instance, between growing economic well-being and restricted democracy levels within some states)
  - International systems (between power capabilities of emerging states and their role in the state system)
  - Demographic systems (between pension requirements and worker numbers)
  - Energy systems (between demand growth patterns for fossil fuels and limited reserves)
  - The environment (between growing levels of emissions and the well-being of biological systems)

More elaborate examination of key transitions and associated imbalances and pressures, which will be undertaken in the next chapters of this report, can help identify major actors affected by them and consider their reactions. This can help lead to or supplement thinking about dynamic interaction patterns, possible turning points, shocks, and surprises. In short, both of the above uses of the base case help build to broader scenario analysis. Such extension is sometimes done rather implicitly (as in analysis of drivers in Global Trends 2015) and is almost always better when made more explicit.

Analysis of pressures, imbalances and transitions has been key to the successful scenario analysis done by Shell (see Wack 1985a and 1985b). In the early 1970s Shell foresaw a tightening of the global oil market as some producers reached maximum production allowed by reserves. In the early 1980s they foresaw a collapse of prices as economic growth and demand constricted but supply built. Both were transition-focused analyses.

#### 4. Consider Uncertainty Explicitly

Especially as we begin to look out further, the explicit introduction of uncertainty and human agency become essential (the next section elaborates the discussion of agency begun in this one). Those are the core of most scenario analysis.

Many analysts divide scenarios into two simple categories: exploratory (alternative assumptions about how things might unfold, with special attention to uncertainty) and normative (the structuring of a preferred future and exploration of paths to attain it, with special attention to agency). These are very useful categories, but may be inadequate. IFs elaborates these with additional elements and facilitates a building block approach to the development of scenarios.

There is no perfect typology of the blocks for building scenarios, but the conceptualization found useful in the IFs project is:

- Framing scenario foundations. Much scenario analysis implicitly or explicitly identifies one or two key dimensions of uncertainty that are, at least in significant part, NOT fully under human control. In global scenarios the most common such dimension is the pace of technological change and of economic growth driven by it. When environmental issues are of interest to the analysis, a second important dimension of uncertainty that is not under human control is whether the environment is fundamentally robust or fragile (with respect to both demands for inputs to human systems and reactions to outputs). Almost all long-term global scenario analysis builds on the first dimension and the IPCC analyses add the second.
- General global, regional, or country behavior. Because these elements, like framing foundations, are often highly aggregated, some analysts may not recognize the importance of making the distinction. Doing so, however, explicitly recognizes that scenario elements in this category do involve human agency.
  - In global forecasting, the pace and even the continuation of globalization is often a key assumption about global behavior. Variations on that assumption may identify levels of cooperation between major actors or regions as an important scenario component, or turn to more issue specific variations such levels of trade protection or openness. Scenarios built around different levels of global population growth would also fall into this category; again, human population growth clearly involves human agency, even when we do not spell out the mechanisms of such agency.
  - Regional or country behavior. This element helps build scenarios that remain above the level of specific agency, but begin to be more focused in space, time, or issue of interest. For instance, the unfolding of the HIV/AIDS crisis in Sub-Saharan Africa over next 10 years might shape one set of assumptions.

Or the US-China geopolitical relationship in 2020s and 2030s, as power balances become more even, could shape another.

- Elaborated agent interventions. In IFs these agents are primarily governments or households, allowing the movement of scenario elaboration closer to the level of representing the manipulation of specific levers of action. IFs is also beginning to build representations of IOs such as the World Bank and IMF, and scenarios would also benefit from representation of NGOs, which is not yet available. Scenarios adding elements of agent behavior can specify changes in the levels and patterns of foreign aid, different fiscal priorities by government (such as more R&D, military or education spending), an OPEC oil production restriction in a given year, economic liberalization within India, etc.
- Shocks, surprises, wild cards. These can refer back to either the technological or environmental dimensions of framing scenarios or to surprises in human agency. Breakthroughs in human life expectancy or, conversely, a new plague would illustrate his category, as would some kind of environmental tipping. So, too, would a scenario element built around an abrupt change in governmental character or behavior patterns. There is an infinite number of such scenarios. Analyses of pressures, imbalances, and transitions may help identify some that are more likely than others. A search for weak signals may also help identify some shocks that are emergent.
- Changes in causal understandings. This is not a typical element in scenario analysis, but mental or computer models clearly can have specifications/understandings that are wrong. Scenarios could be built around alternative formulations, corresponding to alternative theoretical or empirical understandings. For instance, IFs allows users to drive democratization patterns with alternative formulations, some including levels of education within the society, and some not.

One of the important benefits of the interface of IFs and the structure of the model itself is that scenarios can be built up from a wide variety of building blocks specified in each of these general categories. For instance, as Chapter 6 will explain, a framing scenario of rapid technological and economic growth could be adorned with assumptions of any kind concerning global behavior, specific regional or country behavior, wild cards, and agent interventions. As scenario analysis becomes open to participation beyond a small circle of analysts, such a building block approach becomes especially important.

## **5. Explore Potential for Intervention and Leverage**

It is in exploring agent interventions, in the face of a wide variety of different scenario settings, that much of the extended pay-off of forecasting comes for policy analysis.

Consideration of intervention and leverage inevitably moves us from exploratory to normative scenario analysis, considering how action might affect outcomes relative to

values and goals. Such normative analysis generally starts with identifying potential leverage points for human agency. Given the level of aggregation in any model like IFs, we might be able to identify a quite specific action (e.g. spending money on primary education) or we might need to settle for identifying key points where action could be desirable, even if a specific leverage point in IFs is not clear (e.g. lowering the costs of renewable energy production). From a set of such agent-tied interventions, larger and integrated normative scenarios can arise. In IFs there has been exploration, for example, of packages that enhance sustainability and the project is beginning to look at packages for poverty reduction.

A step along the way of building such packages is logically to undertake cost-benefit analysis across various levers of action. In much global policy analysis this is not normally done very effectively. Among the reasons for this failure in analysis are unidentified secondary consequences, including trade-offs and synergies across levers. For instance, large expenditures on agricultural technology might not be useful in absence of some on roads and other infrastructure; building alliances perhaps not useful without collaboration on defining objectives or economic cooperation. The global policy community and debates within it are, however, giving increasing attention to such cost-benefit analysis. Consider the debates around greenhouse gas growth mitigation vs adaptation, or *The Economist's* Copenhagen Consensus project, or the report of the WHO's Commission on Macro-Economics and Health.

In the real world, of course, incrementalism and the monitoring of system feedback to changes in intervention provides much insight into synergies and trade-offs. But the use of a model for some additional potential insight can be useful, particularly when the desirable actions appear not be incremental.

One further step can be taken with models in agent-based, normative scenario development and policy analysis. There are now systems in place, such as the Computer Assisted Reasoning system (CARs) used at the RAND Pardee Center, that can search for and investigate robust action packages in the face of uncertainty, including selected wild cards or surprises. IFs has begun to be used in such manner.<sup>1</sup>

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<sup>1</sup> Agent-attentive scenario and policy analysis is likely to continue growing in sophistication. Within dynamic analysis focused on agent-class action, we could, for example, add action-reaction game theory analysis as an overlay on the underlying model in which agent actions are represented. We could even create smart agent classes that adapt and learn. These approaches now exceed the capability of formal use of IFs, but sophisticated users could simulate them in a more gaming fashion.

## **The Plan of this Paper**

This paper is focused on scenario analysis, not the larger enterprises of decision and policy analysis in which scenario analysis is often embedded. Thus this report elaborates only two of the above five activities:<sup>2</sup>

3. Analyzing where things appear to be going.
4. Considering uncertainty explicitly.

Moreover, this paper focuses only on portions of the above two steps. Specifically, in the next four chapters look in more detail at the base case for evidence concerning the bending of trends and the building of pressures or imbalances that should alert us to issues of potential interest. And in the sixth chapter the paper outlines the way in which IFs can be used to consider uncertainty, not actually presenting elaborated scenario analyses.

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<sup>2</sup> Other papers explore the other activities in the larger enterprise, at least with respect to use of the International Futures (IFs) system (see, for example, Hughes June 2004 on the structure of the IFs modelling system; Hughes March 2004 with detail on the base case; Hughes and Johnson July 2004 on the exploration of human leverage for producing a more sustainable future).

## 2. Demography

This paper presumes some familiarity with the base case of IFs, as described in the companion piece to this report (Hughes March 2004) which lays out key variables and compares the base case forecasts of IFs with those from many other forecasting efforts. That paper emphasized the presentation of major variables such as total population, GDP, energy demand levels, and so on, but also indicated some of the variables that suggest pressures and imbalances in the system. This paper repeats some of discussion from the earlier one, but primarily amplifies and extends it.

Pressures and imbalances, especially those that are growing, but also those that are simply persistent, are of special interest because they often give rise to significant policy challenges. The scenario planning group at Shell has long written about “inevitable surprises” (Schwarz 2003). The timing of such surprises is seldom predictable, but in retrospect their occurrence often appears nearly inevitable because the pressures or imbalances were obvious.

This chapter will attempt to identify some of those pressures and imbalances in global demographic systems. The next three will look at economic, socio-political, and environmental systems.

In demography pressures and imbalances have often been caused by rapid population growth, by deterioration in the health conditions of populations, or by population movements. Increasingly it is recognized that additional pressures are arising now from negative population growth and aging, but this section begins with the traditional sources of potential problems.

### 2.1 The Pressures of Growth and Youth

Global population growth has slowed dramatically since peaking in the 1960s, but it remains very high in some countries. The table below builds on data from the 2002 revision of the UN population data and identifies those countries where population growth rates now exceed 3.2% or appears in the IFs base case likely to do so between now and 2020.<sup>3</sup> The countries in that table were not intended to constitute a list of failed states, but there is obviously strong overlap.

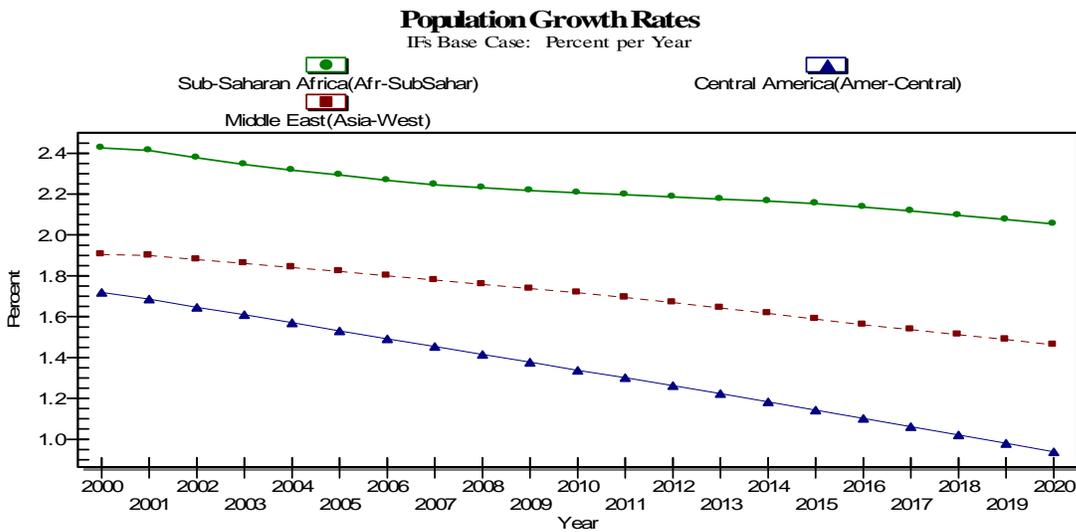
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<sup>3</sup> This table and some others in this report use the “filter” feature of the IFs system, allowing the user to identify a maximum or minimum value or a range and apply that as a criterion to a variable across all countries. Only those countries that meet the criterion remain in the table after application and the value-years of meeting it are shown in bold.

IF: POPR: Filter Minimum Level 3.2									
Continue Refresh Graph Print Save Percent Filter Display Run Horizon									
	POPR[0]	POPR[0]	POPR[0]	POPR[0]	POPR[0]	POPR[0]	POPR[0]	POPR[0]	POPR[0]
	Afghanistan	Burundi	Liberia	Niger	Palestine	Saudi Arabia	SierraLeo	Somalia	
Year	Percent	Percent	Percent	Percent	Percent	Percent	Percent	Percent	Percent
2001	3.748	3.055	3.504	3.2901	3.4233	3.3953	3.575	3.9260	
2002	3.724	3.081	3.47	3.2608	3.3646	3.3153	3.547	3.8754	
2003	3.698	3.103	3.445	3.2336	3.3060	3.2408	3.504	3.8281	
2004	3.668	3.136	3.414	3.2085	3.2557	3.1647	3.465	3.7773	
2005	3.636	3.175	3.384	3.1847	3.2066	3.0905	3.426	3.7281	
2006	3.602	3.20	3.345	3.1564	3.1595	3.0274	3.386	3.6752	
2007	3.568	3.231	3.309	3.1307	3.1176	2.9675	3.348	3.6008	
2008	3.534	3.27	3.263	3.1072	3.0803	2.9114	3.313	3.5473	
2009	3.501	3.276	3.231	3.0838	3.0470	2.8583	3.282	3.5012	
2010	3.468	3.291	3.204	3.0604	3.0172	2.8074	3.254	3.4647	
2011	3.437	3.292	3.189	3.0425	2.9828	2.7597	3.236	3.4422	
2012	3.404	3.288	3.175	3.0243	2.9513	2.7140	3.218	3.4189	
2013	3.368	3.281	3.162	3.0061	2.9217	2.6702	3.202	3.3987	
2014	3.33	3.271	3.146	2.9875	2.8929	2.6279	3.185	3.3828	
2015	3.29	3.258	3.128	2.9686	2.8647	2.5864	3.167	3.3730	
2016	3.255	3.238	3.09	2.9295	2.8349	2.5474	3.141	3.3601	
2017	3.218	3.213	3.052	2.8910	2.8047	2.5080	3.117	3.3400	
2018	3.178	3.184	3.015	2.8526	2.7749	2.4683	3.094	3.3124	
2019	3.136	3.151	2.978	2.8146	2.7455	2.4282	3.07	3.2795	
2020	3.092	3.114	2.942	2.7769	2.7170	2.3877	3.046	3.2408	

If the threshold of interest is set at 3%, additional countries with values that exceed it in the IFs base case between 2000 and 2020 are Burkina Faso, Chad, Congo (Republic of), Uganda, and Zaire (Democratic Republic of the Congo).

The graph below indicates the three developing regions with the highest likely population growth rates in the first 20 years of the century. Sub-Saharan Africa clearly stands out, even though its growth rates reflect the ravages of AIDS.



High population growth rates often give rise to youth bulges. It is widely recognized that a large portion of 15-29 year-old males in a population is historically associated with

greater socio-political instability.<sup>4</sup> One difficulty is that there are multiple ways of operationalizing the youth bulge. Sometimes that age group (or even some variant of it such as 15-24) is compared with the age groups up through 54.<sup>5</sup> Other times the comparison is made to all adults over 15, or to all adults over 30 (Cincotta, Engleman, and Anastasion 2003; see especially Data Sources and Methodology, p. 89). In the comparisons with 30-54 year-olds, the rule of thumb is that ratios above 1.2 (sometimes 1.29) are especially problematic; in the comparison with all adults, the rule of thumb is that ratios above 0.4 or 40% can lead to difficulties. In any case, almost all observers focus attention especially on countries in the Middle East and in Africa as having the largest prevalence of youth bulges. The CIA (2001: 36) identified Sub-Saharan Africa as the most problematic area though 2020, naming Botswana, Namibia, Zambia, and Ethiopia as among countries that would still be above their warning threshold of 1.29 in 2020.

IFs is now using the 15-29/all adults (defined as 15 or older) version of the measure. Using its filtering technique for identifying values at or above 53% between 2000 and 2020 (well above the 40% threshold), the IFs base case finds Burkina Faso, Burundi, Kenya, Mali, Uganda, Yemen, Zambia, and Zimbabwe to be cases for attention.

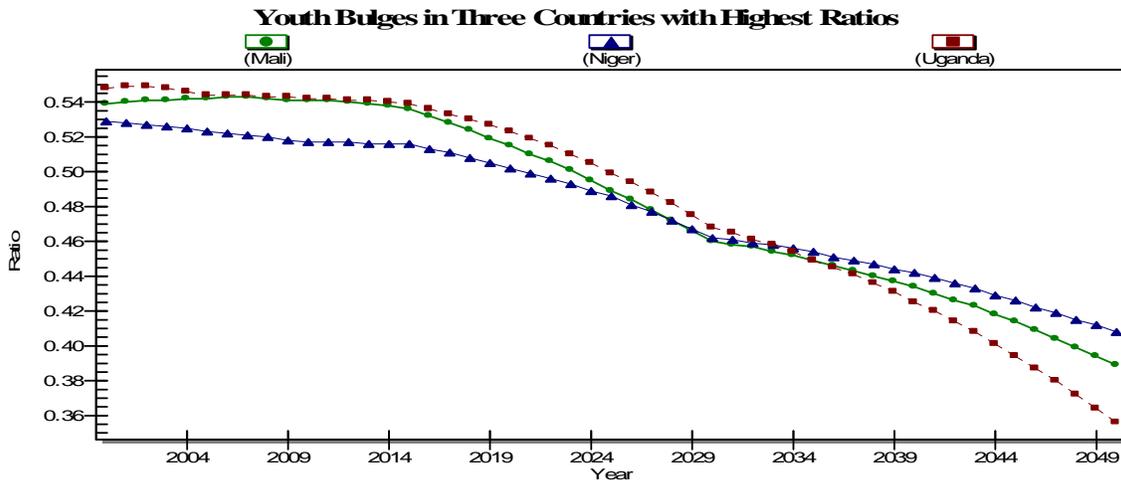
Year	Burkina Faso	Burundi	Kenya	Mali	Uganda	Yemen	Zambia	Zimbabwe
2000	.5484	.523	.542	.539	.548	.515	.5372	.541
2001	.5473	.528	.542	.54	.549	.518	.5368	.542
2002	.5459	.533	.541	.541	.549	.522	.5354	.543
2003	.5443	.537	.54	.541	.548	.526	.5334	.543
2004	.5425	.54	.539	.542	.546	.529	.5307	.543
2005	.5406	.542	.538	.542	.544	.533	.5275	.542
2006	.5395	.543	.535	.543	.544	.534	.5267	.541
2007	.5382	.542	.531	.543	.544	.535	.5257	.539
2008	.5367	.54	.527	.542	.543	.535	.5244	.536
2009	.5351	.537	.521	.542	.543	.535	.5228	.532
2010	.5333	.533	.514	.541	.542	.534	.5209	.527
2011	.5325	.529	.509	.541	.542	.533	.5203	.523
2012	.5313	.523	.503	.54	.542	.532	.5194	.518
2013	.5299	.516	.496	.539	.541	.53	.5181	.512
2014	.5282	.508	.488	.538	.54	.527	.5166	.505
2015	.5263	.499	.479	.536	.539	.524	.5148	.497
2016	.5222	.491	.472	.532	.537	.518	.5114	.488
2017	.5178	.483	.465	.529	.534	.513	.5076	.479
2018	.5133	.475	.458	.524	.53	.507	.5035	.471
2019	.5086	.467	.451	.52	.527	.501	.4992	.462
2020	.5038	.459	.444	.515	.524	.495	.4946	.453

If the filter level is set at 50%, it also identifies Angola, Benin, Botswana, Cambodia, Congo (Republic of), Ivory Coast, Eritrea, Guatemala, Haiti, Jordan, Lesotho, Liberia, Nicaragua, Niger, Rwanda, Senegal, Somalia, Swaziland, Syria, Tanzania, and Zaire (Democratic Republic of the Congo) as potential problem areas.

<sup>4</sup> The analysis by Cincotta, Engelman and Anastasion (2003) on The Security Demographic lists the youth bulge as demographic stress factor (1), followed by (2) rapid urban growth, (3) competition for cropland and fresh water, and (4) HIV/AIDS deaths in the prime of life. This report will touch on all four.

<sup>5</sup> The CIA population study (2001) defined the reference group in Figure 14 as 39-54 year-olds and on page 39 as 30-54 year-olds.

Of all of the above countries, the IFs base case suggests that Burkina Faso, Mali, Niger, and Uganda will have or still have ratios above 50% in 2020.<sup>6</sup>



Uganda is frequently identified as a country with especially good leadership relative to others in its region and its development level. The size of population growth and the size and persistence of its youth bulge suggest that maintenance of such leadership will be an ongoing challenge.

## 2.2 The Pressure of HIV/AIDS

The pressure of HIV/AIDS on countries and on global system comes both from growing HIV infection rates in some parts of the world and, perhaps more significantly for most of Africa, from movement of the epidemic into the “death phase.” The death phase represents a period during which HIV infection rates stabilize or fall, but deaths increase as those who contracted the infection during the growth period of the epidemic sicken and die.

For most African countries, UN forecasting assumptions posit that the year of peak HIV prevalence is already past or will be in the first decade of the century.<sup>7</sup> The UN identifies only a few African countries still moving towards peak incidence: Angola (up to 6.1 percent in 2006, Equatorial Guinea (up to 4.4% in 2009), Eritrea (up to 3.2% in 2007), Liberia (up to 7.2% in 2006), and Sierra Leone (up to 9.8% in 2008).

Nonetheless, the death rates for much of Sub-Saharan Africa will likely continue to rise. The table below identifies the countries of the world, all in Sub-Saharan Africa, where

<sup>6</sup> The variable in IFs is YTHBULGE (Mali, etc.).

<sup>7</sup> UN Population Division (2003), Annex Table 17. Again, this does not mean that the peak year of AIDS deaths has been reached, because those infected in years with higher rates will continue to die for a considerable period of time.

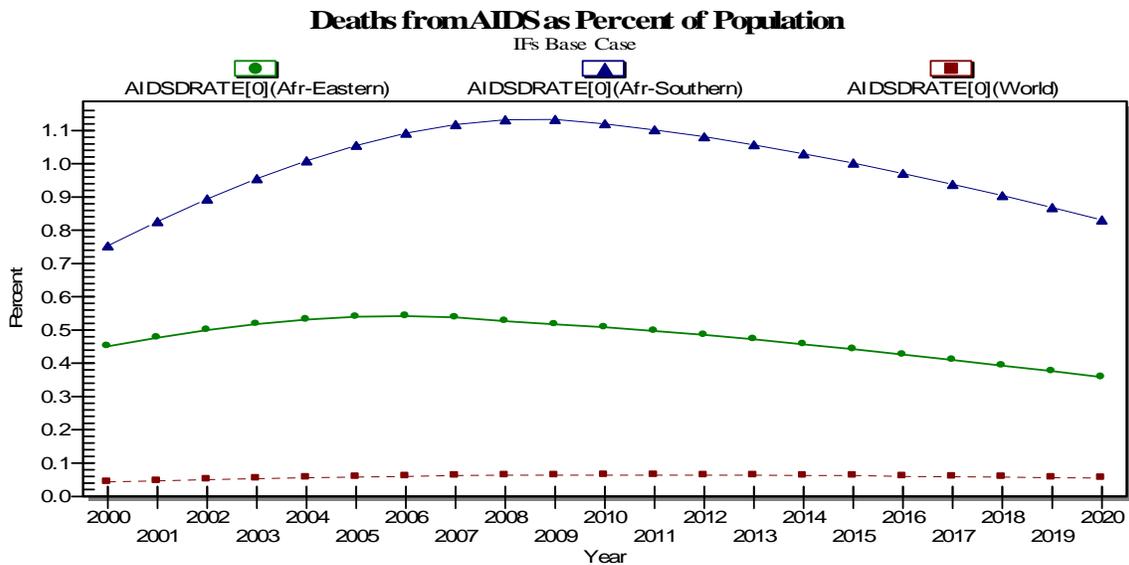
deaths attributable to AIDS appear likely to exceed 1% of total population at some time before 2020. Setting the filter at 0.5% would add Burundi, Cameroon, the Central African Republic, the Ivory Coast, Kenya, Mozambique, Rwanda, and Tanzania.

IF: AIDS RATE: Filter Minimum Level 1								
Continue Refresh Graph Print Save Percent Filter Display Run Horizon								
	AIDSDRATE[0]							
	Botswana	Lesotho	Malawi	Namibia	South Africa	Swaziland	Zambia	Zimbabwe
Year	Percent							
2000	1.475	.994	.713	.865	.705	.894	1.065	1.404
2001	1.616	1.087	.779	.946	.774	.978	1.165	1.498
2002	1.746	1.173	.841	1.02	.837	1.055	1.256	1.582
2003	1.864	1.25	.896	1.087	.895	1.124	1.339	1.653
2004	1.968	1.317	.944	1.146	.946	1.184	1.41	1.71
2005	2.055	1.372	.984	1.194	.989	1.234	1.47	1.751
2006	2.125	1.416	1.015	1.232	1.023	1.273	1.516	1.774
2007	2.174	1.445	1.035	1.257	1.048	1.299	1.547	1.777
2008	2.201	1.458	1.045	1.268	1.061	1.311	1.561	1.758
2009	2.201	1.454	1.042	1.265	1.063	1.307	1.557	1.734
2010	2.174	1.43	1.025	1.244	1.051	1.286	1.532	1.706
2011	2.139	1.403	1.005	1.221	1.034	1.262	1.503	1.674
2012	2.098	1.372	.983	1.194	1.014	1.234	1.47	1.637
2013	2.052	1.338	.959	1.164	.992	1.203	1.433	1.596
2014	2.001	1.301	.932	1.132	.967	1.17	1.393	1.552
2015	1.946	1.261	.904	1.097	.94	1.134	1.35	1.504
2016	1.886	1.218	.873	1.06	.911	1.096	1.305	1.453
2017	1.822	1.174	.841	1.021	.881	1.056	1.257	1.40
2018	1.755	1.127	.808	.981	.848	1.014	1.207	1.345
2019	1.686	1.079	.774	.939	.815	.971	1.156	1.288
2020	1.615	1.03	.739	.897	.78	.927	1.104	1.229

Even rather successful countries of the region such as Botswana and South Africa will quite presumably be challenged to their limits during the death phase.<sup>8</sup> The challenge to Botswana is already extraordinary and will almost certainly become greater. Obviously, changes in availability of anti-AIDS drugs or an effective vaccine could bend these forecasts.

The two regions of Africa at greatest risk are Southern and Eastern. The graph below compares their possible death rates with the global pattern.

<sup>8</sup> The forecast in the IFs base case of peak AIDS deaths in South Africa is about 40% below that of the Actuarial Society of South Africa (reported in *The Economist, The World in 2004*, p. 65).



In some parts of the world the HIV rate itself is still increasing quite rapidly. Eberstadt (2002) and Lamptey et al. (2002), both drawing in part on analysis from the National Intelligence Council, provide estimates of current infection rates in China, India, and Russia that are above those in UN data, quite substantially above for China and Russia. Eberstadt, focusing on these three countries, suggests the possibility of cumulative AIDS deaths from 2000-2025 in a mild epidemic of 19 million, 21 million, and 3 million, in China, India, and Russia, respectively. In an intermediate epidemic the numbers grow to 40, 56, and 9, respectively, and in a severe epidemic they are 58, 85, and 12 million. Eberstadt proceeds also to estimate the impact that such numbers would have on demographic structures and economic growth.

The base forecast for those countries in IFs relies on UN data and is substantially below the “mild epidemic” forecast numbers of Eberstadt. The data in this area are, however, highly unreliable. Although many communities may well underestimate infection rates, the UN revised a fair number of its estimates of HIV infection rates for 2001 downward relative to estimates for 1999. The spread of drug availability, with the initial goal of providing antiretroviral therapy to 3 million people by 2005 (“3 by 5”) could begin to bring down African and other death rates. Thus forecasting is very difficult. Regardless of the specific forecasts, however, this is an area of growing pressures for countries, regions, and the global system.

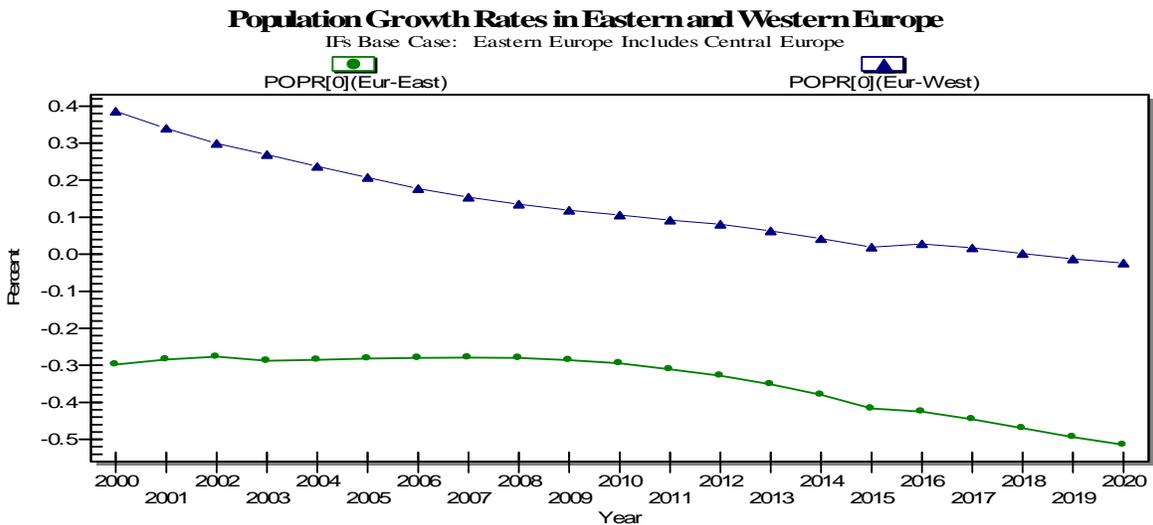
### 2.3 The Pressures of Aging and Decline

Even while much of the world continues to struggle with the accommodation of high population growth rates, an increasingly large set of countries is now struggling with the implications of declining populations or those that soon will do so. The table below indicates countries that have or are likely before 2020 to have population growth rates that at some time are less than -0.5%. In some cases, declines are likely to exceed 1.0%. Interestingly, in part because so much attention is given to Western European countries

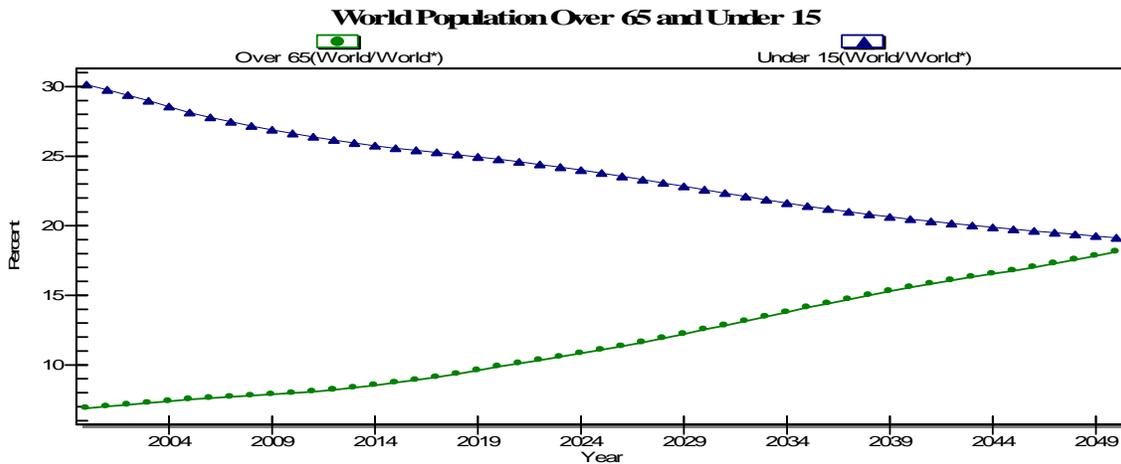
like Italy or Spain, the greatest rates of decline are appearing primarily in the former Soviet Union and Central Europe. Another important feature of the table below is that the declines are likely to accelerate in most cases.

IF: POPR: Filter Maximum Level -.5										
Continue Refresh Graph Print Save Percent Filter Display Run Horizon										
	POPR[0]	POPR[0]	POPR[0]	POPR[0]	POPR[0]	POPR[0]	POPR[0]	POPR[0]	POPR[0]	POPR[0]
	Estonia	Georgia	Greenland	Guyana	Kazakhstan	Latvia	Moldova	Russia	Ukraine	
Year	Percent	Percent	Percent	Percent	Percent	Percent	Percent	Percent	Percent	Percent
2001	-.907	-.686	-.611	.217	-.181	-.349	-.012	-.386		-.578
2002	-.91	-.695	-.537	.151	-.197	-.347	-.005	-.368		-.583
2003	-.937	-.726		.11	-.231	-.368	-.018	-.369		-.608
2004	-.955	-.744		.06	-.249	-.378	-.019	-.351		-.62
2005	-.971	-.764		-.005	-.266	-.388	-.025	-.329		-.634
2006	-.991	-.785		-.07	-.269	-.402	-.04	-.31		-.648
2007	-1.006	-.806		-.137	-.263	-.412	-.056	-.293		-.661
2008	-1.02	-.825		-.204	-.257	-.42	-.074	-.281		-.673
2009	-1.034	-.845		-.268	-.249	-.427	-.093	-.277		-.687
2010	-1.048	-.865		-.329	-.242	-.433	-.116	-.279		-.703
2011	-1.071	-.889		-.376	-.256	-.445	-.143	-.291		-.725
2012	-1.096	-.914		-.417	-.275	-.461	-.174	-.307		-.743
2013	-1.126	-.943		-.451	-.303	-.481	-.21	-.33		-.764
2014	-1.163	-.976		-.478	-.34	-.507	-.254	-.362		-.793
2015	-1.208	-1.014		-.499	-.389	-.541	-.306	-.402		-.83
2016	-1.218	-1.037		-.511	-.414	-.547	-.339	-.413		-.835
2017	-1.227	-1.067		-.524	-.448	-.567	-.378	-.435		-.855
2018	-1.134	-1.102		-.212	-.54	-.488	-.42	-.461		-.879
2019	-1.033	-1.036		-.198	-.498	-.533	-.62	-.464		-.904
2020	-.929	-.935		-.184	-.509	-.582	-.647	-.509		-.924

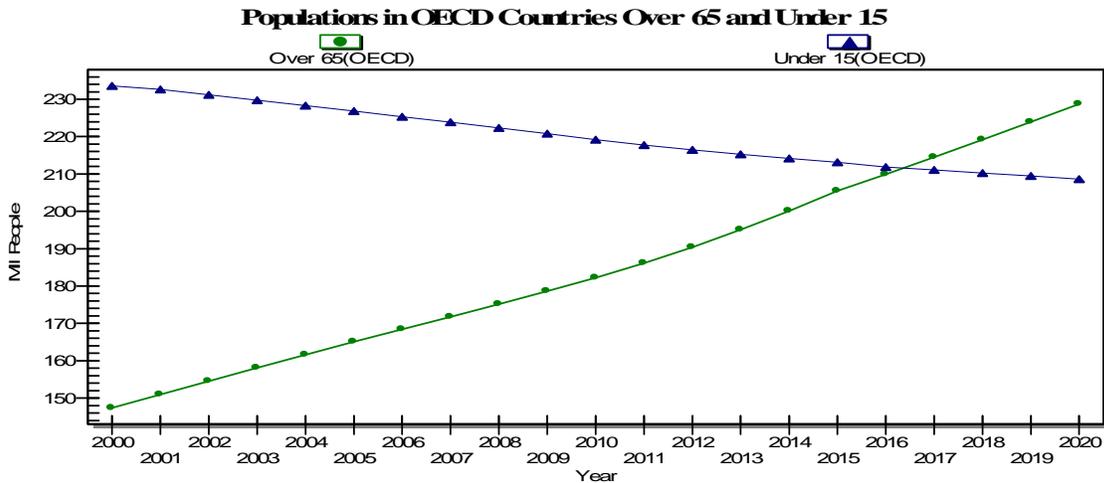
The graph below shows a likely population growth rate pattern for Western Europe relative to Eastern/Central Europe. The absolute decline in population of the latter is well underway, while that in the former will begin in about 2020.



The graph below shows the possible pattern for convergence of the two age groups globally that are often considered dependent or economically less productive. On a global basis the phenomenon does not look too threatening, because the sum of the two populations remains relatively stable through 2050.

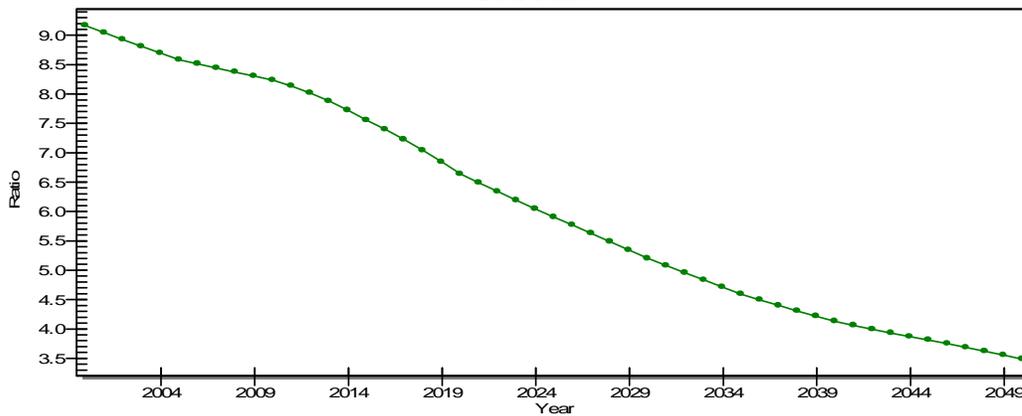


The phenomenon looks quite different, however, when examined only for the OECD countries. The graph below shows that in those states, the decline in those under 15 is quite modest, while the growth in those over 65 is comparatively explosive, with the lines crossing before 2020.



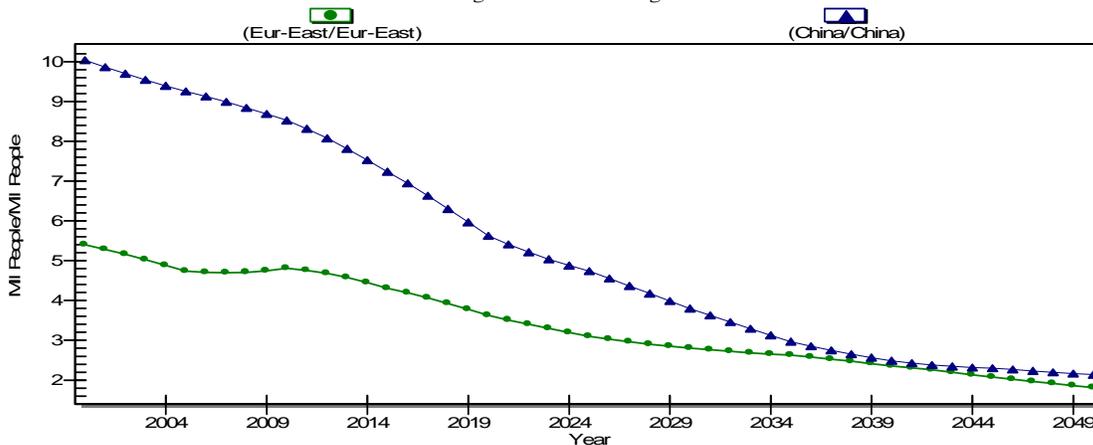
Even on a global basis, however, the populations are hardly equivalent. The young are cared for within the family, but the aged increasingly look everywhere for part of their care to the government and to pension plans. The graph below returns to the global level, but shows the sharp decrease that is nearly inevitable in the ratio of those working to those who are of retirement age. The CIA (2001:7) suggests that the same ratio for “industrialized nations” will fall from 4 to 1 by 2050.

**Working-Aged (15-65) Over Retirement-Aged Population**  
Global Totals



The graph below shows that Central and Eastern Europe (including Russia) will face the greatest problems in the next two decades, with the ratio of workers per retiree falling to just 3.5 already by 2020. These countries are getting old before they get rich, greatly exacerbating the problem faced by most of the OECD countries. The even more striking change in this ratio in terms of speed, however, is in China. The graph shows a decline of the ratio from 10 to about 2 by 2050 (already to 6-to-1 by 2020). The ramifications across all elements of society of such rapid change can hardly be exaggerated.

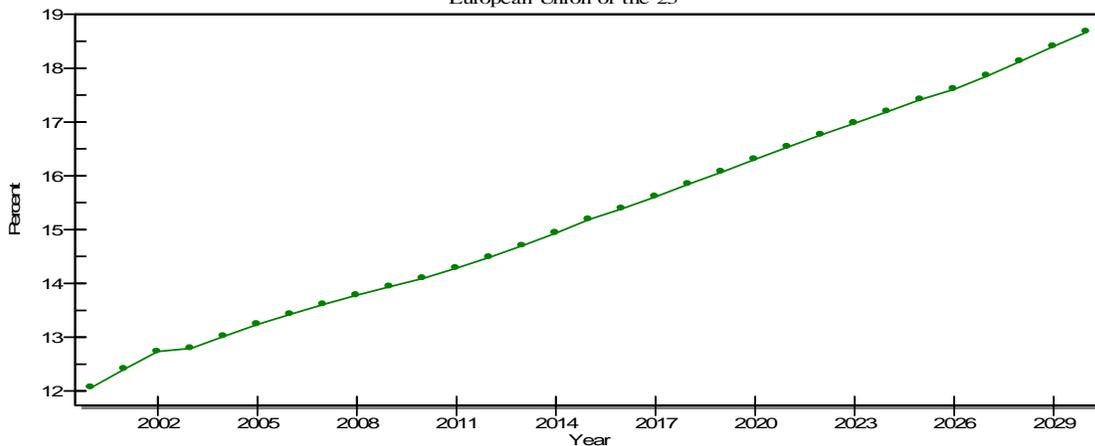
**Working-Aged (15-65) over Retirement-Aged Population**  
Getting Old Before Getting Rich



Across the world, the growing share of the aged will have a significant impact on the pension bills of government. The CIA reports an OECD conclusion that the bill for public pensions in Europe will grow by more than 6 percent of GDP over the next three decades (CIA 2001: 27). That is almost exactly the same growth increment shown in the IFs base case, below.<sup>9</sup>

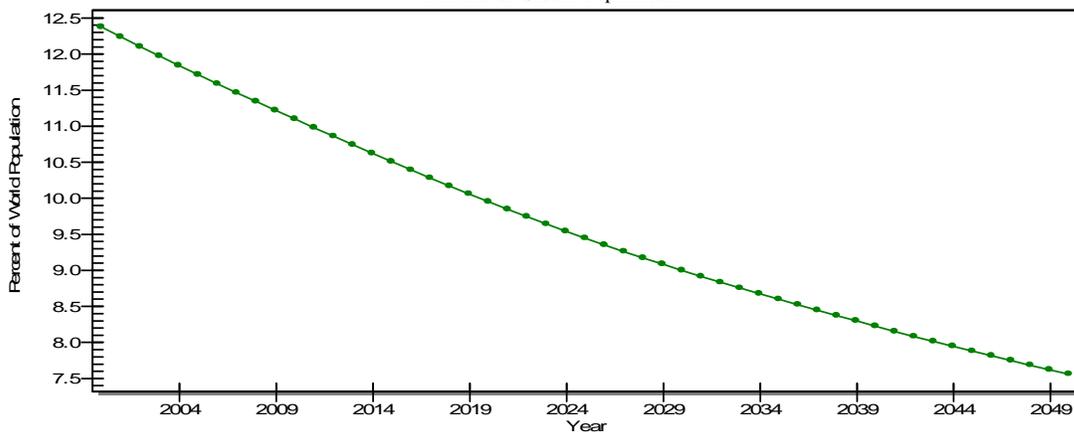
<sup>9</sup> The IFs variable in the graph below is GOVHHPENT(EU25) over GDP(EU25) times 100.

**Pension Payments as Percent of GDP**  
European Union of the 25



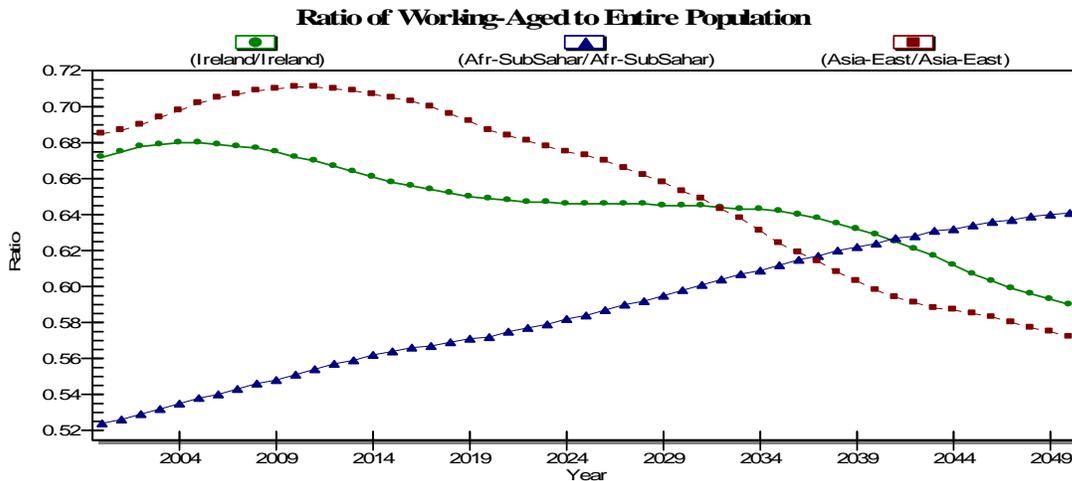
And the problems associated with aging populations are not only local. The graph below indicates the share that the broader European population, including Eastern Europe and Russia, are likely to be of the global population. To the extent that global power is tied to population share, that of the region will decline. This paper returns later to this topic.

**European Population, Including Russia**  
Percent of World Population



#### 2.4 The Benefits of Demographic Dividend

Aging of population need not always be an indication of growing pressures or imbalances. Some countries with historically rapid growing populations are now reaping a bonus (often called the “demographic dividend”) as population growth rates decline and young age cohorts shrink, while the portion of the population in the labor force increases. The figure below is the version from the IFs base case of a figure in Bloom, Canning, and Sevilla (2003: 38). It shows that Ireland is essentially at the end of its demographic dividend period, which has run since the 1960s. East Asia will see its period of dividend end before 2015, after a similarly long period of growth in the ratio of those in the working years. But Sub-Saharan Africa, even with the AIDS epidemic, is likely to experience a period of increasing dividend throughout the first half of the century.



## 2.5 The Pressures of Movement

Demographic pressures and imbalances arise not just from growth rates and changing age patterns, but also from movements within and across countries. The table below shows the forecasts of urban population growth within IFs.

IF: Table Display			
	POPURBAN[0]/	POPURBAN[0]/	POPURBAN[0]/
	World/World	OECD/OECD	non-OECD/non-
Year	Mil People/Mil F	Mil People/Mil F	Mil People/Mil F
2000	.462	.769	.382
2005	.488	.784	.414
2010	.517	.80	.45
2015	.546	.815	.486
2020	.573	.829	.518
2025	.595	.842	.545
2030	.615	.853	.569
2035	.631	.862	.588
2040	.647	.87	.607
2045	.665	.877	.629
2050	.684	.883	.651

For the purposes of considering consequences, however, it is not just or perhaps even primarily the size of the urban population that is significant, but the rate of its growth. Cincotta, Engleman, and Anastasion 2003: 54-55 divided countries into four categories of stress based on urban growth rates: extreme stress (above 5%), high stress (4-5%), medium stress (1-4%), and low stress (below 1%). The representation of urbanization in IFs is too crude to trust forecasts around urbanization rates or levels. Nonetheless, initial data and the IFs formulation as it stands now suggest a number of problem countries for much or most of the period to 2020, including Afghanistan, Bhutan, Burundi, Burkina

Faso, Burundi, Ethiopia, Gambia, Laos, Lesotho, Nepal, Niger, Papua New Guinea, and Uganda.

Interstate migration are, perhaps, nearly unpredictable. IFs relies on UN numbers to initiate its forecasts and it is the initial values that are of most relevance. The table below shows those countries that, at the turn of the century, had the highest rates of immigration from abroad. Each of these is likely to feel some pressure from such flows. In addition, the countries whose populations are declining in the aggregate or are becoming increasingly hard-pressed to maintain retirees, are likely to all feel either the pressure of assimilating increasing immigration or the burden of choosing not to accommodate it.

Year	Afghanistan	Burundi	French Guiana	Hong Kong	Kuwait	Luxembourg	Sierra Leone	Singapore
2000	.981	.667	.678	.749	.801	.852	.96	.917
2001	.981	.667	.677	.749	.801	.852	.96	.917
2002	.981	.667	.678	.749	.801	.852	.96	.917
2003	.981	.667	.678	.749	.801	.852	.961	.917
2004	.982	.667	.678	.749	.801	.852	.961	.917
2005	.982	.667	.678	.749	.801	.852	.961	.917
2006	.982	.667	.678	.749	.802	.852	.961	.918
2007	.982	.667	.678	.749	.802	.853	.961	.918
2008	.982	.667	.678	.749	.802	.853	.961	.918
2009	.982	.667	.678	.749	.802	.853	.961	.918
2010	.982	.667	.678	.749	.802	.853	.961	.918
2011	.982	.667	.678	.749	.802	.853	.961	.918
2012	.982	.667	.678	.749	.802	.853	.961	.918
2013	.982	.667	.678	.749	.802	.853	.961	.918
2014	.982	.667	.678	.749	.801	.852	.961	.917
2015	.981	.667	.678	.749	.801	.852	.961	.917
2016	.981	.667	.678	.749	.801	.852	.96	.917
2017	.98	.666	.677	.748	.80	.851	.96	.916
2018	.98	.666	.677	.747	.80	.85	.959	.915
2019	.977	.664	.675	.746	.798	.849	.957	.914
2020	.974	.662	.673	.743	.795	.846	.954	.91

Large emigrations are also historically indicators of pressures and imbalances, although in some cases, like the emigration during the Irish potato famine or the movements of Mexican workers today, they can operate so as to help relieve domestic pressures. The table below shows the countries with the highest annual percentage rates of emigration at the beginning of the century.

IF MIGRATE: Filter Maximum Level -25										
Continue Refresh Graph Print Save Percent Filter Display Run Horizon										
	MIGRATE[0]									
	Iran	Jamaica	Kazakhstan	Lesotho	Mali	Mexico	Suriname	Tajikistan	Trinidad	
Year	Percent									
2000	-2645	-49	-89	-3213	-3086	-2828	-786	-764	-2828	
2001	-2646	-49	-891	-3213	-3087	-2828	-786	-764	-2828	
2002	-2645	-49	-89	-3212	-3086	-2827	-786	-764	-2827	
2003	-2644	-49	-89	-3212	-3085	-2827	-786	-764	-2827	
2004	-2644	-49	-89	-3211	-3085	-2826	-786	-764	-2826	
2005	-2643	-49	-89	-3211	-3084	-2826	-785	-764	-2826	
2006	-2643	-49	-89	-3210	-3084	-2825	-785	-764	-2825	
2007	-2643	-49	-89	-3210	-3083	-2825	-785	-764	-2825	
2008	-2643	-49	-889	-3209	-3083	-2825	-785	-763	-2825	
2009	-2642	-49	-889	-3209	-3083	-2825	-785	-763	-2825	
2010	-2642	-49	-889	-3209	-3083	-2824	-785	-763	-2824	
2011	-2642	-49	-889	-3209	-3083	-2825	-785	-763	-2825	
2012	-2642	-49	-889	-3209	-3083	-2825	-785	-763	-2825	
2013	-2643	-49	-89	-3210	-3083	-2825	-785	-764	-2825	
2014	-2643	-49	-89	-3211	-3084	-2826	-785	-764	-2826	
2015	-2644	-49	-89	-3212	-3085	-2827	-786	-764	-2827	
2016	-2645	-49	-89	-3213	-3086	-2828	-786	-764	-2828	
2017	-2647	-49	-891	-3215	-3088	-2829	-787	-765	-2829	
2018	-2649	-491	-892	-3218	-3091	-2832	-787	-765	-2832	
2019	-2655	-492	-894	-3225	-3097	-2838	-789	-767	-2838	
2020	-2664	-494	-897	-3235	-3108	-2848	-792	-77	-2848	

### **3. Economics**

In economics the pressures and imbalances have often been caused by slow economic growth and resultant unemployment or poverty, and by increasing inequalities within populations. Other potential problems arise, however, from two other areas. The first is especially rapid economic growth, because it, like any change, creates difficulties and because it may be subject to rapid falls in the rate, causing even greater problems. It has long been argued that revolutionary situations arise especially often when periods of improvement in conditions come to a halt — even more than in situations of prolonged stagnation and poverty. Second, economic interconnections can create pressures and imbalances. Although they may provide great economic benefits and “soft power” for at least one partner, they often create dependencies and actual or potential disruptions for one or more partners.

We begin by looking at the traditional areas scanned for pressures and imbalances, namely slow growth and inequalities.

#### **3.1 The Pressures of Poverty and Slow Growth**

There are about 15 countries in the world that may reach 2020 with roughly the same level of GDP per capita that they had in 2000, and several of them may regress. Essentially all of them are already poor, so they will remain poor. The most likely candidates, according to the base case of IFs, are Afghanistan, Angola, Burundi, Djibouti, Eritrea, Guinea Bissau, Haiti, Kenya, Lesotho, Liberia, Malawi, Palestine, Sierra Leone, Somalia, Togo, Zaire (Democratic Republic of the Congo), and Zambia.

The list suggests the great uncertainty about the prospects of each of them, because in most cases a scenario can be developed that would suggest substantially improved prospects over the next 15 years. The rebuilding of Afghanistan could well succeed. Angola has substantial oil wealth, and if it could actually find its way to a capable government and on to citizens, much could be done now that a horrendous civil war has ended. Palestine could emerge as a real state and somehow prove economically viable. The reasons that they end up on the highly questionable list for growth prospect usually involve some combination of very weak governance, heavy dependence on raw materials with poor recovery of earnings, or being landlocked with poor infrastructure and little economic base in place.

Most of the countries on the list are in Africa, but within sub-Saharan Africa economic prospects do vary substantially. As the table below suggests, both AIDS-ravaged southern Africa and resource-dependent northern Africa have better than average prospects of economic advance. It is the countries of what is sometimes called central Africa that appear most problematic.

IF: Table Display					
Continue Refresh Graph Print Save Percent Filter Display Run Horizon					
	GDPPC[0]	GDPPC[0]	GDPPC[0]	GDPPC[0]	GDPPC[0]
	Afr-Eastern	Afr-Middle	Afr-Northern	Afr-Southern	Afr-Western
Year	Thousand \$	Thousand \$	Thousand \$	Thousand \$	Thousand \$
2000	.245	.382	1.352	3.81	.337
2001	.251	.384	1.375	3.85	.341
2002	.253	.385	1.398	3.923	.344
2003	.256	.376	1.423	3.905	.349
2004	.258	.369	1.448	3.926	.355
2005	.262	.364	1.478	3.943	.362
2006	.265	.36	1.512	3.973	.371
2007	.269	.356	1.55	4.01	.382
2008	.274	.354	1.594	4.059	.395
2009	.279	.354	1.642	4.119	.41
2010	.284	.355	1.693	4.197	.425
2011	.291	.357	1.747	4.298	.441
2012	.297	.359	1.802	4.424	.449
2013	.304	.362	1.858	4.56	.455
2014	.312	.366	1.918	4.701	.462
2015	.32	.371	1.98	4.849	.469
2016	.329	.376	2.048	5.011	.478
2017	.338	.381	2.121	5.182	.486
2018	.349	.386	2.199	5.363	.497
2019	.36	.391	2.284	5.554	.508
2020	.373	.396	2.376	5.755	.518

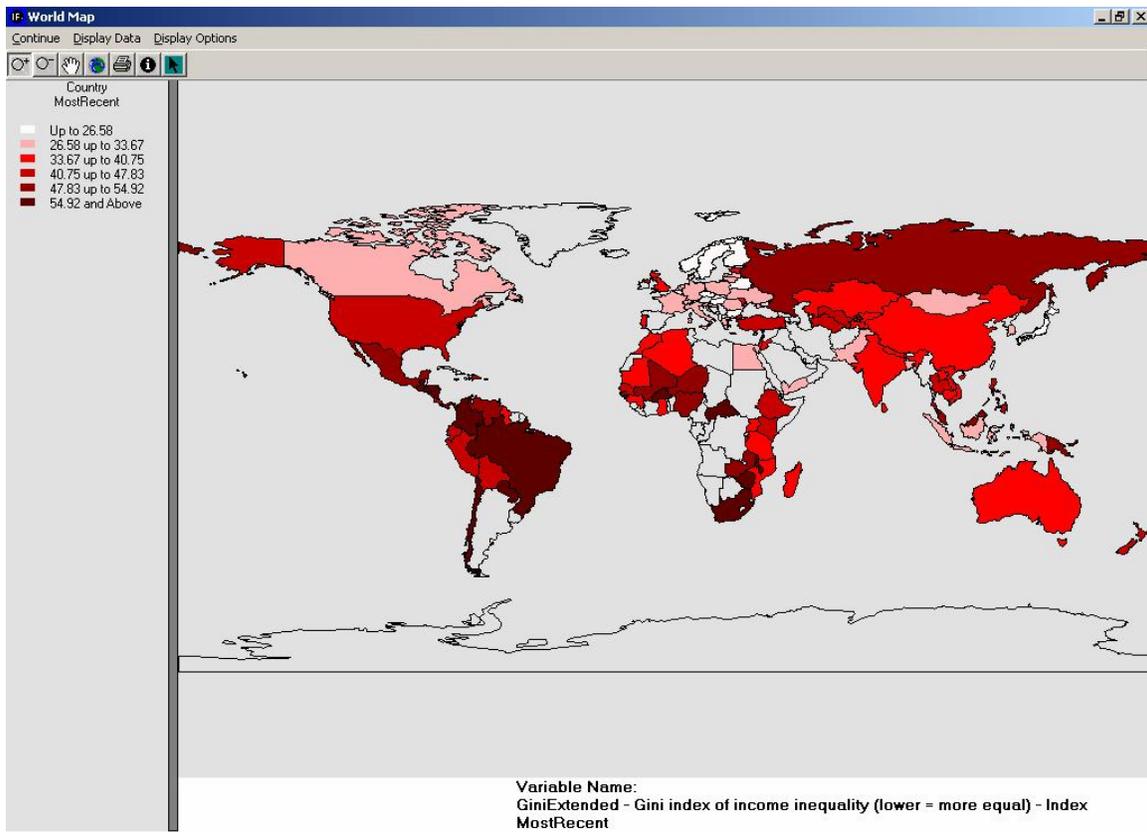
The table below shows the countries of central Africa individually, and they, too, have differential prospects. Overall, however, it is a “poor” neighbourhood in more ways than one, and that may further limit its economic growth.

IF: Table Display							
Continue Refresh Graph Print Save Percent Filter Display Run Horizon							
	GDPPC[0]						
	Angola	Cameroon	Central Afr	Chad	Congo	Gabon	Zaire
Year	Thousand \$						
2000	.525	.696	.339	.23	.792	4.377	.16
2001	.538	.712	.339	.242	.778	4.338	.157
2002	.55	.724	.332	.251	.793	4.24	.155
2003	.504	.713	.333	.252	.766	4.368	.153
2004	.473	.71	.33	.254	.742	4.413	.151
2005	.448	.706	.329	.257	.724	4.479	.15
2006	.427	.705	.327	.258	.709	4.541	.148
2007	.407	.705	.327	.26	.698	4.606	.147
2008	.387	.708	.328	.262	.69	4.669	.147
2009	.374	.714	.331	.264	.692	4.734	.148
2010	.362	.723	.334	.267	.706	4.822	.149
2011	.352	.735	.338	.27	.725	4.905	.149
2012	.344	.75	.342	.273	.739	4.965	.15
2013	.339	.766	.346	.275	.755	5.048	.151
2014	.337	.782	.351	.278	.775	5.15	.152
2015	.337	.799	.355	.281	.795	5.266	.153
2016	.339	.816	.36	.284	.815	5.393	.154
2017	.342	.833	.364	.286	.838	5.528	.155
2018	.346	.851	.368	.289	.862	5.669	.155
2019	.347	.869	.372	.292	.888	5.821	.156
2020	.35	.887	.377	.295	.914	5.982	.155

Poverty consists of much more than income level and human development involves much more than increasing income. The next chapter will return to the human condition as a foundation for further discussion of pressures and imbalances, but this chapter introduces the topic with a focus on income.

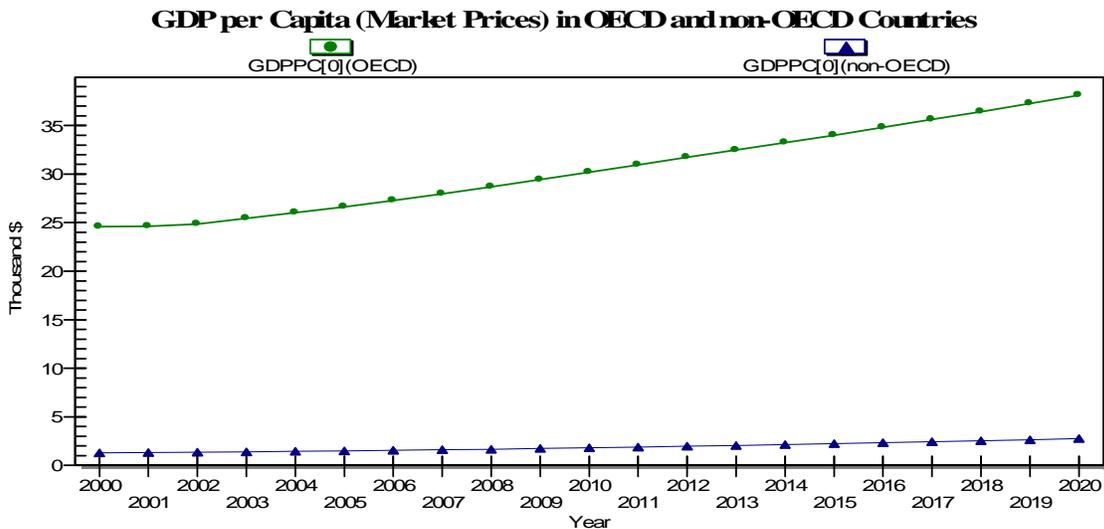
### 3.2 The Pressures of Unequal Condition, Local and Global

Gini indices provide a snapshot of intra-state income distributions. Although the database of indices represents a variety of surveys at different time points and many countries are not in the database, the general pattern is both clear and rather stable. There are tremendous debates over the directions of change, but change in domestic distributions is rather slow – the pattern in 2020 will not likely look very different from that in 2000 or the most recent year for data in each country, below. The tendencies for developing countries to be more unequal than more economically developed ones and for Latin America and Africa to have especially pronounced inequalities are well known. In those countries with high levels of inequality, the pressures for change are very likely to grow as populations become more educated and active.

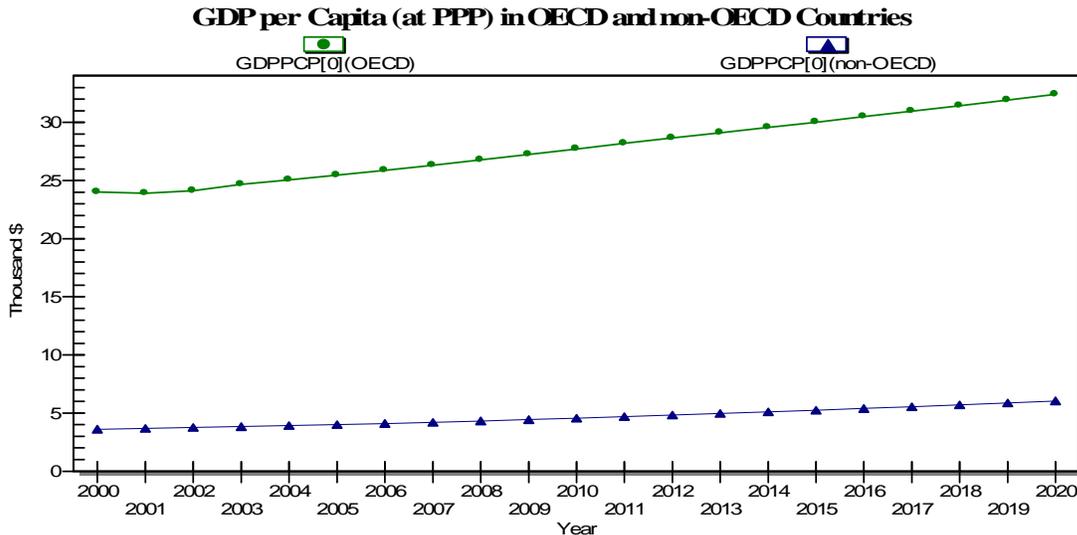


Is the world itself becoming more unequal and does that create pressures and imbalances? The appropriate answer probably is: (1) the world is clearly very unequal, (2) it's a matter of perception whether the world is becoming more unequal and (3) the perception that it may be becoming more unequal intensifies pressures around inequality.

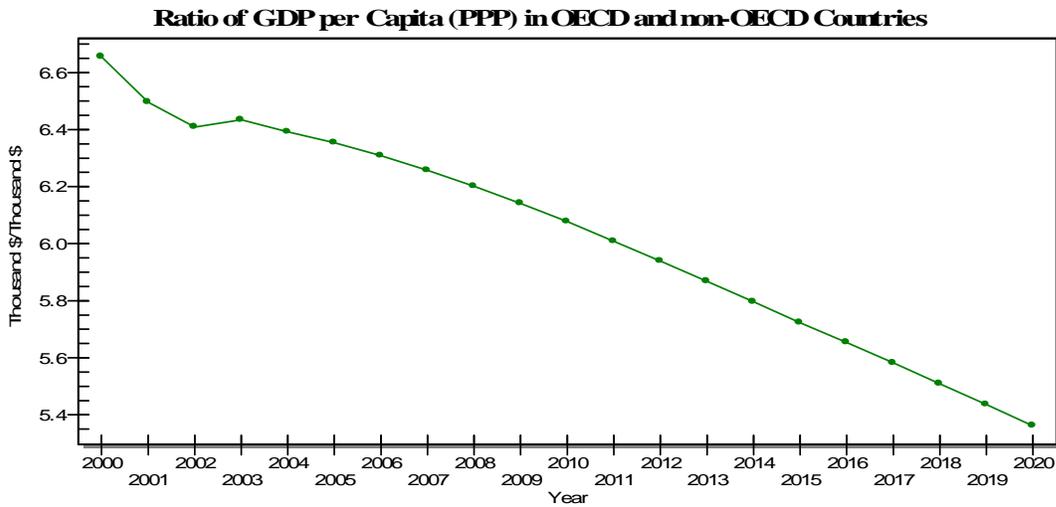
The first of four graphs below displays GDP per capita of OECD and non-OECD countries, using those groupings as a rough proxy for global rich and poor. The graph shows a nearly 20-fold gap in income between Northern and Southern states. There can be no question that this is an imbalance that stands at the core of many global difficulties. The discussion below on socio-political pressures and imbalances will further argue that the salience of global inequities continues to grow. The graph below further shows that GDP per capita at market prices in the OECD countries will likely grow by more than \$10,000 before 2020, while that in non-OECD countries will grow by a relatively insignificant absolute amount.



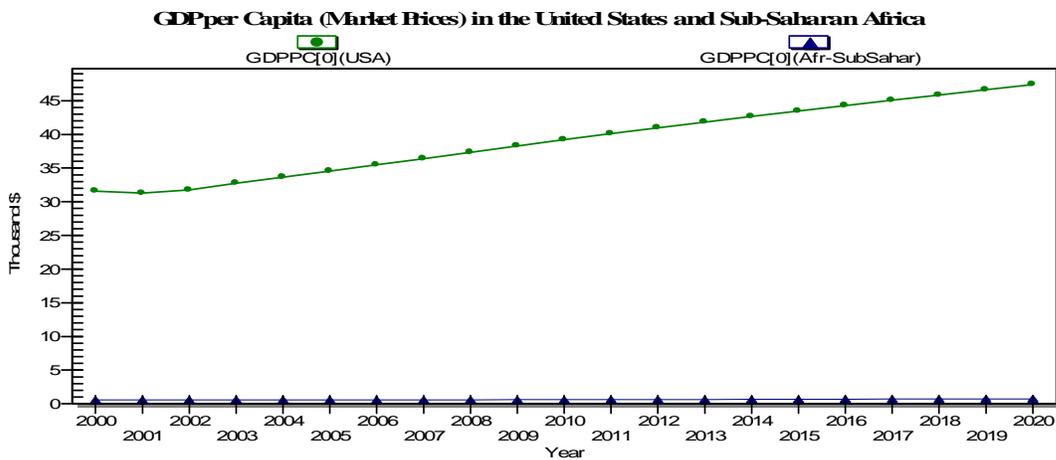
A second graph shifts the perspective to purchasing power parity, dropping the differential in income per capita well below 10-to-1. At purchasing power parity the per capita GDP in OECD countries will still grow substantially more in absolute terms than that in non-OECD countries, but some significant growth of non-OECD countries becomes apparent.



The third graph switches the perspective from absolute numbers to the ratio of GDP per capita (at PPP) in OECD and non-OECD countries. That graph, again from the IFs base case, suggests strongly that the developing countries are likely to gain on the richer countries, with a ratio beginning to approach 5-to-1 by 2020. This graph might suggest that the pressures and imbalances of global inequality are clearly subsiding.



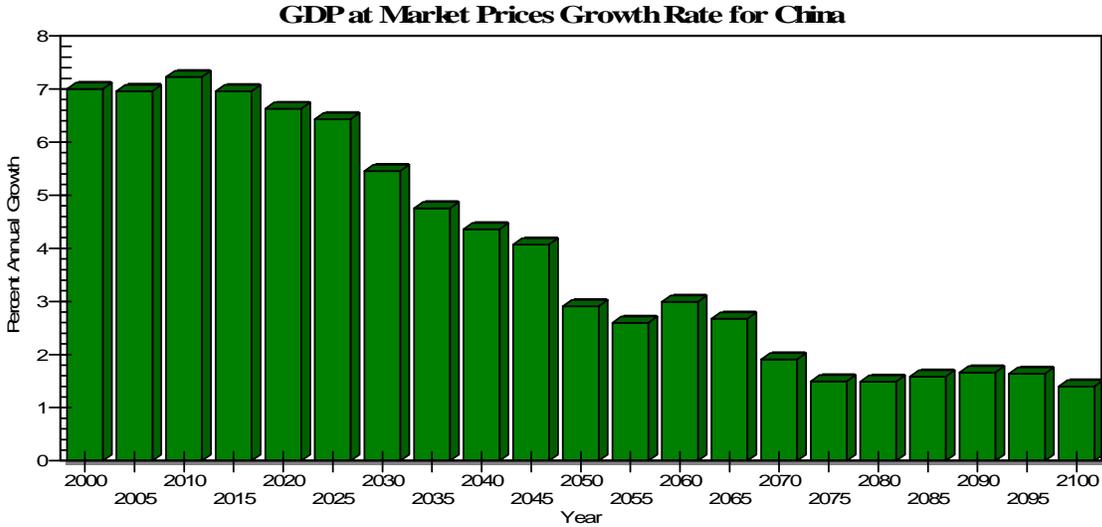
Yet the issues of inequality are both real and perceptual. The final graph returns to GDP per capita at market prices, comparing the United States and sub-Saharan Africa. Again the conclusion appears obvious. Sub-Saharan Africa is hardly in the game.



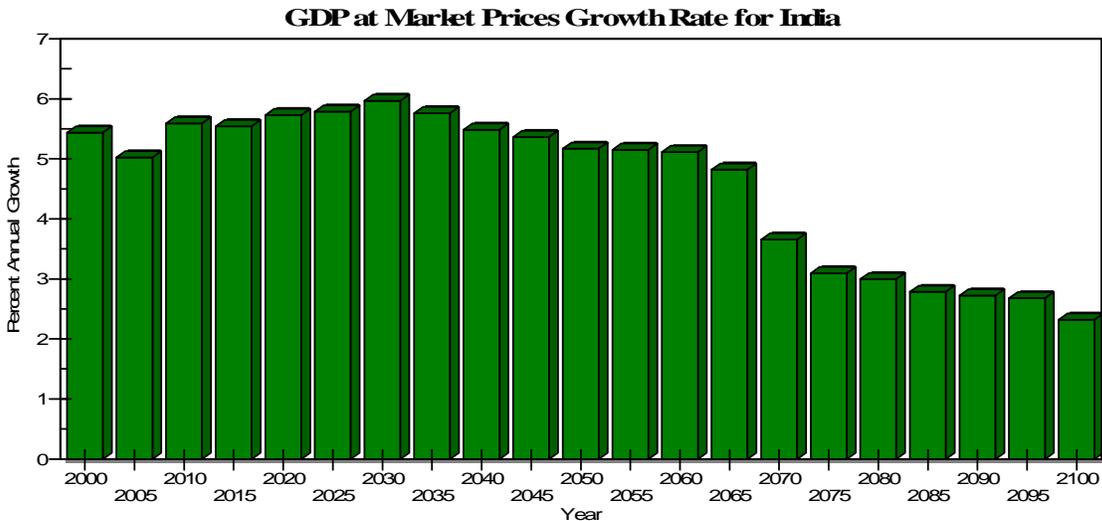
Regardless of the specific numbers and even of trends, there are many factors that are likely to intensify the pressures and imbalances around domestic and global inequality over the coming 15 years. These include the formulation of the Millennium Development Goals for 2015, the coalescence of large numbers of international actors around them, rapidly rising education levels in most countries, and growing democracy and therefore political participation around the world over recent decades. It is likely that global inequality will create even more dissension in the coming 15 years than it has in the last 30.

### 3.3 The Pressures of Fast Growth (and Possible Reversal)

The figure below shows the economic growth rate of China in the IFs base case. It shows continuing rates around 7% for the early years, with steady erosion over the longer run. In fact, the graph may be underestimating growth in the first decade of this century – there is considerable debate about the quality of Chinese statistics on growth and about the exact rates it is now experiencing.

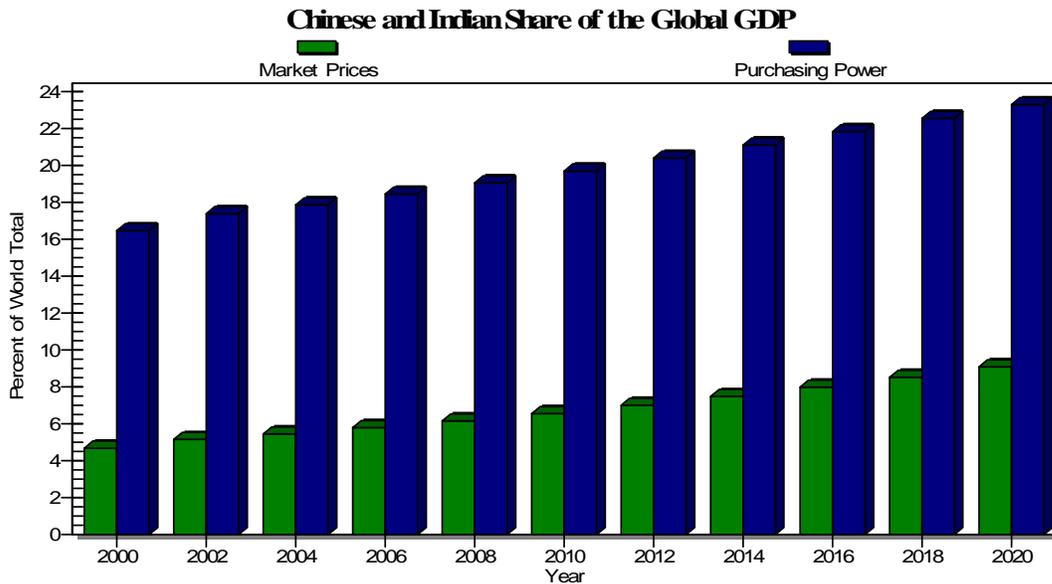


Because of the importance of India, the figure below shows long-term growth rates in the IFs base for it as well. In contrast to China, and in part because its economic catch-up is less far along, the higher growth rates it has been achieving in recent years persist in the base case for the first half of the century.

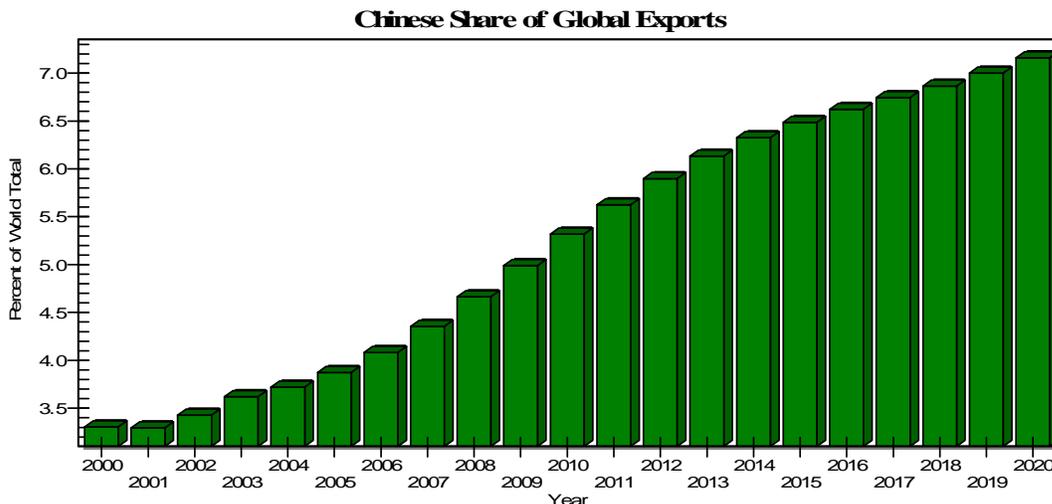


Such long-term forecasts are, of course, not to be given much credibility. The reality is that even forecasts through 2020 are highly speculative. Yet the possibility of such growth patterns essentially guarantees one of two kinds of pressures in the system. The

first will arise if the growth continues. The graph below shows the shares of the global economy that China and India may collectively have at market prices and at purchasing power, should their growth continue. Although the share and its increase are more impressive in purchasing power, economic weight in the global market place may be best measured by market prices. The forward march is substantial even at market prices.



The graph below looks at the possible share in world trade of China, substantially the greater export power relative to India. The current share of China is already creating pressures for some countries, notably the U.S. as it runs larger bilateral trade deficits with China. The larger share forecast would almost certainly exacerbate those pressures.



Still, the Chinese and/or Indian growth patterns may not continue. One or both could follow in the footsteps of Japan or South Korea, which exhibited long-term sustained growth until reaching the top ranks of economic developed. And one or both could follow the footsteps of Argentina early in the twentieth century, nearly reaching those ranks and then falling far back. With well above 2 billion citizens, more than 1/3 of the global total, with nuclear weapons and regional if not global political aspirations, the

Argentine pattern for China or India would like create even greater system pressures than would the Japanese.

### 3.4 The Pressures of Interconnected Growth

Interdependence of almost any sort is both a blessing and a curse. Neither cooperation nor conflict occurs between Haiti and Myanmar. Interdependence creates the potential for both. And clearly, economic growth has occurred globally in a way that has enhanced connections and interdependence among states everywhere. Thus the pressures of such interconnection have continued to grow. Among the most important of these economically is financial interconnection.

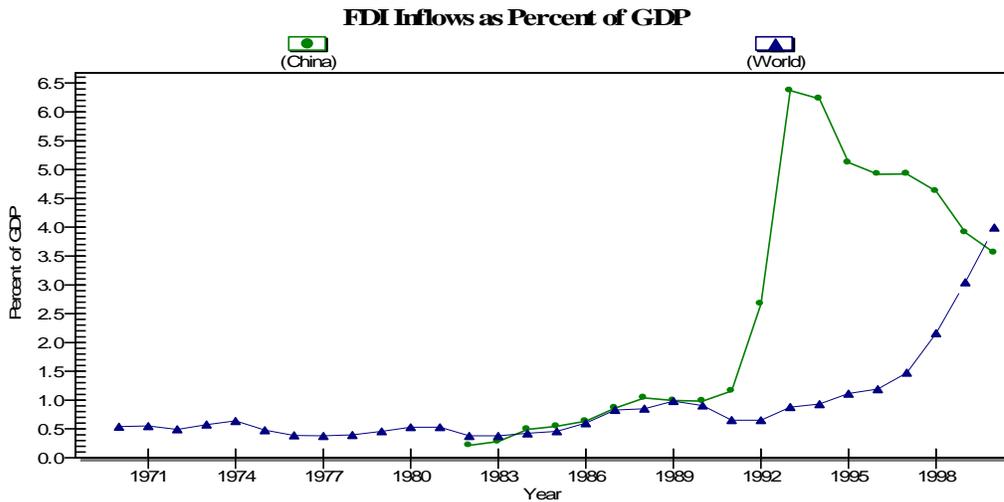
Financial variables, particularly the imbalances that may give rise to volatility and crisis, are nearly impossible to forecast through 2020. Financial crises, like that in Mexico in 1982 or those in East Asia and elsewhere in 1997, obviously surprise even most of the supposedly sophisticated analysts who are focused on them and have access to a wide range of data. Thus looking at the general patterns of interconnection that have emerged and that may continue to characterize the coming years has potentially more benefit than providing graphs of the future.

The phenomenon of financial globalization has consisted of major expansions in a variety of flows. The graph below shows the expansion of exports as a portion of GDP globally, adding a line for China because of the key role identified above and because of its rapid movement from a largely closed economy to a remarkably open one. Again, these enhanced trade connections bring a combination of cooperation, potential and actual conflict, and the threats of disruption.

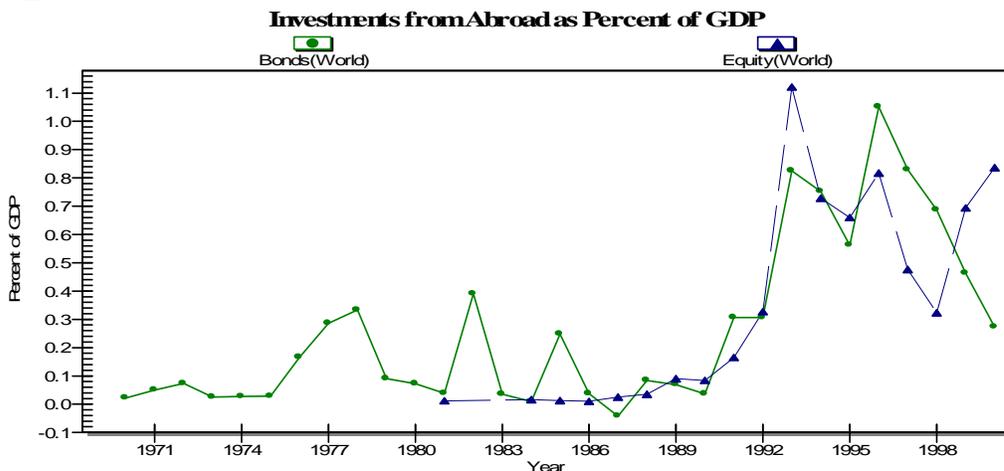


The four graphs below turn to financial flows in recent decades. The first shows the rapid global growth of foreign direct investment inflows as a portion of GDP. This graph also includes China because it has become the leading developing country target of FDI. Interestingly, the highest percentage numbers for China were actually in the early and mid 1990s – later in the 1990s China grew so rapidly that even larger flows became a smaller portion of its GDP. The graph does not show data for the early twentieth century,

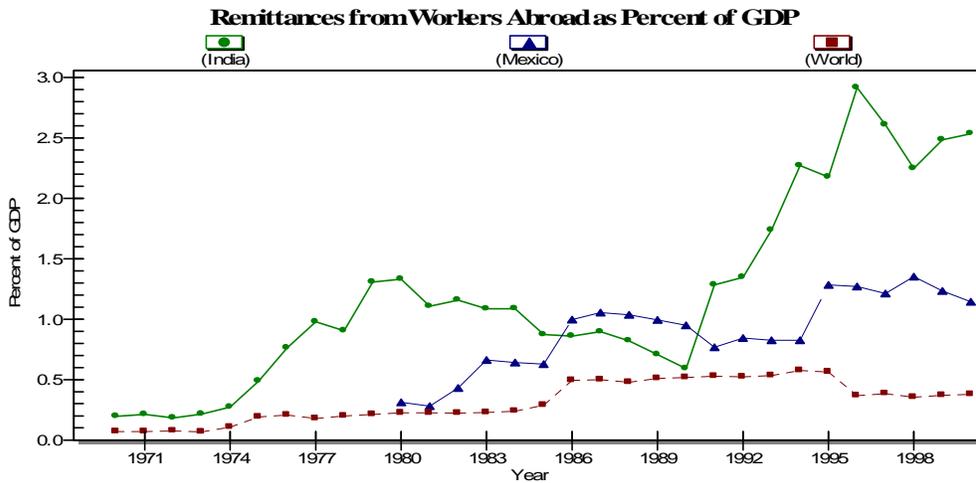
but FDI remains a very large portion of the capital formation in China, with all of the benefits and risks that it entails.



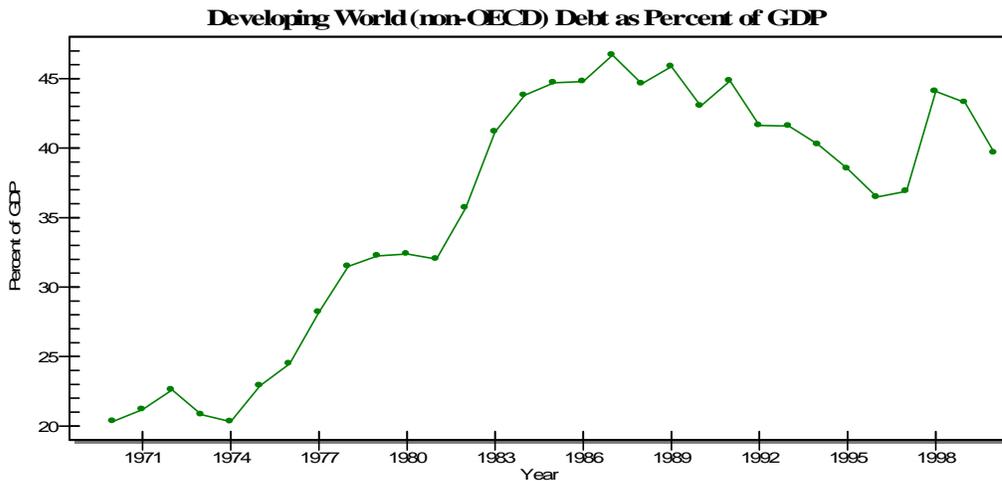
The two graphs below are each built from data that almost exclusively focus on developing countries. The immediate graph below shows bond and equity investment as a portion of GDP -- the pattern in developing East Asia is much the same as the global one.



Workers remittances have now also become a very substantial international financial flow. They have a special character, because they often come to those in the home country who are relatively poor. Many investment oriented flows and even foreign aid, as much as they are generally intended for the poor, most immediately enter the hands of firms and governments. It is striking to see what a large portion of Indian GDP now comes from worker remittances.



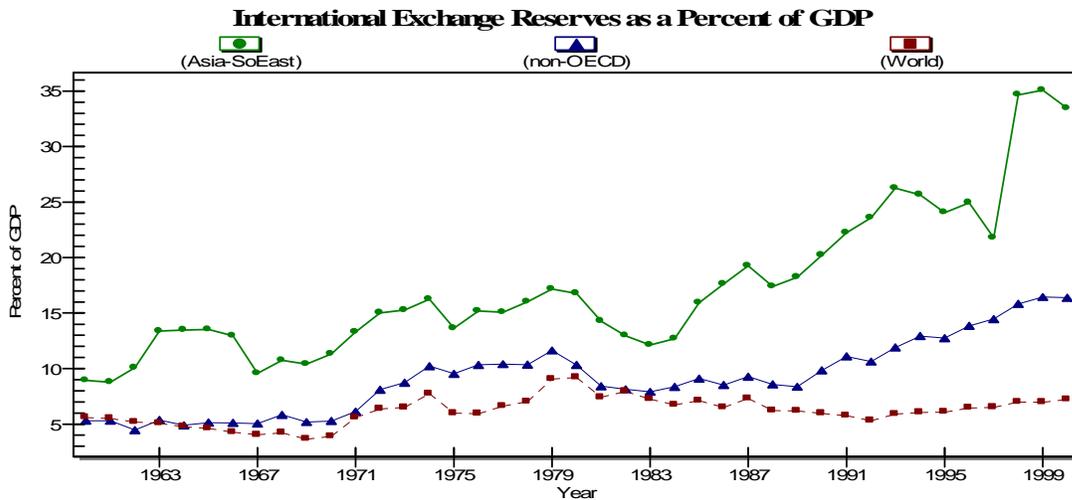
Among the key pressures and imbalances that arise from financial flows is indebtedness. The graph below indicates how it, too, has ballooned as a portion of developing country GDPs.



The table below shows the world's most highly indebted countries at the end of the twentieth century. The numbers in that table are ratios (not percentages) of GDP, and the filter that was applied identified countries with debt of 100% or more of their GDP (a ratio of 1). The zeros at the end of the series for Somalia and Zaire indicate missing data, not the repayment of debt.

IF: XDebt%GDP: Filter Minimum Level 2									
	XDebt%GDP[-1]								
	Mozambique	Nicaragua	SierraLeo	Somalia	Sudan	Syria	Vietnam	Zaire	Zambia
Year	Percent								
1966									
1967									
1968									
1969									
1970	.00	.261	.15	.239	.183	.129	.00	.00	.455
1971	.00	.302	.27	.255	.174	.132	.00	.072	.519
1972	.00	.35	.261	.243	.183	.135	.00	.108	.504
1973	.00	.407	.275	.245	.184	.156	.00	.132	.423
1974	.00	.401	.317	.374	.289	.115	.00	.159	.411
1975	.00	.506	.303	.322	.333	.115	.00	.198	.687
1976	.00	.481	.356	.357	.349	.151	.00	.302	.709
1977	.00	.574	.437	.791	.351	.237	.00	.297	.926
1978	.00	.679	.413	.918	.391	.218	.00	.292	.915
1979	.00	.979	.403	.977	.485	.235	.00	.30	.905
1980	.00	1.023	.402	1.093	.68	.272	.00	.332	.835
1981	.019	.998	.473	1.51	.649	.309	.00	.406	.90
1982	.035	1.196	.446	1.578	.775	.379	.00	.372	.947
1983	.131	1.489	.524	1.922	.887	.491	.00	.485	1.131
1984	.426	1.542	.435	1.90	.844	.49	.001	.673	1.383
1985	.644	<b>2.151</b>	.59	1.871	.719	.663	.004	.86	1.997
1986	.666	<b>2.347</b>	.965	1.935	.603	.968	.007	.888	<b>3.392</b>
1987	1.753	<b>2.058</b>	1.238	1.99	.545	1.393	.006	1.146	<b>2.867</b>
1988	1.989	<b>3.301</b>	.803	<b>2.009</b>	.768	1.581	.026	.966	1.798
1989	1.885	<b>9.559</b>	.902	1.977	.847	1.786	<b>3.29</b>	1.026	1.643
1990	1.888	<b>10.64</b>	1.284	<b>2.585</b>	1.121	1.402	<b>3.596</b>	1.099	<b>2.103</b>
1991	1.928	<b>7.361</b>	1.493	.00	1.335	1.475	<b>2.434</b>	1.193	<b>2.064</b>
1992	<b>2.768</b>	<b>6.288</b>	1.801	.00	<b>2.413</b>	1.45	<b>2.466</b>	1.337	<b>2.108</b>
1993	<b>2.63</b>	<b>6.438</b>	1.81	.00	<b>2.006</b>	1.473	1.883	1.256	1.981
1994	<b>3.338</b>	<b>6.712</b>	1.612	.00	<b>2.071</b>	<b>2.04</b>	1.597	<b>2.118</b>	<b>2.033</b>
1995	<b>3.228</b>	<b>5.653</b>	1.308	.00	<b>2.447</b>	1.879	1.259	<b>2.346</b>	<b>2.003</b>
1996	<b>2.663</b>	<b>3.107</b>	1.26	.00	<b>2.062</b>	1.558	1.12	<b>2.186</b>	<b>2.157</b>
1997	<b>2.247</b>	<b>3.17</b>	1.35	.00	1.54	1.443	.789	<b>2.129</b>	1.702
1998	<b>2.143</b>	<b>3.124</b>	1.809	.00	1.629	1.478	.828	<b>2.364</b>	<b>2.121</b>
1999	1.752	<b>3.207</b>	1.873	.00	1.609	1.405	.811	.00	1.886
2000	1.901	<b>2.929</b>	<b>2.002</b>	.00	1.367	1.275	.408	.00	1.969

Global connection and financial market volatility has given rise to a variety of approaches to addressing that volatility. One approach has been for foreign exchange reserve holdings to grow as a percentage of GDP. The graph below shows this trend for non-OECD countries as a whole, with a sharper variant of it in the Southeast Asian countries that experienced the 1997 crisis. Interestingly, the growth in those reserves of Southeast Asia, roughly in line with their growth in connection to the world economy (exports for the region grew from 20% to 80% of GDP between 1960 and 2000 and annual FDI inflows from about 0.5% to 4.5% of GDP), did not protect those countries from the crisis of 1997.

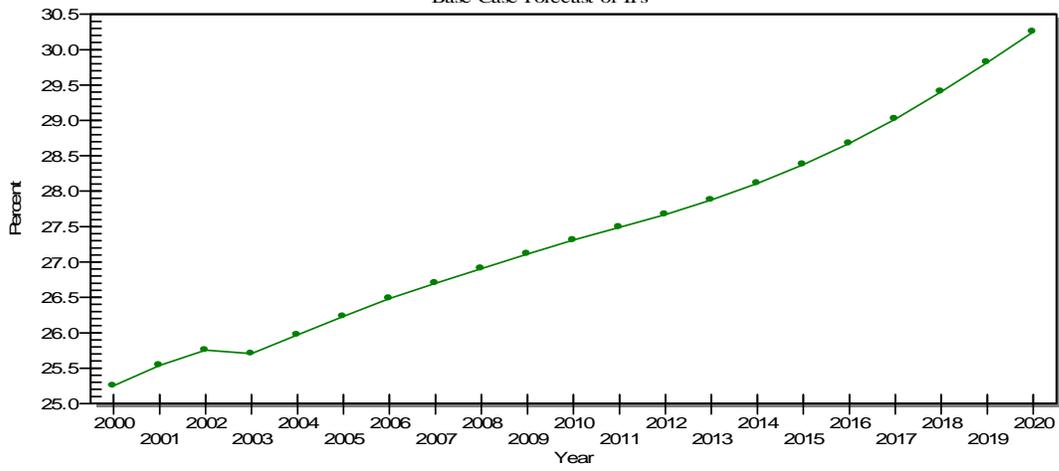


When reserve growth provides inadequate protection against loss of confidence, the resulting shocks lead to major shifts in patterns. The graph below shows the rapid movement of Southeast Asia from a small net importing position to a large net exporting position, essentially required by the markets to restore confidence.



Perhaps specific forecasting of timing and even location of financial crises and volatility as a result of increased global interconnection is impossible, but IFs does forecast (below) the continued growth of world trade as a portion of GDP. Thus the foundations for both the benefits and the costs of globalization may well grow stronger. If they do not, that will obviously bring a very different and perhaps even more substantial set of challenges.

### World Trade as a Percent of Global GDP Base Case Forecast of IFS



## 4. Socio-Political Systems

Turning first to domestic socio-political systems, pressures and imbalances often show up in several different areas. One is around the issue of values and identities. Culture does change, but often not as rapidly as other human systems. Thus the stress of culture being inconsistent with objective conditions is always possible. A second is around the human condition and the satisfaction of human needs. Socio-political systems must in some way “deliver the goods.” A third is around the structure and capabilities of institutions, formal and informal. Democracy can run ahead of or behind conditions that tend to support its stability. Poor governance can characterize any society and form of government.

Looking next at the global socio-political system, power has historically and will most likely remain at the core of tensions and imbalances. Both rising power and falling power have implications that can unbalance regional and global systems.

### 4.1 The Pressures of Value Change and Identity:

There are, roughly speaking, two quite contradictory views with respect to the past and future patterns of global development concerning values and cultures. One school sees values changing with economic development and political democratization in a larger pattern of modernization that is occurring almost everywhere, even though differences across cultural regions also have great staying power. Much of the writing from the World Values Survey (WVS) project (Inglehart 1997; Inglehart and Welzel 2003) falls into this perspective. The second school sees an intensification of conflict between broader cultural, primarily religious groupings, now that the ideological layer of the Cold War has been stripped away from global belief systems. Huntington (1993) is clearly associated with this “clash of civilizations” perspective.<sup>10</sup>

Once again, before thinking about the next 15 years, it is useful to gain some perspective on the evolution of values and belief systems in the past. Ronald Inglehart of the WVS has been very generous in providing data from that project to the International Futures modelling system. We can rely on some of that data to gain a perspective on value trends.

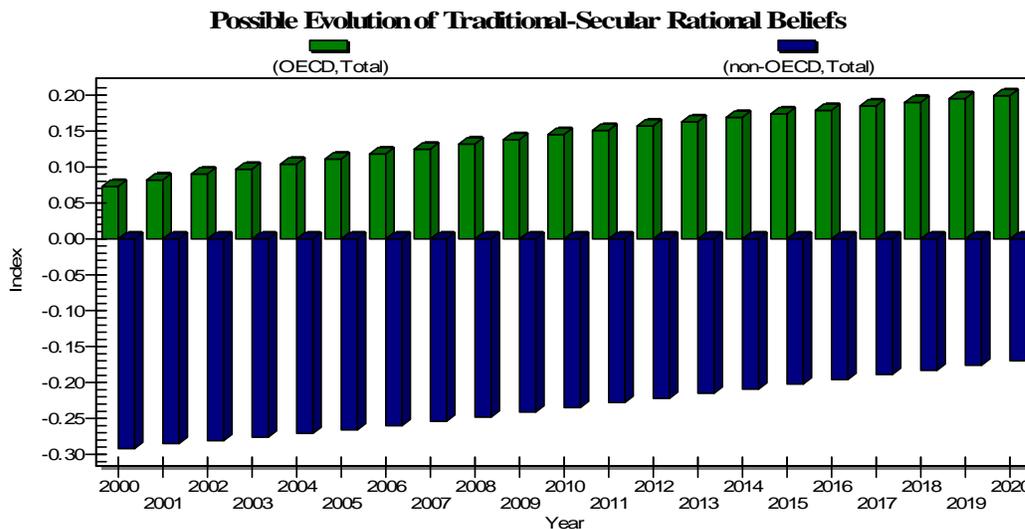
Undertaking and then analyzing surveys from four waves and across more than 60 societies, that project has identified two unrelated (orthogonal) dimensions of values that

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<sup>10</sup> There is remarkably little widely-accepted empirical analysis, either within the WVS project or elsewhere, upon which to base forecasting of the important dynamics of interactions of value structures across subpopulations or across societies (as opposed to forecasting of change due to forces solely within populations). At the same time, the prospects of intensified cultural conflict or “culture wars” within societies as rapid development reshapes them is a fairly common theme or hypothesis (e.g. Hunter 1991). Arnold Toynbee has also at least suggested that such intercultural dynamics are critical to the possible toppling of civilizations and their related cultures: when ruling minorities fail to deal creatively with external challenges (varying as widely as other civilizations or environmental degradation), a majority population can withdraw its support, leading to a loss of social unity and either large-scale re-orientations of cultures or the collapse of their civilizations.

organize a large portion of human values around socio-political phenomena. The first is traditionalism/secular-rationalism and the second is survival/self-expression. Based on cross-sectional and pooled longitudinal/cross-sectional analysis, the project has shown that humans seem to move across these values structures with economic and broader development, moving first to modernism and then to a post-modern value structure. At the same time, however, the WVS project recognizes that changes in values are strongly path-dependent, with starting points rooted in cultural traditions and history.

Based on this perspective, the graph below shows one possible evolution of values on the traditional-secular rational dimension through 2020. The graph suggests that both OECD and non-OECD country groupings may continue a pattern of becoming more secular-rational. In fact, if only because of the saturating properties of the questions that make up such an index (only 100% of a population can support abortion or oppose it), there appears in the graph to be a small degree of convergence with more rapid change occurring in the non-OECD countries.

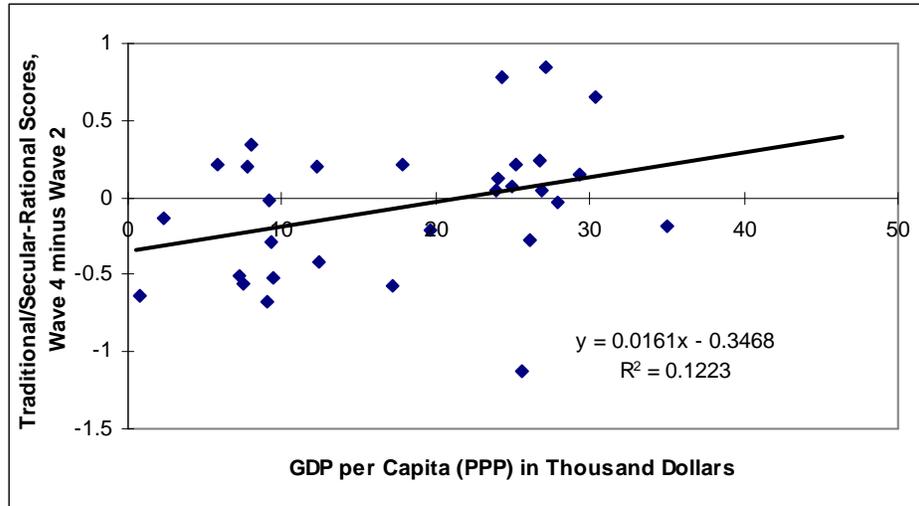


It should be emphasized that the above graph is not a product of the WVS project; in fact, it was produced by a formulation in the IFs model. That formulation is, however, substantially consistent with the analysis from the WVS project. Further analysis can, however, begin to cast doubt on formulation used for the above forecast and begin to suggest that there could be something more like the intensification of cultural differences taking place.

The WVS has undertaken four waves of surveys, in 1980-81, 1990-91, 1995-97, and 1999-01. The first wave was the smallest and least well developed methodologically. Inglehart has suggested focusing longitudinal analysis on the last three and that has the advantage also of corresponding mostly to the post-Cold War period.

The graph below shows the differences between country values on the traditional/secular rational dimension between waves 2 and 4, as a function of GDP per capita at purchasing power parity. Although the number of countries surveyed in both waves is not great and

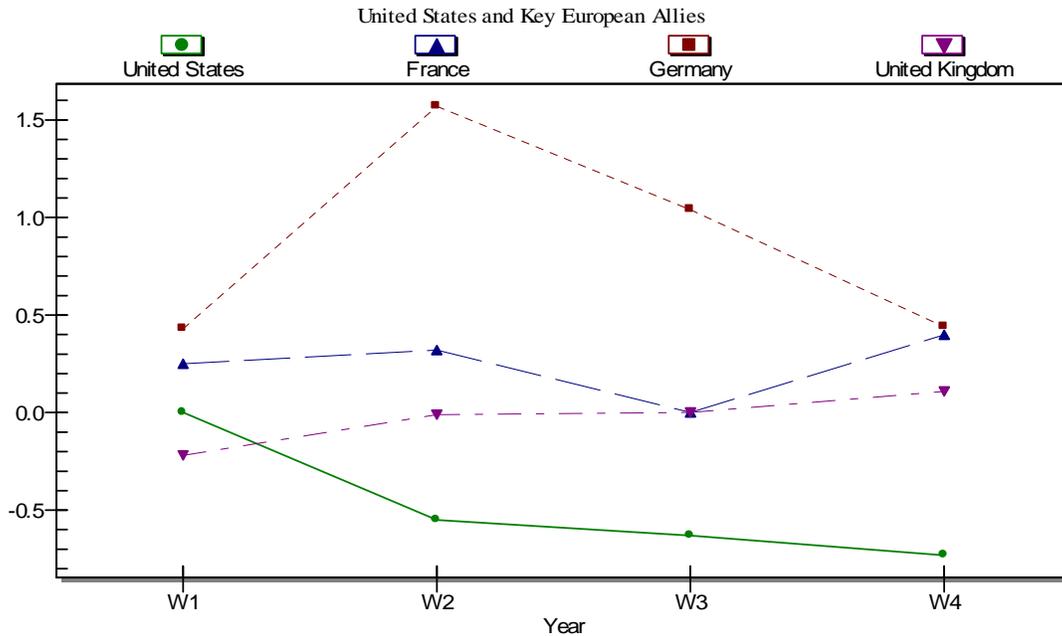
the dispersion of points is substantial, the overall suggestion is that during the 1990s the richer countries, on average, became more secular-rational, but the poorer countries became more traditional. In short, it suggests a pattern of differentiation globally rather than parallel paths, much less convergence.



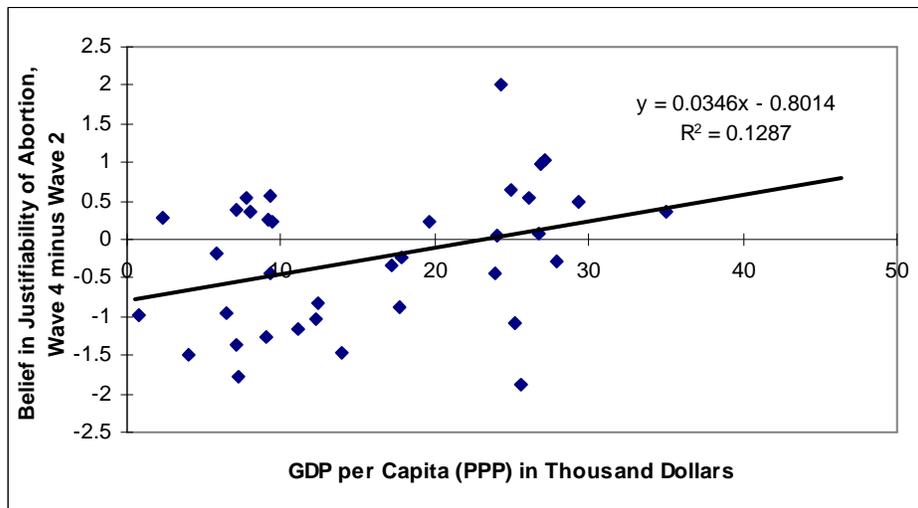
The graph does not, of course, suggest a clash of civilizations, but rather a growing North-South split. Unfortunately there are not enough countries in both of the two surveys to begin doing a regional analysis. Yet the countries that show a movement toward traditional/secular values over the decade are a poly-cultural combination of Latin American (Argentina, Brazil, Chile, Mexico), Eastern European (Poland), Asian (India), African (Nigeria) and some mostly wealthier European and North American countries (Canada, Germany, Ireland, Portugal, Spain, Turkey, and the United States). The poorer countries that shifted towards the secular-rational end of the dimension are formerly communist: Belarus, Bulgaria, Hungary, Russia, and Slovenia.

The inclusion of the United States in the set of countries that became relatively more traditional in values during the 1990s is interesting. The graph below shows that this relative shift of the United States has been longer-term, going back to the first WVS wave in the early 1980s, at which time there was no obvious difference in the scores of the United States and its major European allies. Values on this dimension in the United States appear to have become significantly less like those in Europe and more like those in developing countries.

### Traditional/Secular-Rational Value Scores Across Four Waves



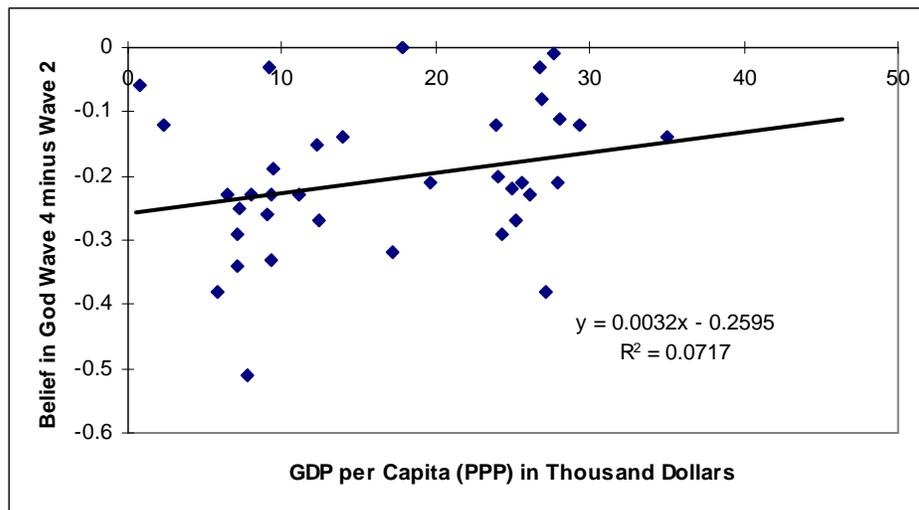
Turning to the specific beliefs that make up the dimension,<sup>11</sup> beliefs about whether abortion, divorce or homosexuality are ever justifiable all exhibit the same pattern of divergence across income levels. For instance, the graph below shows that on a 10-scale of acceptability of abortion, the least developed and most developed countries appear to have shifted away from each other by more than a full point over the decade. In the same period, there was a little less than a full point of separation of the extremes on divorce, and a bit more than a full point on homosexuality (although somewhat greater acceptance of it even in the poorest countries).



<sup>11</sup> Each of the WVS dimensions emerges from factor analysis and certain questions therefore correlate (load) highly with the respective dimensions.

Attitudes concerning respect for authority changed relatively little. But statements about the importance of god shifted apart by more than a full point on a 10-point scale, with the least developed countries again moving in the more traditional, god-embracing direction.

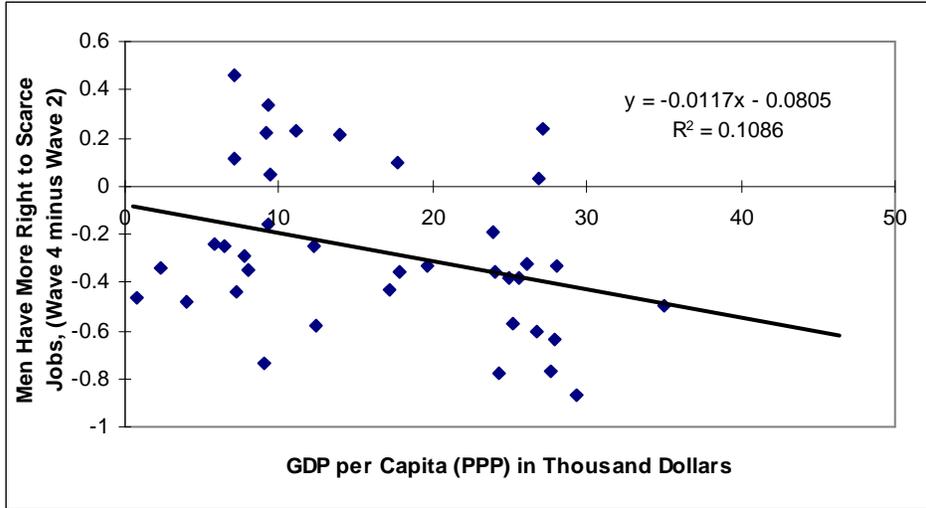
One of the most striking examples of value change over the decade concerns expressions of belief in god. The answers to the question were coded 1 for yes and 2 for no. Thus a shift of the values in the negative direction on Wave 4 minus Wave 3 is a shift towards belief in god. Again, the less developed countries have moved further in the traditional direction,<sup>12</sup> but the amazing aspect of the graph is that essentially no country moved towards less belief. This finding will require checking with the WVS project in case the question or coding somehow has determined that result.<sup>13</sup>



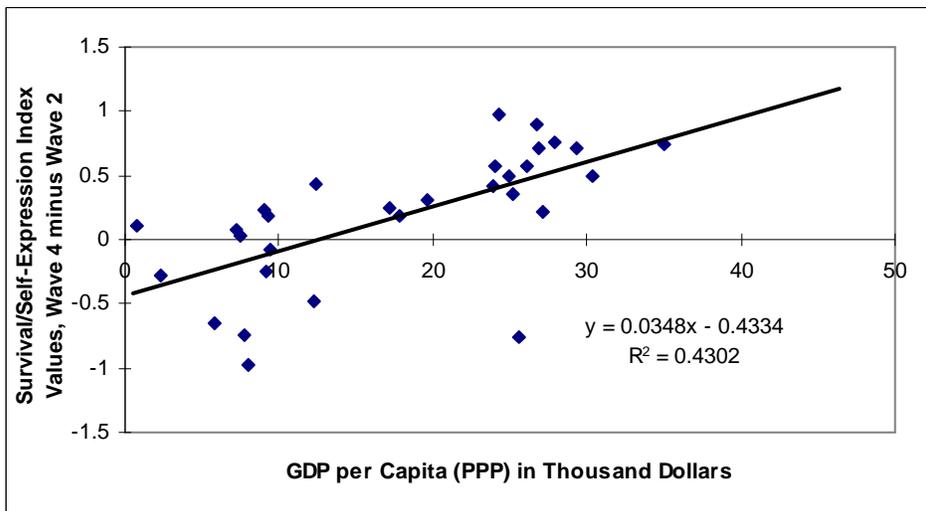
One other very interesting result related to the traditional/secular-rational dimension concerns attitudes towards sexual equality. The graph below looks at change in responses to a question about whether or not men have more right to scarce jobs. The answers are coded 1 for agree and 3 for disagree. Thus a shift in the negative direction over the decade indicates a growing belief that men have more right to scarce jobs. Two aspects of the graph are quite surprising: (1) the general pattern globally was towards acceptance of the proposition and (2) the greater shift occurred in more economically-developed countries. This is the only example discussed here in which more developed countries moved more substantially towards traditional positions that did less developed countries. It would suggest a very substantial global backlash against women's movements. (Again, this bears checking with the WVS project).

<sup>12</sup> The shift from Wave 2 to Wave 3 towards greater belief occurred in developing countries; developed countries shifted very slightly in the other direction. Between Wave 3 to Wave 4 nearly all countries shifted towards greater belief and the shift was somewhat greater for more developed countries.

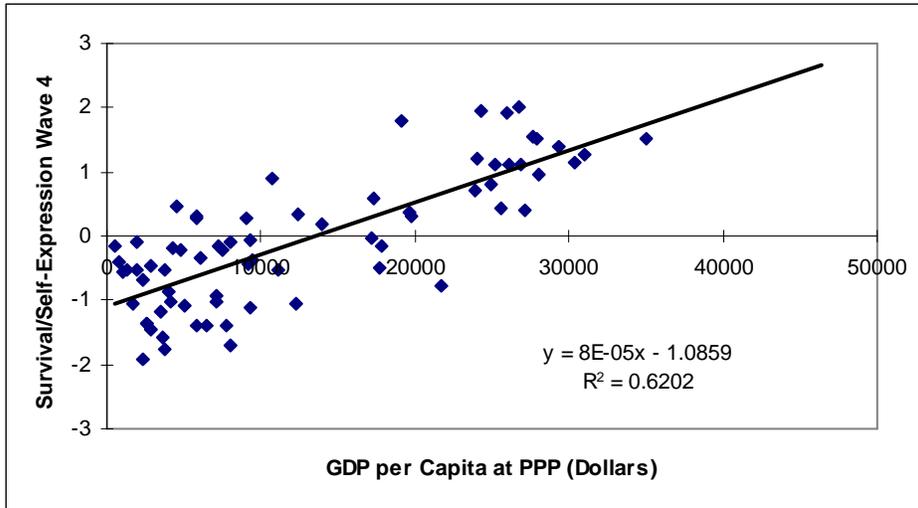
<sup>13</sup> Potentially the result could be an end of the Christian Millennium phenomenon, but that is unlikely given different calendars in other religious traditions.



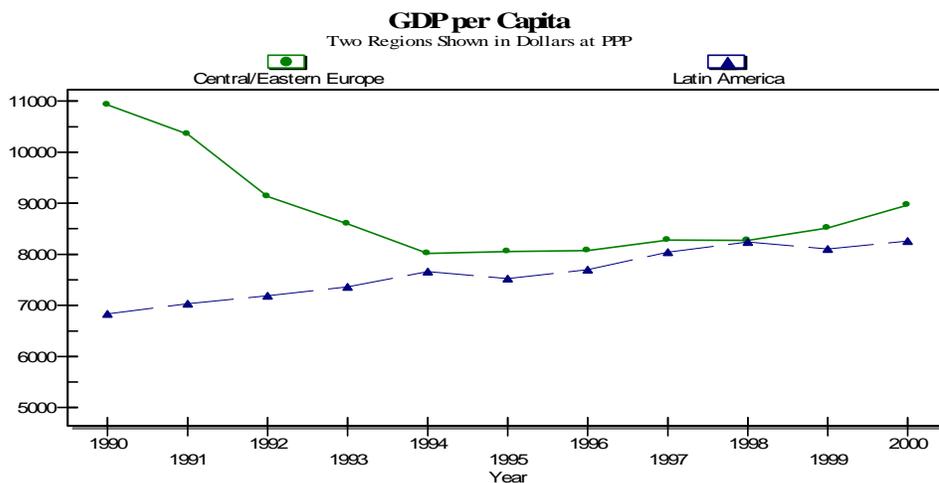
Turning to the survival/self-expression dimension, the overall finding of North-South divergence is statistically even stronger than it was for the traditional/secular-rational dimension. Whereas the rich appear to have become more interested in self-expression, the poor have become relatively more concerned with survival. The graph below shows both a remarkably steep line and a quite high R-squared. The pattern is quite consistent with the discussion in the last chapter about the growing salience of global economic divisions. One reasonable hypothesis is that the poor of the world increasingly see themselves as such, and have turned their attention to survival needs. That may, however, be an inappropriate interpretation of the situation. The countries that have moved toward the survival end of the spectrum are almost entirely formerly communist countries, where living conditions for many and security for almost all did deteriorate in the 1990s: Belarus, Bulgaria, Hungary, Poland and Russia. India, Germany (including East Germany, of course), and South Africa join the set. In contrast, small shifts towards self-expression were registered in a mostly Latin American set subject to globalization processes, but generally not to such significant economic liberalization : Argentina, Brazil, Chile, Mexico, Nigeria, Slovenia, and Turkey.



With respect to survival/self-expression, even more than on the traditional/secular-rational dimension, there is a very strong relationship with levels of economic well-being. The graph below, from the fourth wave, shows that relationship quite clearly.



The graph below suggests, moreover, that the movement of developing countries that we saw above either towards survival values or towards self-expression is quite closely tied to absolute economic condition. Measured by GDP per capita at PPP, economic condition deteriorated sharply in formerly communist countries of Central and Eastern Europe in the 1990s; at exchange rates the deterioration was significantly more dramatic. In contrast, the GDP per capita in Latin American countries improved somewhat.



Looking inside the dimension of survival/self-expression, the changes in responses on a 10-point question concerning satisfaction with life generally reinforce the above finding. Argentina and Mexico show somewhat greater satisfaction over the decade, whereas Bulgaria and Russia show more dissatisfaction in the first half of the decade and then some recovery. With respect to general happiness, Argentina and Mexico show a very

small shift towards greater reports of happiness, whereas there is a more complex pattern in Bulgaria and Russia.

What can we conclude about values, beliefs, and cultural systems as we use the evidence of last decade to look forward to the next 15 years or so? With respect to the survival/self-expression dimension, there were no real surprises, with a pattern of historic change that seems quite directly related to underlying economic conditions. Because of the deterioration of those conditions in former communist countries, there was a reinforcement of survival-oriented values in the 1990s. That is likely to be changing in the more favourable economic conditions of the new century.

It is the historic development of countries traditional/secular rational scale that presents some surprises. There appears to have been some divergence in values between richer and poorer countries during the 1990s, and also some between the United States and its primary European allies over a longer period. These value shifts generally appear contrary to the expectation that higher incomes bring more secular-rational values. In the case of both many developing countries and the United States, both with incomes rising faster on average than those in European countries, values have become relatively more traditional. In addition, it appears that there may also have been some absolute shift, as well as relative one, towards increasing religiosity and belief in God. This shift appears to have been essentially global.

The pattern of the last decade or so also suggests some support for the existence of the phenomenon forecast by Huntington, namely a *growing* clash of civilizations, based to a considerable extent on religious differences. Yet the WVS surveys do not include any significant time series data for Islamic countries, so we are not really seeing, for example, a growing Islamic reaction against the west. If Huntington's perspective does offer insight, it appears to come to a greater extent from his notion of the "West versus the rest."

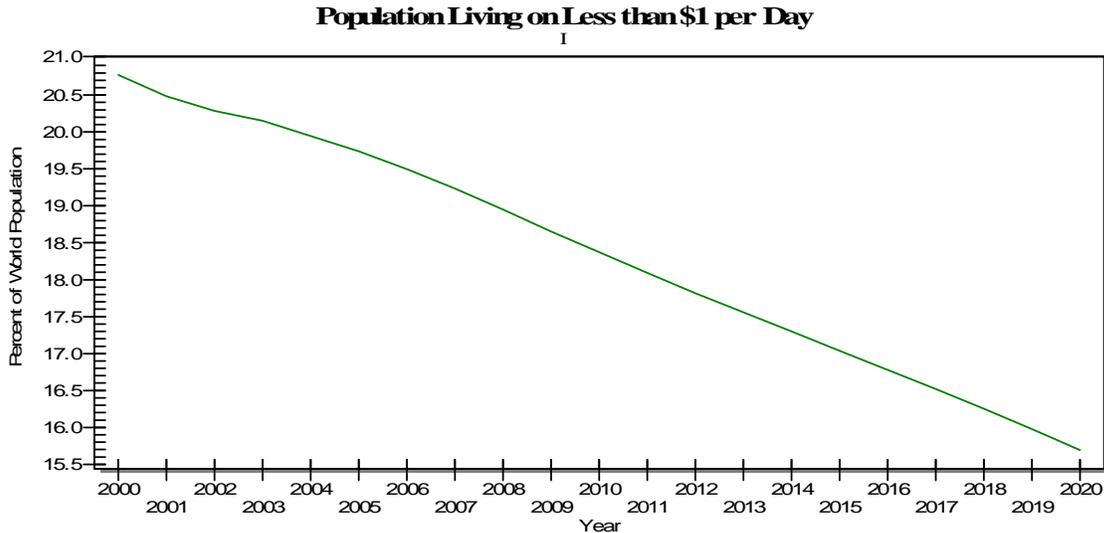
The overall pattern might more clearly suggest a development consistent with the hypothesis of Thomas Friedman around the symbols of the Lexus car of economic modernization and the olive tree of cultural identification. In the face of rapid economic change (for better or for worse), many people have reached for more traditional values. Although the notions that growing affluence over time shifts values in both the secular-rational and self-expression directions may be true, it may be that rapid change can also set up reactive dynamics that at least temporarily push people in other directions, especially with respect to traditional values.

The broadest conclusion is certainly that values and value change very much call for careful attention. The historical data period is too short and the country coverage too limited to draw strong conclusions. We shall return to other insights that can be drawn from WVS data when we focus on socio-political institutions.

## 4.2 The Pressures of Human Condition

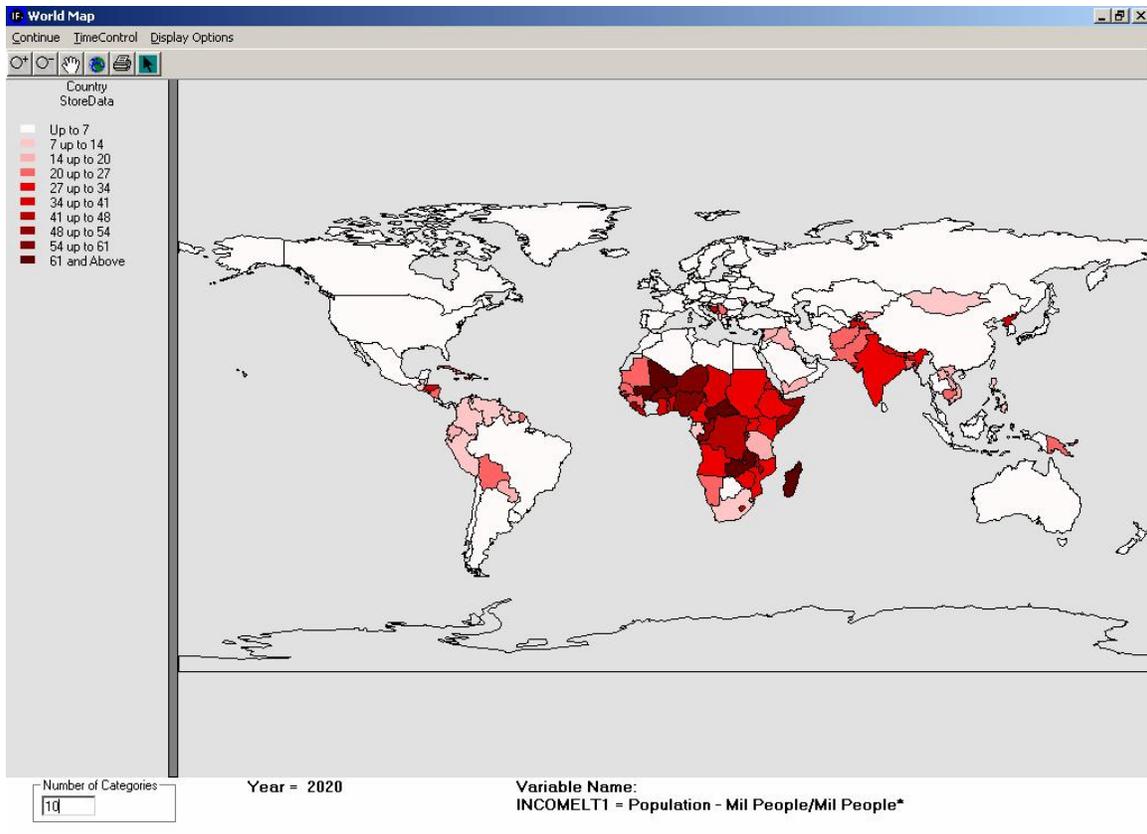
As discussed earlier, average income per capita provides important insight into human condition, but by no means determines it. The Millennium Development Goals (MDGs) are increasingly drawing attention around the world to the numbers living in poverty (as measured by those who have incomes less than \$2/day or, in extreme poverty, of less than \$1 per day. They also direct a spotlight on to levels of hunger, on infant and maternal mortality rates, on education levels, and much else. Clearly some of the pressures and imbalances in local and global systems relate to such variables, so this section looks at some of the forecasts of the IFs base case with respect to them.

The base case of IFs is generally somewhat less optimistic than the UNDP and the World Bank concerning the rate of progress likely towards the MDGs. In spite of the fact that the percentage in poverty in 2000 shown in IFs is slightly less than that of UNDP figures,<sup>14</sup> the goal of globally reducing it by 50% relative to levels in 1990 is not quite attained by 2020, much less exceeded by 2015.



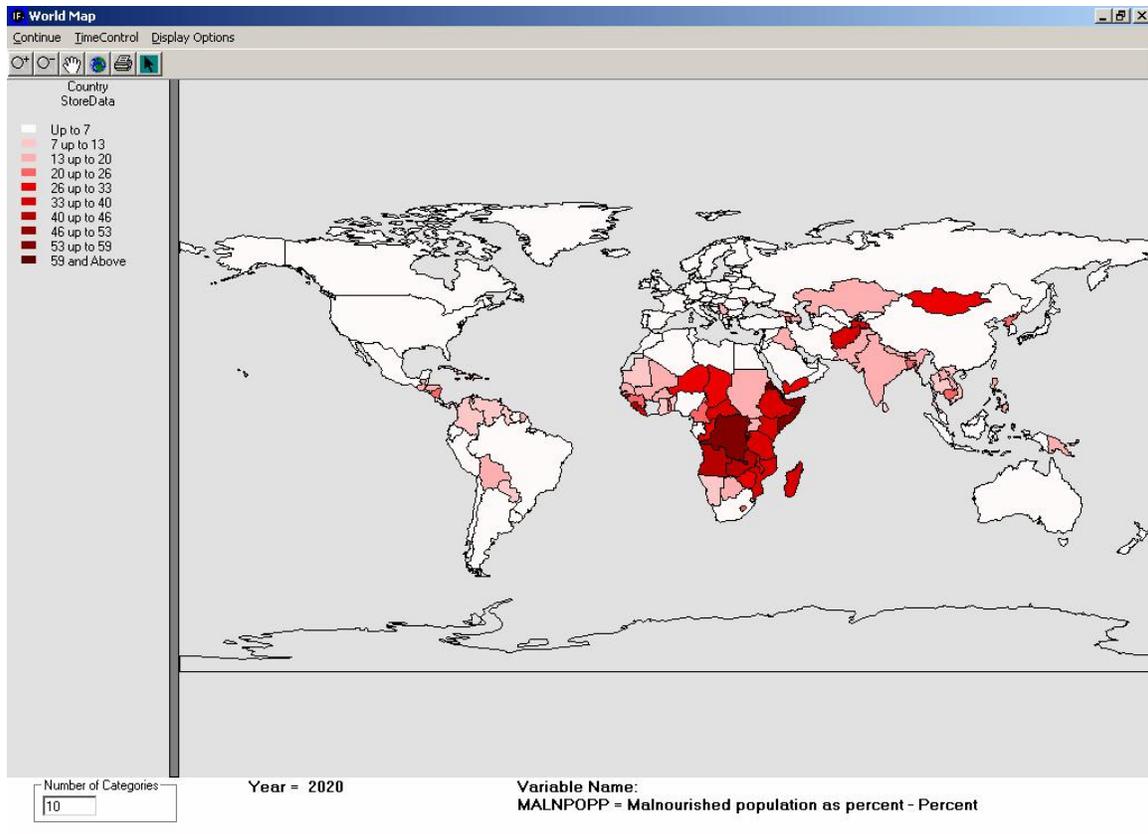
Most importantly, as all analysts agree, the failures to alleviate poverty will be concentrated regionally. The map below shows that the biggest pockets in 2020 will likely be in Africa, Latin America (notably the northern countries of South America and in Central America), and South Asia. There will most likely still be extremely high levels of poverty in quite a number of countries.

<sup>14</sup> Because IFs uses the UNDP data for those in poverty, it is surprising that the 2000 figure is not identical to that from the UNDP assessment.



The second target associated with the first MDG is to reduce the *proportion* of people who suffer from hunger, again by half between 1990 and 2015. In analysis of the global food system and calorie availability, the UN FAO (2000) concluded that the earlier World Food Summit target of reducing the *numbers* of globally malnourished by 50% before 2015 will not be reached and may still not be accomplished in 2030

The figure below shows the percent malnourished in 2020, as forecast in the IFs base case. Not surprisingly, the global distribution is almost identical to that for poverty.



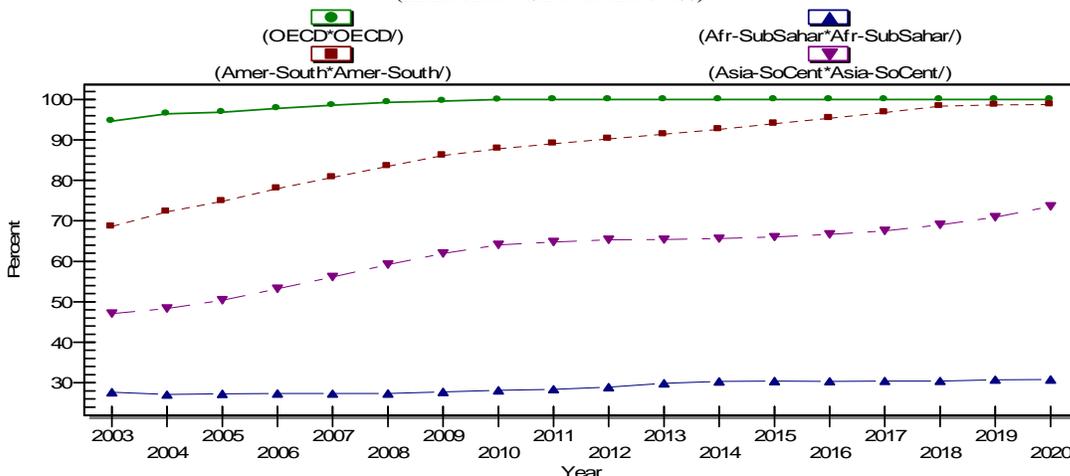
The second MDG is achievement of universal primary education. The third specific target is associated with that goal, and it calls for both boys and girls to meet the target by 2015. The UNDP (2003: 33) concludes that without intensification of effort this goal will not be met before 2050, with South-Asia, Arab States, and Sub-Saharan Africa being the most challenging regions.

The graph below shows the IFs forecast for the percent of those in the appropriate age category likely to complete a primary education (defined as five years globally).<sup>15</sup> That is essentially a universal phenomenon in OECD and developing East Asian countries (basically China). South America is moving rapidly towards it. Even South Central Asia and Africa show significant levels of completion, although further progress in completion rates is likely to be slow.

<sup>15</sup> Mohammad T. Irfan is developing an education module for IFs that, although it is still very much a work in progress, has begun to produce forecasts for primary, secondary, and tertiary education.

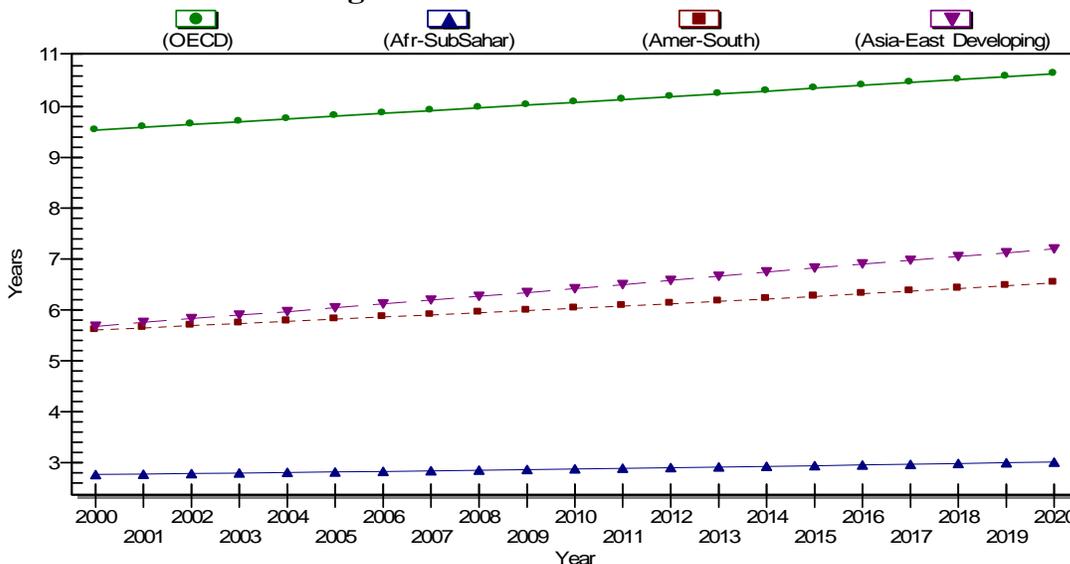
### Percent of School-Aged Population Completing Grade 5

(Intake Rate \* Survival Rate / 100)



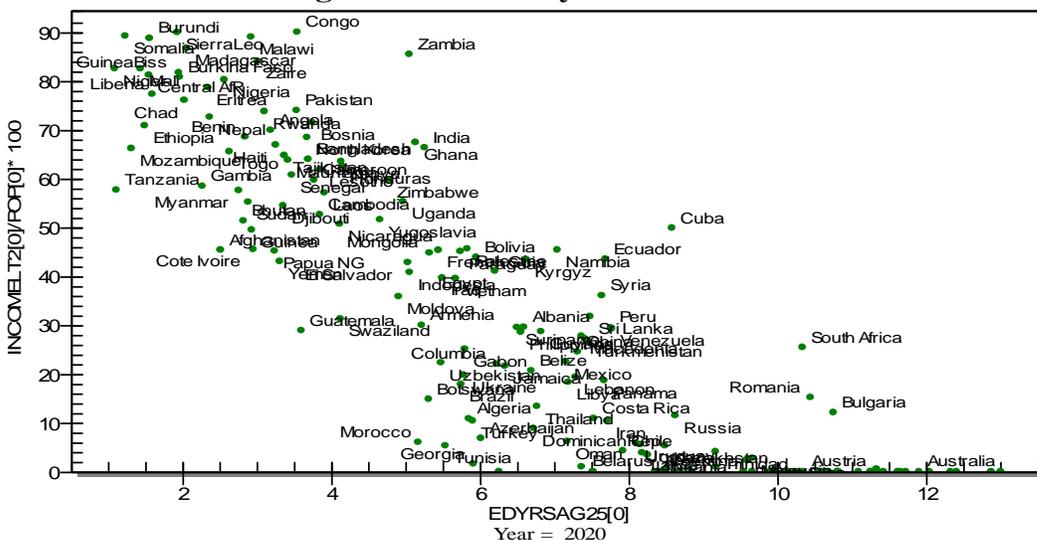
The graph below shows, however, why even movement towards universal primary education completion will not easily turn around the educational conditions in most developing countries. Because so many people in those countries have already reached or will yet reach adulthood without having completed primary education, the average years of education will not quickly rise in most developing regions. Even as the population with primary and higher educations rises (creating its own social transformation pressures), the average level of education in most developing regions will remain low through 2020.

### Average Years of Education for Those Over 25



Years of education of the adult population is a very important variable of human condition because it is highly correlated with much else: fertility rates, democracy stability, and, of course, poverty (see below).

### Percent Living on Less Than \$2/Day as Function of Education Years



The fourth MDG is to reduce child mortality, with the specific target being to reduce the under-five mortality rate by two-thirds between 1990 and 2015. The UNDP (2003: 33) again suggests that the world is NOT on track to meet this goal by 2015, but in the absence of quite substantial intervention is more likely to do so between 2020 and 2050.

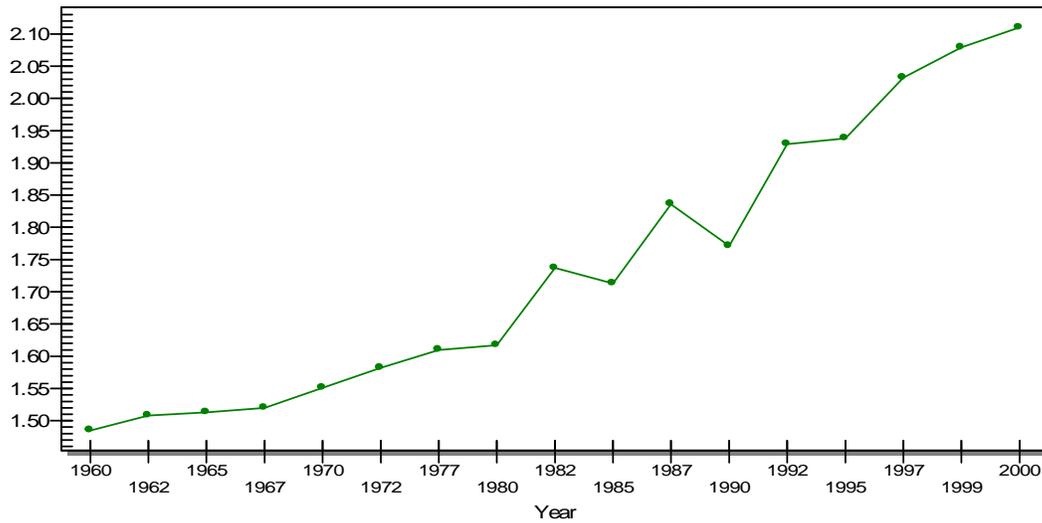
Global infant mortality (the greatest part of under five mortality) in 2000 was about 49. The table from the IFs base case below shows infant mortality forecasts for all countries that have or appear likely to have rates of 135 or higher between now and 2020. These countries are obviously great outliers from global patterns and are therefore candidates for high levels of instability. Note that the rate might actually worsen in Somalia, a failed state that could well experience increased food shortages and associated mortality.

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	INFMOR[0]	INFMOR[0]	INFMOR[0]	INFMOR[0]	INFMOR[0]	INFMOR[0]	INFMOR[0]
	Afghanistan	Angola	Liberia	Niger	SierraLeo	Somalia	Zaire
Year	Per Thous	Per Thous	Per Thous	Per Thous	Per Thous	Per Thous	Per Thous
2000	166.6353	150.7	152.7	136.2053	182.6055	133.7	157.4417
2001	165.0173	149.6	151.6	134.9645	181.0856	133.0	156.5902
2002	164.2599	148.4	152.6	134.3027	179.4892	133.4	155.9185
2003	163.2886	149.6	152.8	133.6387	179.2857	133.8	155.2807
2004	162.5287	149.5	153.4	132.9401	178.5236	134.6	154.6411
2005	161.6931	149.2	154.0	132.2346	177.8546	135.2	154.0012
2006	160.7359	149.2	154.5	131.5115	177.0774	135.8	153.3192
2007	159.6263	149.1	154.6	130.7579	176.2765	142.6	152.5657
2008	158.3598	148.9	159.0	129.9574	175.3615	145.1	151.7347
2009	156.9579	148.4	159.6	129.1266	174.4180	146.5	150.8175
2010	155.4809	147.6	159.3	128.2856	173.4794	146.1	149.8827
2011	153.9649	146.6	157.9	127.4389	172.5139	144.8	148.9397
2012	152.4518	145.4	155.8	126.5979	171.5647	143.9	148.0028
2013	150.9560	144.1	153.1	125.7510	170.6090	142.4	147.0828
2014	149.4869	142.7	150.4	124.9172	169.6988	139.9	146.2083
2015	148.0470	141.5	148.1	124.0901	168.7885	135.8	145.3849
2016	146.6308	140.5	146.7	123.2983	167.9156	131.6	144.6234
2017	145.2371	139.9	145.7	122.4850	167.0517	128.9	143.9341
2018	143.7540	139.9	144.7	121.6787	166.1625	127.6	143.3081
2019	142.2275	139.9	143.7	120.8676	165.2795	126.6	142.7351
2020	140.6428	140.3	142.6	120.0610	164.3895	126.0	142.1995

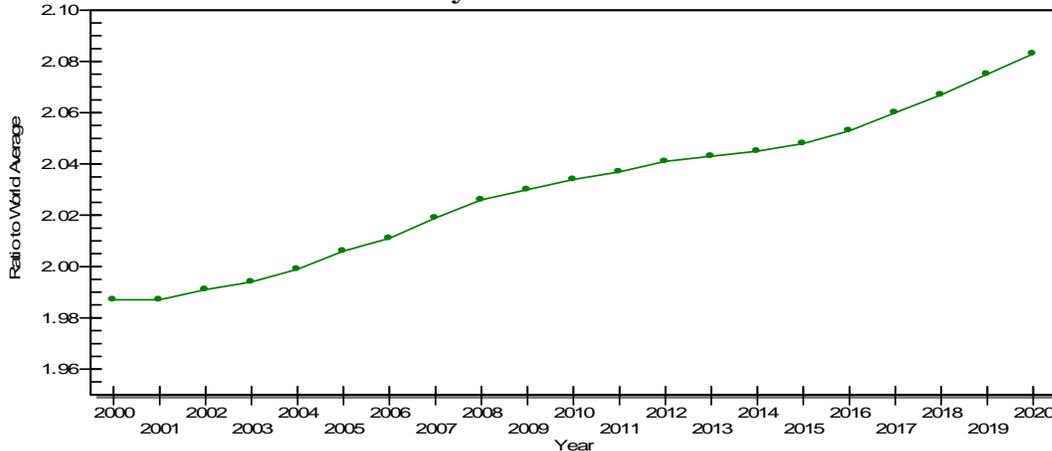
The pair of graphs below turns to the measure of infant mortality found by the State Failure Project to be of special significance. The project uses a logged and normed formulation, dividing infant mortality for states by the world median. IFs uses world averages instead of the median. To compute world and regional averages, the IFs system uses population weightings. The historic pattern shows a steady historic deterioration of African government ability to deliver improved infant mortality levels at the rate of the rest of the world (in absolute terms there is improvement almost everywhere, but it is considerably slower in Africa). The second graph in the pair suggests that the deterioration is likely to continue.

### Historic Infant Mortality in Sub-Saharan Africa

Normed: Divided by the World Average



### Normed Infant Mortality in Sub-Saharan Africa: IFs Base Case



There are a total of eight MDGs with 12 targets. One of those is to combat HIV/AIDS, malaria and other major diseases, with a specific sub-target of halting and reversing the spread of HIV/AIDS by 2015. As was discussed earlier, the UN AIDS forecasts now posit a peaking of the infection rate for most countries by about that year and IFs, using UN AIDS assumptions, does the same. However, AIDS deaths are likely to continue to

grow in much of the world through 2020. And, rates of infection and of infection growth in China, India, and Russia might well have been underestimated, creating special pressures in those countries over the next 1-2 decades.

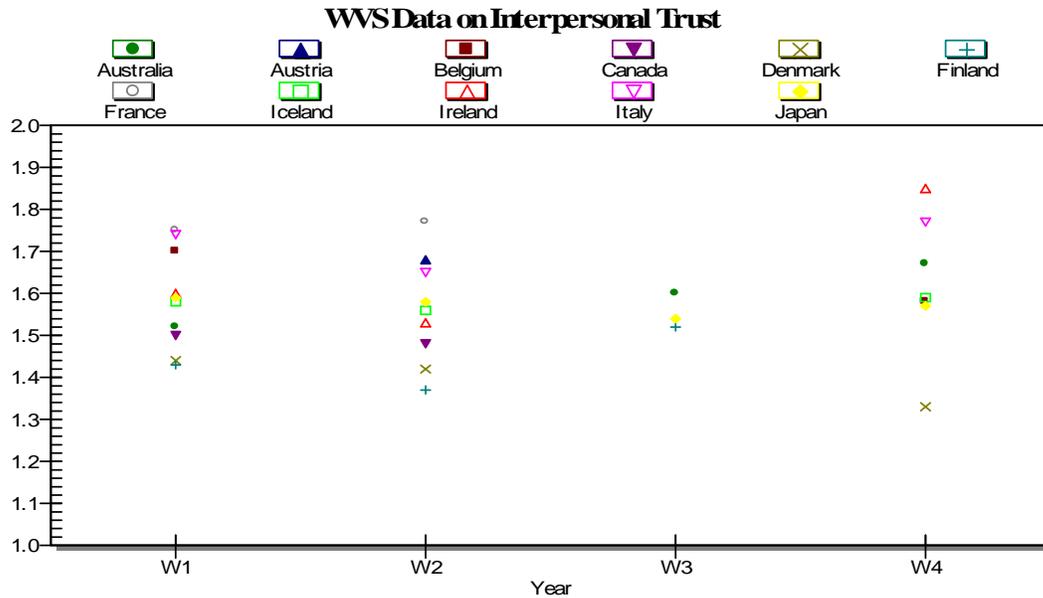
### **4.3 The Pressures of Institutional Change**

The key institutional development globally is democratization. Other project documents (Hughes June 2004) have discussed the representation of democracy within IFs at considerable length. Here the focus will be on the degree to which support systems are in place for democratization and the degree to which democratization levels in various countries seem to be approximately where broad analysis of the process suggests they should be. The foundational assumption is that democracy that outstrips its foundational base or democracy that falls behind its normal evolution both create pressures and imbalances.

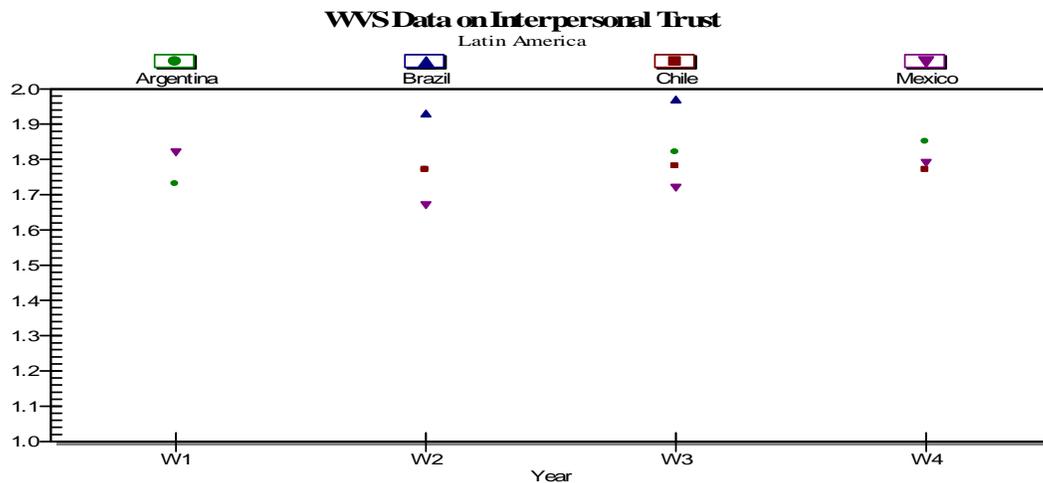
Economic development is widely recognized to be a foundation for democratization. But so too are various elements of civil society, including interpersonal trust, and of value systems (especially movement towards the self-expression end of the survival/self expression dimension). It is worthwhile looking at these foundations, beginning with trust, before turning to democratization levels.

The World Value Survey can help us begin exploring values and beliefs about socio-political institutions, to which the discussion will return later. In particular it is useful to know what kinds of options people believe they have to improve their conditions. Do they trust others in the society and are they therefore likely to engage actively in civil society? Can they rely on their national government? Do they believe in democracy? Do they believe in the efficacy of their own active participation?

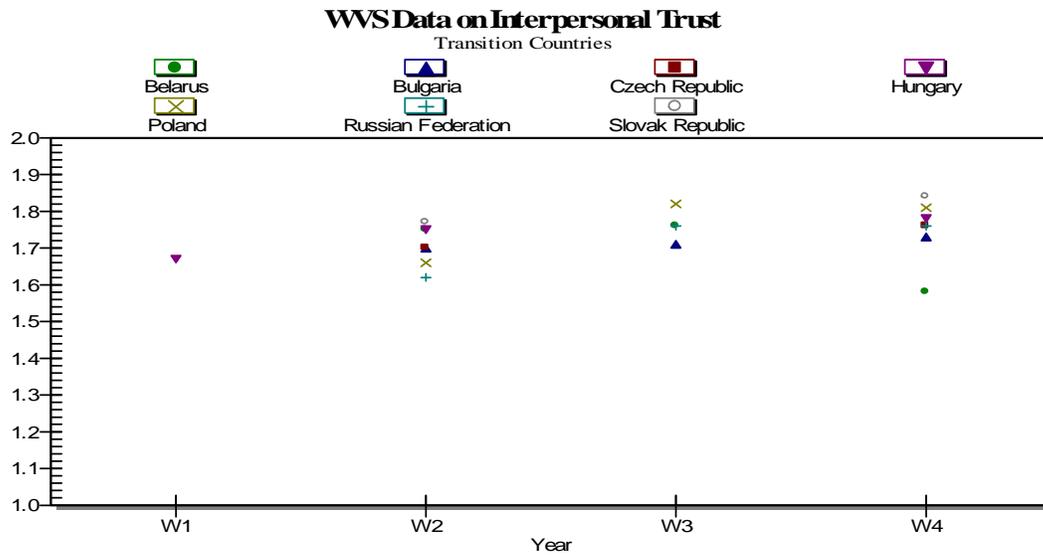
Below is a figure across the four survey waves (early 1980s to early 2000s), showing the average level of trust within selected countries, an arbitrary, low-alphabet set of the OECD countries. The question provided two alternatives: most people can be trusted (coded 1) and you can't be too careful (coded 2). Putnam (1995) and Fukuyama (1999) have both argued that since the 1960s there has since the 1960s been a breakdown in social capital, measured especially for Fukuyama by such interpersonal trust. Unfortunately, the WVS data do not go back far enough to provide a baseline in the 1950s or 1960s before the posited disruption of social capital. The WVS data do not, however, show any significant average change across the OECD societies during the last 20 years (Fukuyama suggested an ongoing deterioration across much of it, with some possible rebuilding of social capital emerging near the end of it). Instead, what we see is the rather persistently low level of trust in Italy, consistent especially with studies by Banfield and Putnam of its South, an increase in trust over time within Denmark and a deterioration of trust in an economically-booming and immigrant-absorbing Ireland.



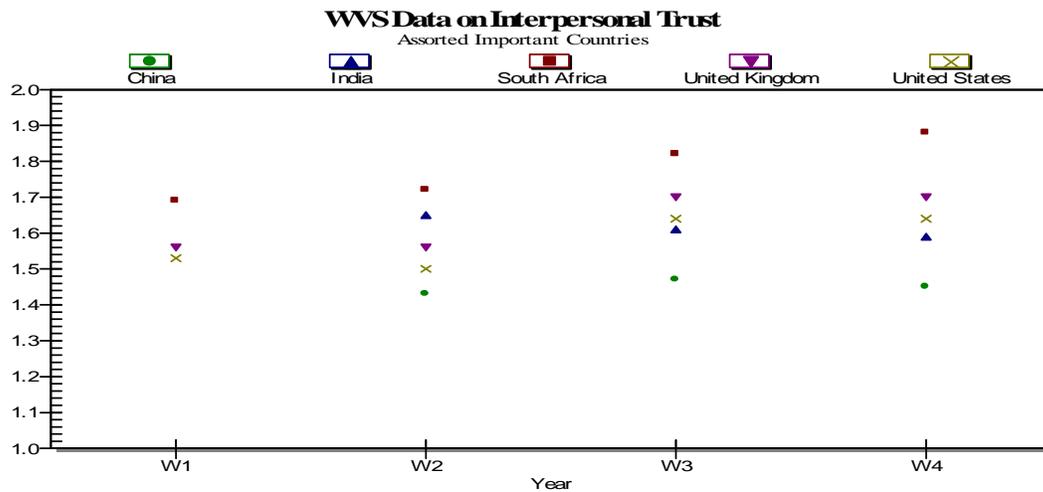
To the degree that interpersonal trust is an important foundation of civil society and democratization, the World Value Survey does not provide a great deal of hope for the stability of democracy in many developing countries. Below is an illustration of trust levels over time in Latin American countries. Trust tends to run much lower (as indicated by values close to 2) than in the OECD.



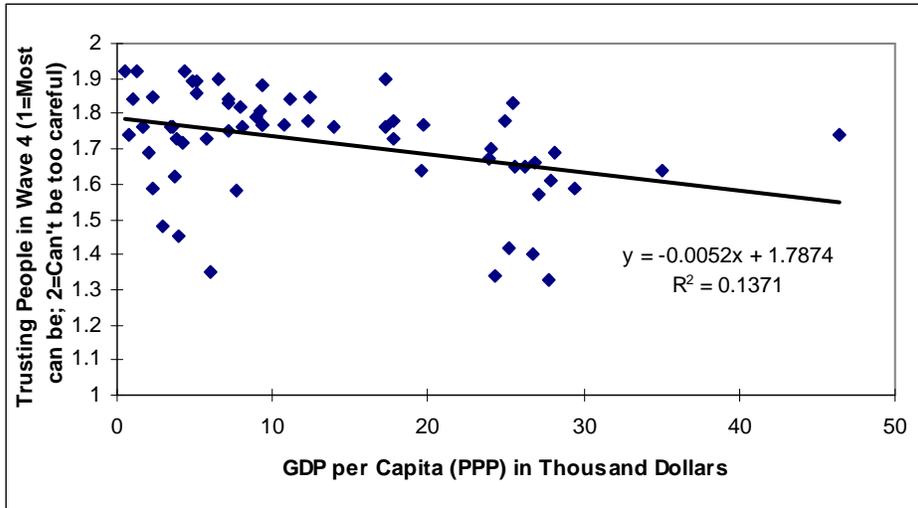
The transition countries from communism, however, show somewhat greater levels of trust, if not at OECD levels on the whole.



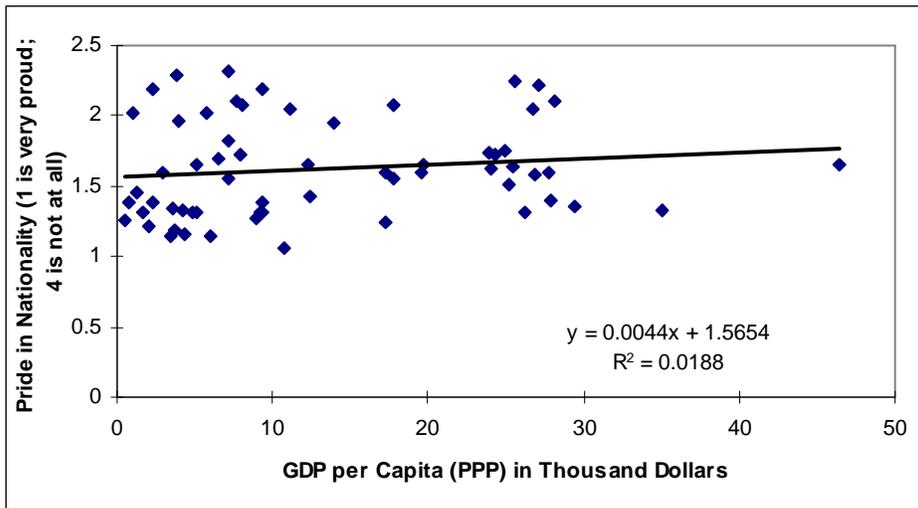
There are some hopeful findings in the WWS data on trust. For instance, both India and China, especially the latter, show high levels of trust. See the graph below. That is in sharp contrast to deteriorations over time in South Africa.



How does the situation look globally and how is it changing? The graph below, from the 4<sup>th</sup> wave, confirms the information in earlier graphs, namely that substantially more people believe that you can't be too careful than believe that most people can be trusted. Between the second and fourth waves there was a small shift in the direction of less trust (about 0.03 points of the 1.0 point separating the two code categories), most notably in more developed countries.



With respect to belief in one's nation, as opposed to ones fellow citizens, that is high. The graph below shows that the average in Wave 4 is much closer to very proud (value 1) than not at all proud (value 4), with developing countries ever so slightly more proud. The change from wave 2 to wave 4 on this question was not significant, although there was a great jump in German pride.



It should be noted, however, that identities remain a great issue for many countries. The paper developed for the NIC 2020 project called "Social identity: Will Islam be as politically important for social identity in 2020?" built the table below from data of the WVS's fourth wave survey. It shows that in a number of Islamic countries, as well as in Israel, religious identity supersedes national identity. Such rankings tend to create pressures upon states with respect to peoples outside the state that cannot always be accommodated.

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Sources of political identity in 10 Muslim countries in (2001). Percentage reporting: Above all, I am a Muslim and above all, I am a ... 'the nationality', and Above all I am an Arab (Arab countries only). The question asked in surveys was 'Which of the following best describes you?'

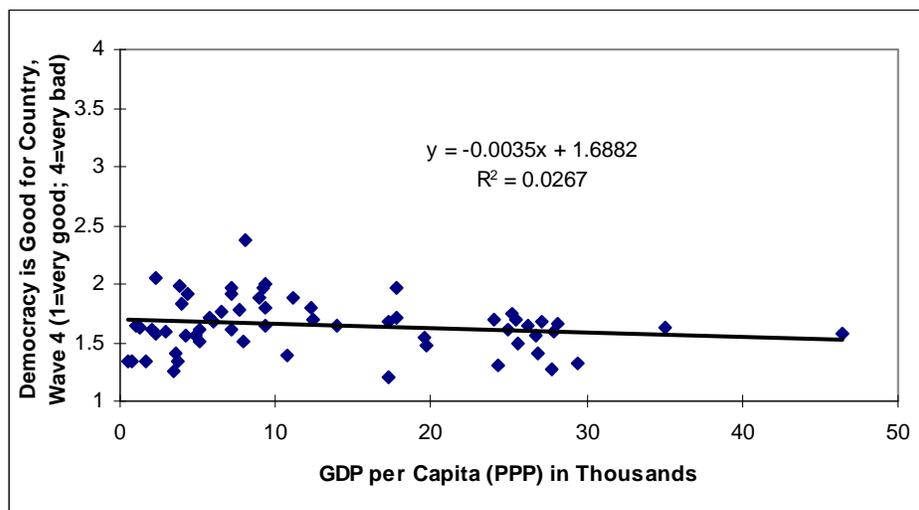
Nation	Identification with Islam: Above all I am a Muslim	Identification with the Nation Above all I am ...	Identification with Pan-Arabism Above all I am an Arab
Egypt	79.4	9.8 Egyptian	1.0
Jordan	72.5	15.3 Jordanian	8.6
Algeria	67.2	25.3	3.1
Turkey	64.4	34.1 Turkish	
Morocco	63.1	33.2	3.4
Iran	61.0	34.1 Iranian	
Nigeria	44.7	50.2	
Indonesia	42.0	52.2 Indonesian	
Bangladesh	23.6	55.0 Bangladeshi	
Pakistan	19.4	78.4	
Israel	43.9 Jewish	31.2 Israeli	

Source: WVS fourth wave 2001. The latest data available are presented in the table.

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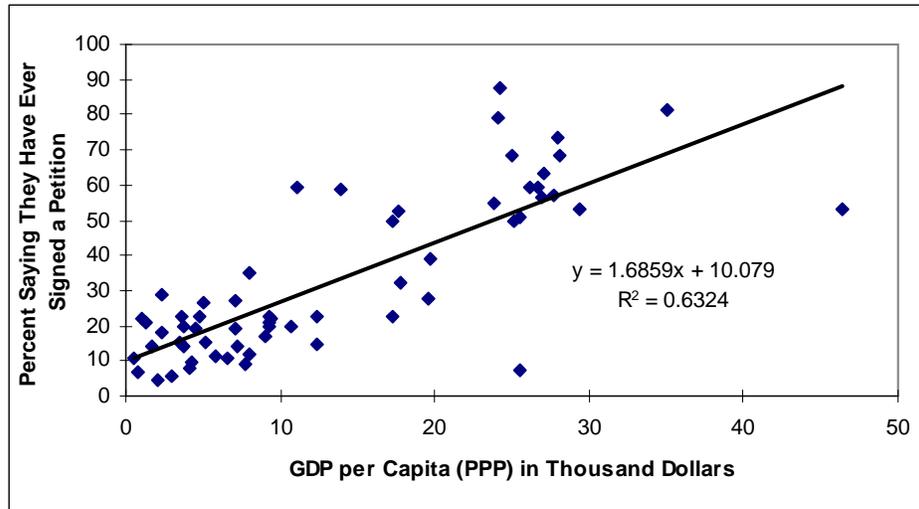
3 of 5

Do people believe in democracy, even for their own country rather than just in the abstract? That figure below strongly suggests they do (1 is a belief that democracy is very good and 4 is a belief that it is very bad). And although there still were relatively few Islamic and Middle Eastern countries in the 4<sup>th</sup> wave of the WVS survey, several studies have found that self-reported democratization sentiment is strong there also. There was little difference between the 2<sup>nd</sup> and 4<sup>th</sup> wave on this question.



Will people participate in political systems? On another four-point question, this one about political interest, countries average about 2.7 (with 1 being very interested and 4 being not at all interested). One is tempted to believe that a question about sports would have drawn an average answer much closer to 1, but it is always unclear how low interest should be evaluated. There was little change across waves 2 and 4.

On a question about whether citizens have ever signed a petition, an important indicator of real political-social involvement, there is a striking correlation with DP per capita level and a high level of such behaviour in richer countries.

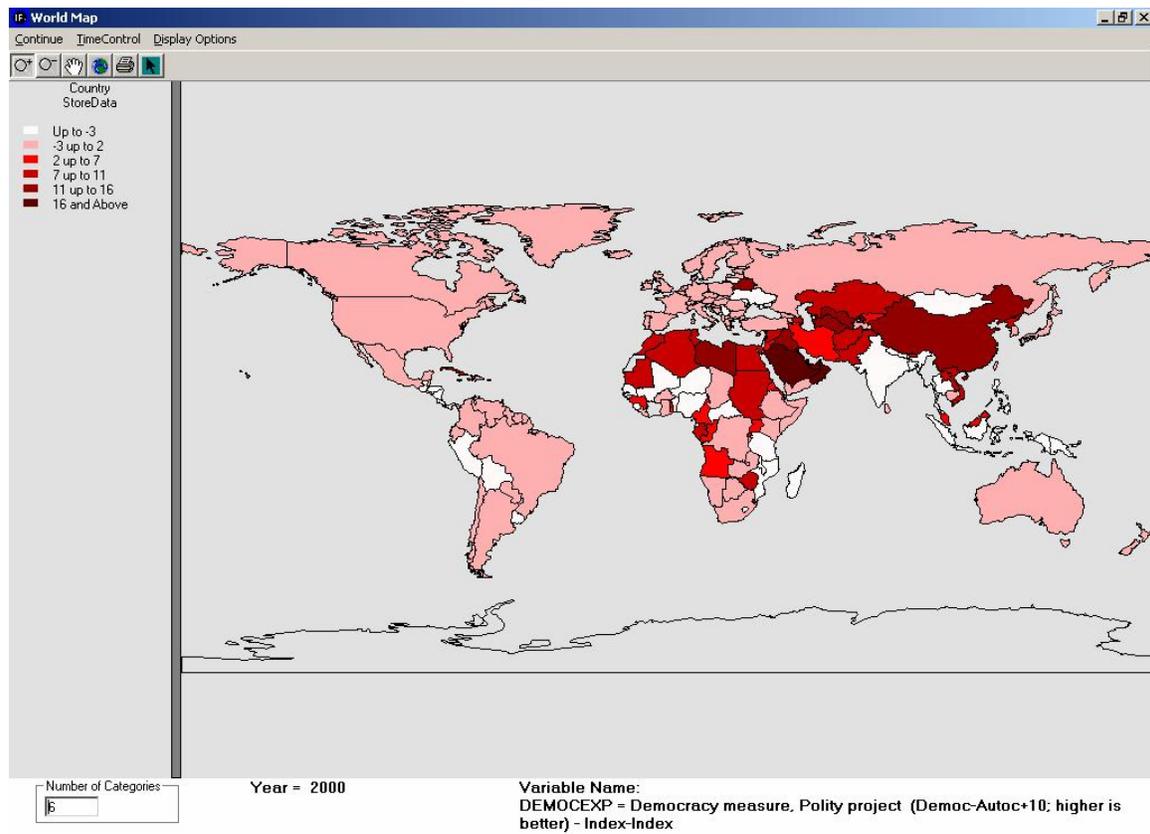


The state of civil society and of values and beliefs is the foundation for democracy. The above data suggest that the foundation is sometimes shaky, especially in less developed countries where trust levels are strikingly low. The third wave of democratization could conceivably have outrun its foundations. In fact, Huntington has argued that global democratization has wave-like, rather than persistently progressive character of that spread, and such wave character has become conventional wisdom. He concluded (1991: 315) his discussion of “Whither” the most recent or third wave may take us with the rather non-specific forecast that it “will not last forever” and that “it may be followed by a new surge of authoritarianism constituting a third reverse wave.” The conventional wisdom of the literature is nonetheless that, in spite of such possible and likely temporary reversals, democratization will continue its global spread.

What can we see if we look directly at democracy relative to its apparent foundations? That is, how does the “expected level” of democracy in countries compare with the actual level in different countries? The expected level can be computed in a cross-sectionally estimated function that brings in GDP per capita levels, education levels, values (survival/self-expression is powerful), and even cultural regions. The map below uses a function for expected levels with a high R-squared that draws upon economic conditions and values, but not cultural regions. It compares it with actual levels in 2000. Countries in North America and Western Europe are basically at the levels that the cross-sectional formulation would expect, as are most of those in South America. A few countries in

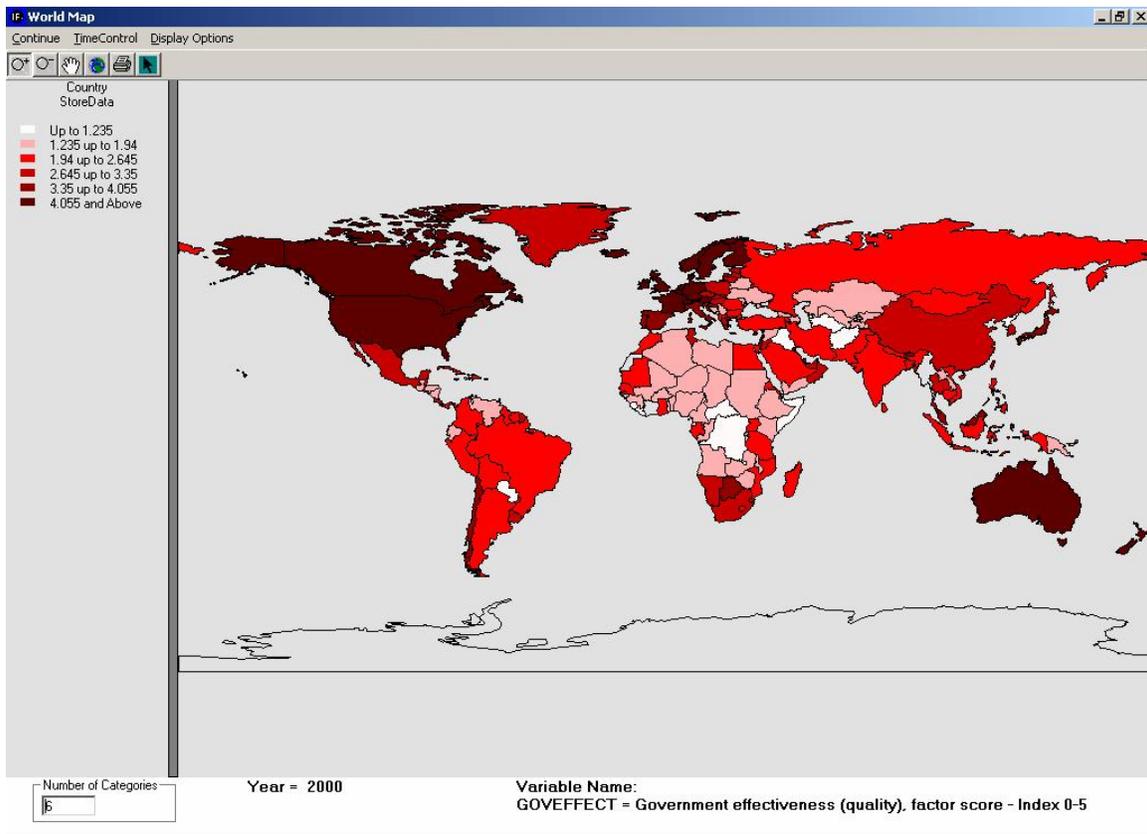
Latin America (like Peru and Bolivia), a number in Africa, and a few elsewhere (including India) are more democratic than would be expected. This suggests one form of pressure or imbalance.

More strikingly, a substantial number of countries, especially in the Middle East, North Africa, and Central Asia, are currently measured on the Polity scale as less democratic than one would expect. This includes China, and at the most extreme level, Saudi Arabia. Obviously, this “under-democratization” constitutes another form of pressure or imbalance. On the map, significant under-democratization appears more common than significant over-democratization.



#### 4.4 The Weight of Bad Governance

Increasingly, governance quality is recognized as the foundation for government performance, whether the issue arena be economic development or international relations. Daniel Kaufman and others at the World Bank have developed a set of measures of that quality. The map below shows their government effectiveness measure for the year 2000. The countries in white on that map constitute, once again, something close to a picture of the world’s failed states. The counties in pink are not that far behind.

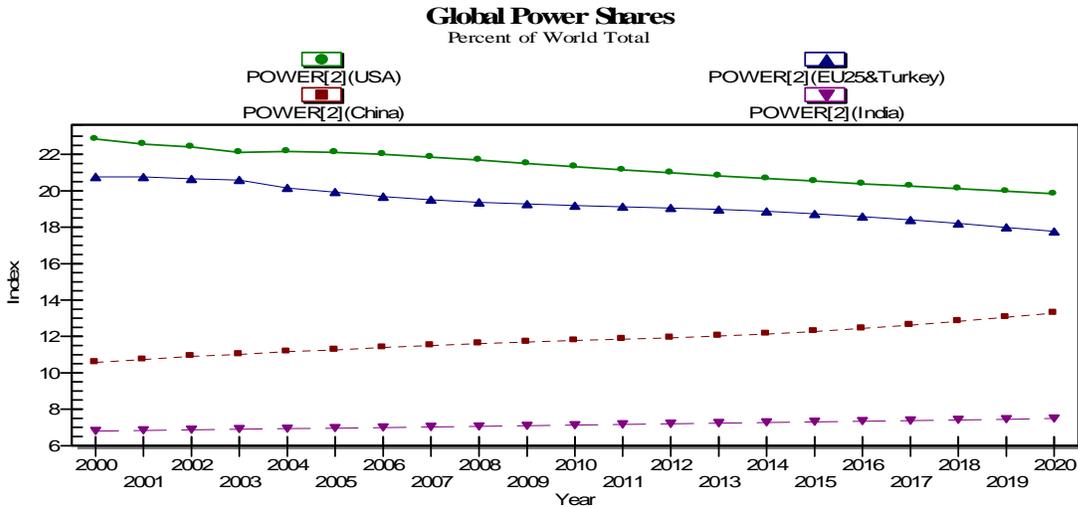


#### 4.5 International Relations: The Pressure of Growing Power upon Global Roles

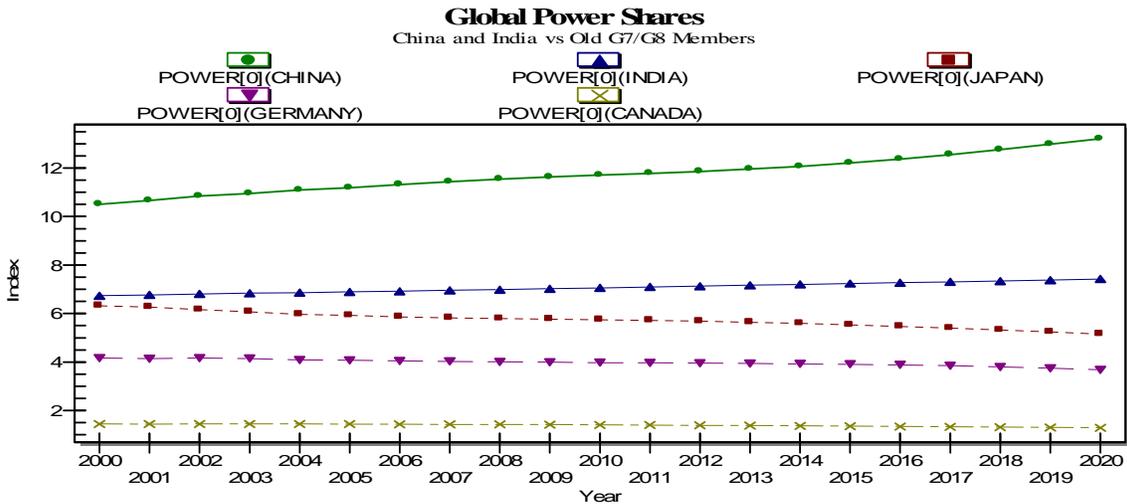
Students of interstate power are accustomed to looking for pressures and imbalances. Theories of power transition and of status discrepancy are based on doing so. Power is, of course, exceedingly difficult to measure (see Hughes June 2004 for a discussion of the approach in the IFs base case). In particular, soft power modifications of the calculations shown in this section could either delay or accelerate transitions and challenges to global roles.

Nonetheless, some conclusions about the pressures and imbalances associated with global power levels and trends are fairly obvious. In almost all forecasts, including the base case of IFs below, the global power of India and especially of China will rise through 2020, while that of the United States and the European Union (even should it include Turkey) will fall. Although the transition of US and Chinese power positions may not fully occur until 2035-2050, it is highly likely to occur. And the gap in power is likely to narrow by about one-half already by 2020.<sup>16</sup>

<sup>16</sup> In the figure shown, China does not enter the critical range of 90% of US power before 2020.



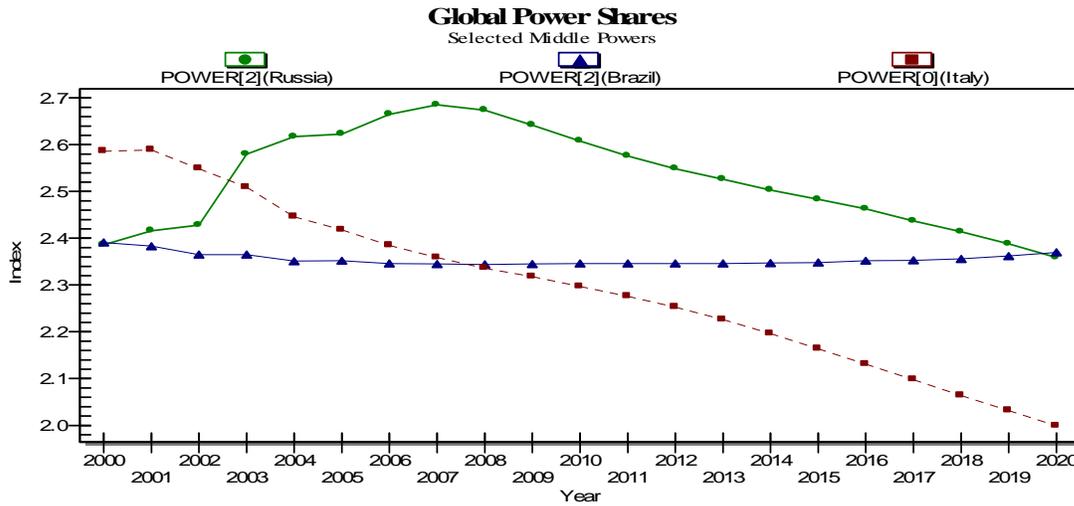
Looking more specifically at the power of China and India relative to three members of the Group of Eight industrial countries, the graph below suggests that the power of both now equal or exceeds even that of Japan, much less of Germany. They greatly outstrip that of Canada. Is not the pressure and imbalance between power and system role obvious and growing and will they not increasingly press for a global leadership role?



#### 4.6 International Relations: The Pressure of Shrinking Power Capabilities

There are, of course, other significant power actors in the global system, but even the largest of them, like Russia, Brazil and Italy tend to fall in the range of the above graph between Canada and Germany. Russia's power globally may prove to follow one of the most irregular patterns in coming years, something that, along with its continuing nuclear power, suggests the need to watch the situation carefully. The IFs base case figure below suggests the possibility that Russian power could rise through the current decade as economic growth recovers from the shock of system change, but that the demographic pressures of the society are likely to cause it to resume a fall thereafter. Russia already

faces the difficulty of dealing with a dramatically reduced global role. The struggle, while temporarily ameliorated, is not likely to disappear.



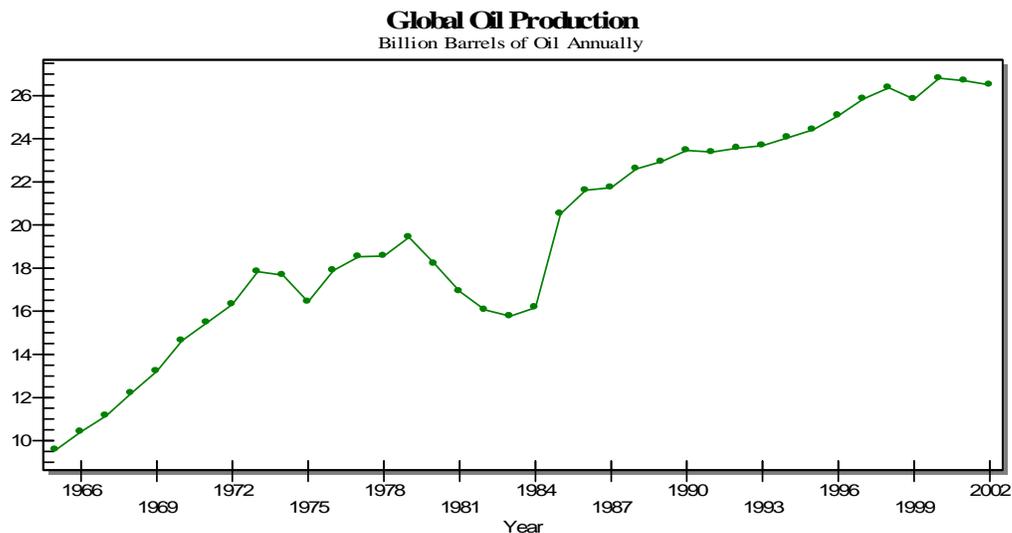
The very brief discussion of interstate politics in this chapter has made no attempt to address the myriad specific issues that could be identified as giving rise to pressures and imbalances in regional and global systems. These obviously include the assorted global flash points (Taiwan, Kashmir, Palestine, etc.), a range of civil wars (the Sudan, Iraq, Zaire, etc.) or the war between terrorist groups like al Qaeda and assorted states around the world. The purpose of this discussion was much more limited, focusing on identifying some of the underlying drivers of pressures and imbalances.

## 5. Biological and Physical Environmental Systems

The sources of pressure and imbalance with respect to human relationships with larger biological and physical systems fall easily into two general categories: extraction from the environment and release back into it. With respect to extraction, the largest and growing sources of pressure and imbalance concern energy, water, and forest. With respect to release into the environment, the most significant is almost certainly carbon emissions.

### 5.1 The Pressure of Fossil Oil Demand and of Growing Supply Concentration

The graph below shows the growth of world oil production historically, interrupted and “bent” by the shocks of the 1970s.

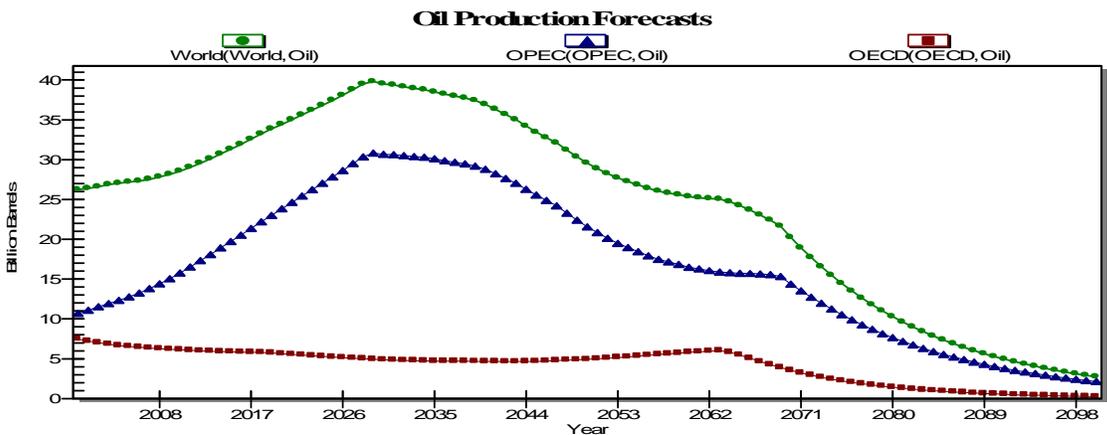


Most of us learn at an early age the dangers of crying “wolf” prematurely. With respect to fundamental physical constraints on global energy availability, as opposed to politically-motivated supply disruptions, those who cried “wolf” in the 1970s are no longer easily believed.

Yet there obviously is a finite supply of oil and gas resource and there remains a serious debate over when the peaks of global production might be reached. Much of the analysis is based on the Hubbert’s curve, the same technique that allowed M. King Hubbert in 1956 to correctly forecast the peak of U.S. oil production about 1970. The pessimists, like Rifkin (2002), Campbell and Laherrère (1998), and members of the Association for the Study of Peak Oil (ASPO) and the Oil Depletion Analysis Centre (ODAC) argue that global oil production is likely to peak quite soon, possibly as early as 2010. Buttressed by rapidly growing demand in China and elsewhere, they argue that the global price of oil could rise very sharply in the coming decade and more. In sharp contrast to that argument, other analysts such as Morris Adelman or Hans-Holger Rogner (2000) argue

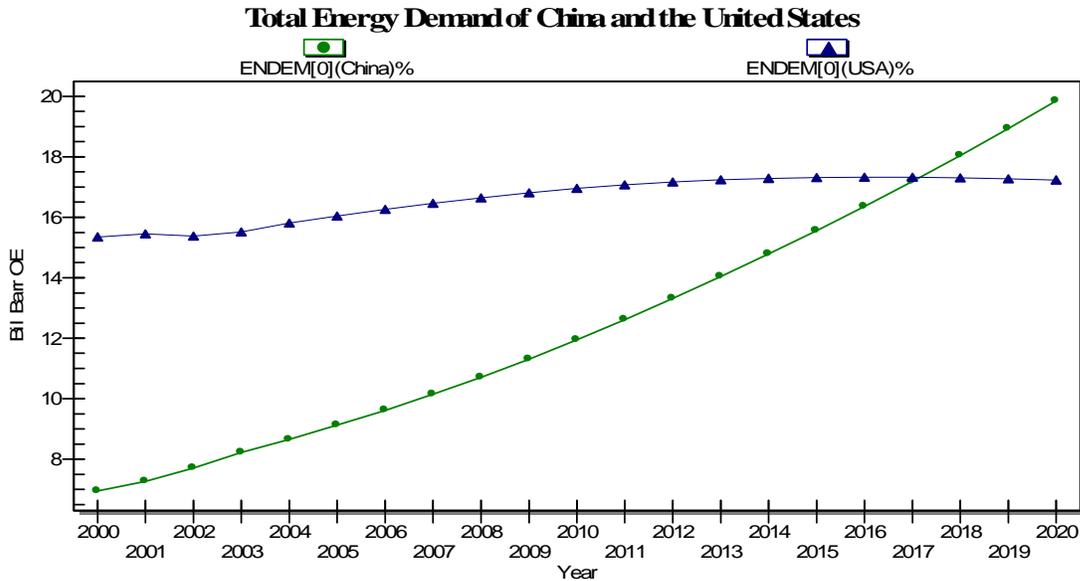
that oil resources are much greater and that, at least for the 21<sup>st</sup> century, pose no constraint on production and use of fossil fuels.

The U.S. Geological Survey (USGS) is somewhere in the middle, but seen as a bit on the optimistic side (Charpentier 2003). The IFs base case uses global resource volumes comparable to those of the USGS (adjusting World Energy Council numbers to reach them).<sup>17</sup> The figure below shows the kind of global production pattern (Hubbert's curve) that results from use of those estimates; the peak of global production comes near 2030 with increasing reliance on OPEC up to and beyond that time. OECD resources, including those of the United States in Alaska and those of Europe in the North Sea, are likely to decline steadily.

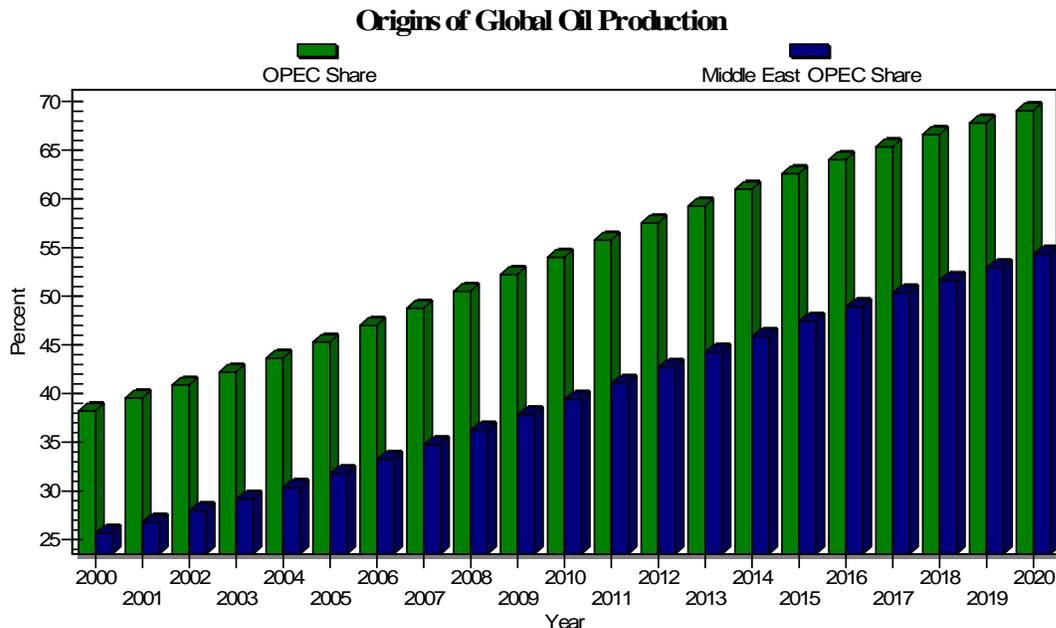


One does not need to become embroiled in, or take a strong position on the global peaking of the Hubbert's curve to see the growing pressures and imbalances in the energy system. The graph below focuses on the demand side and shows how rapidly Chinese energy demand, driven by both economic growth generally and transformation of the economic and social systems more specifically, are causing it to rise toward the level of the United States. The pressures that China will likely be putting on global energy systems over the next two decades are very substantial.

<sup>17</sup> IFs will be switching to USGS numbers before long.

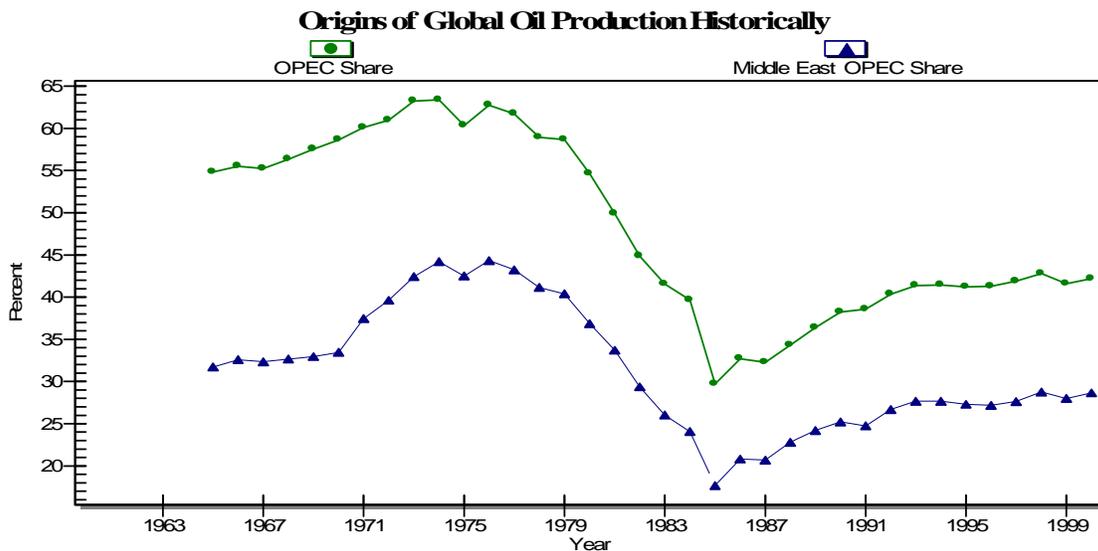


Moreover, most of the debate concerning ultimate oil supplies focuses on the size of conventional resources in OPEC countries and of unconventional resources in places like the tar sands of Canada or oil shale in the United States. Leaving aside the unconventional resources, which are not likely to be developed in substantial volumes by 2020, the graph below shows how the origins of global oil supply may change in coming years. The OPEC share overall may grow very rapidly. And even more striking is the share of the Middle Eastern oil producers: Iran, Iraq, Kuwait, Qatar, Saudi Arabia, and the United Arab Emirates. Those countries could well move from providing about one-fourth of global supplies at the beginning of the century to providing one-half by 2020, if they are able and willing.

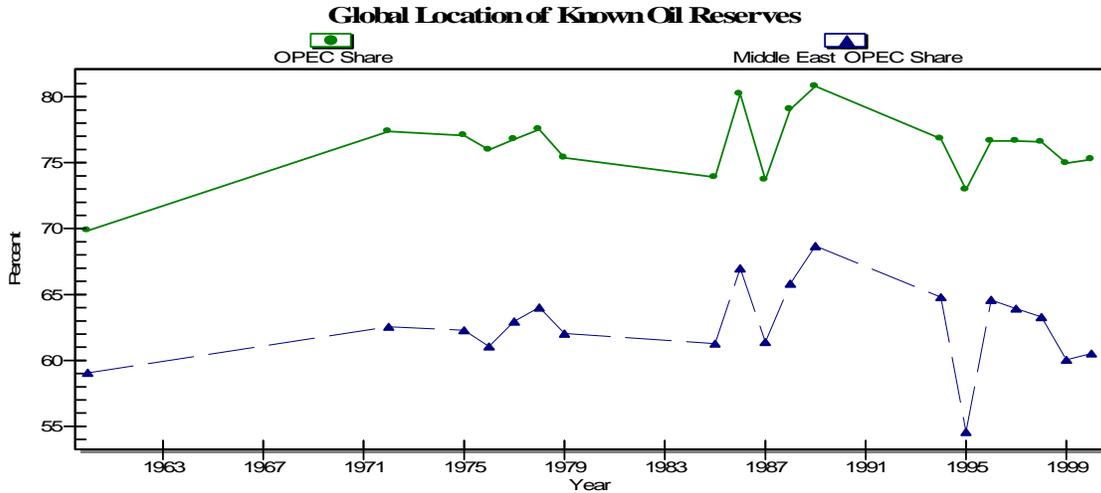


The above figure is sufficiently striking that it bears further checking to make sure that it is not simply a model artefact. Models are always subject to substantial potential error

and the IFs energy model is not one of its strongest submodels. The figure below, using data from *British Petroleum*, helps put the prospect for rapid rise of OPEC global oil production share in historic context. It shows that the shares forecast above for 2020 are actually fairly similar to those that prevailed at the time of the oil shocks in the 1970s. Thereafter a scramble for alternative supplies shifted production share sharply away from OPEC and the Middle Eastern members of it. Since the mid-1980s, the OPEC share has climbed again, but not as sharply as in the forecast above.

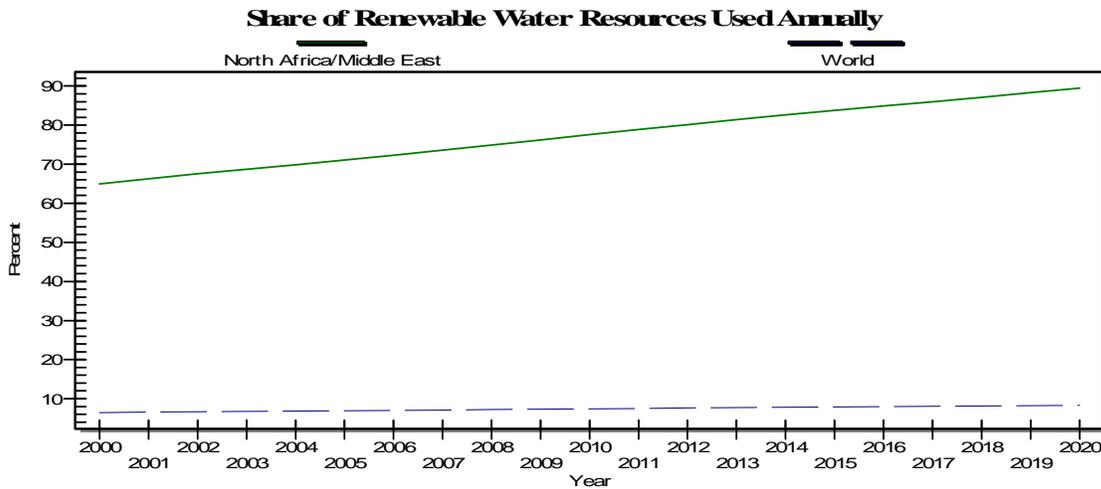


The figure below further investigates the potential for rapid rise in OPEC world oil production share by looking at the data on known reserves (drawing primarily on data shown in the *Oil and Gas Journal*). It shows that the OPEC and Middle Eastern OPEC country shares of global oil reserves have consistently been at or well above their shares in global production. Although a pattern of great mismatch globally between production and reserve shares can long persist, it presumably cannot indefinitely persist. Just as policies in the United States (oil depletion allowances and oil import quotas) were justly characterized by some in the 1970s, when U.S. oil production peaked, as having been “drain American first” policies, the scramble by countries around the world over the last two decades to rely on domestic sources rather than imported ones can be characterized as having been a “drain all but the Middle East first” effort. The question remains concerning whether such efforts are now about to yield delayed but even more rapid growth in dependence on the Middle East. It does look possible. The pressures and imbalances are continuing to grow.



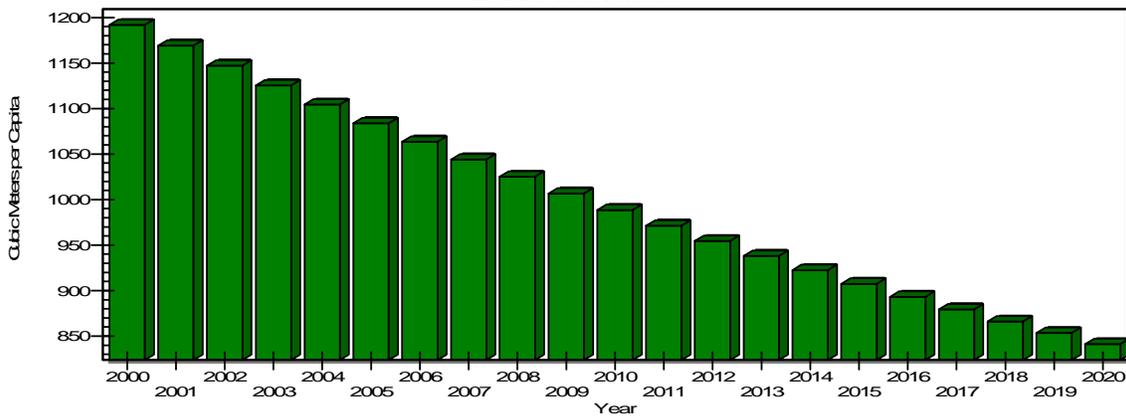
## 5.2 The Pressure of Demand on Water Resources

Fresh water resources are increasingly understood to be under pressure around the world. The graph below shows the share of renewable water resources used annually in the world as a whole and in the Middle Eastern and North African region, specifically. That region is obviously already using nearly all available water and the pressure upon resources is growing.

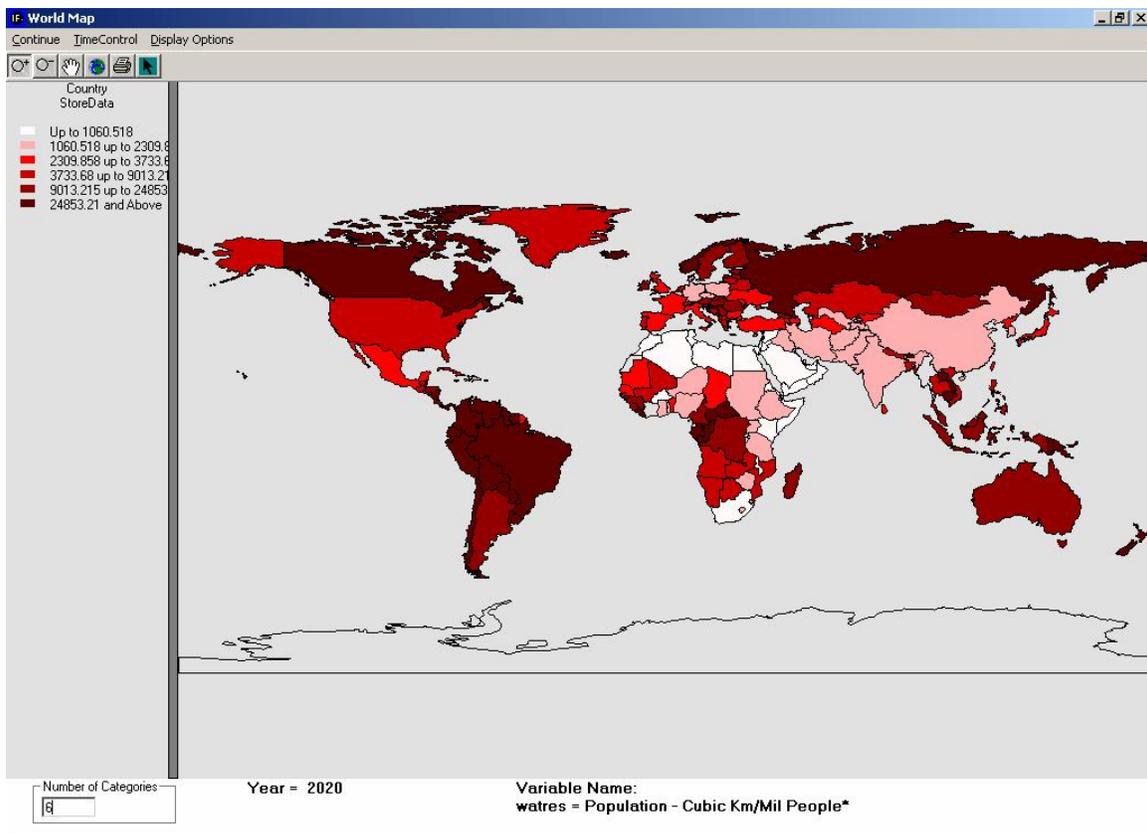


A relatively common measure of water stress is water resources per capita (The World Water Council Vision Report 2000a). If that falls below 1,700 cubic meters, the country's water system is considered to be under stress. If it falls below 1,000 meters, the system is under severe stress. The graph below shows that the Middle East and North Africa as a whole is likely to be under very severe stress by 2020.

### Renewable Water per Capita in North Africa and the Middle East IFS Base Case Forecast

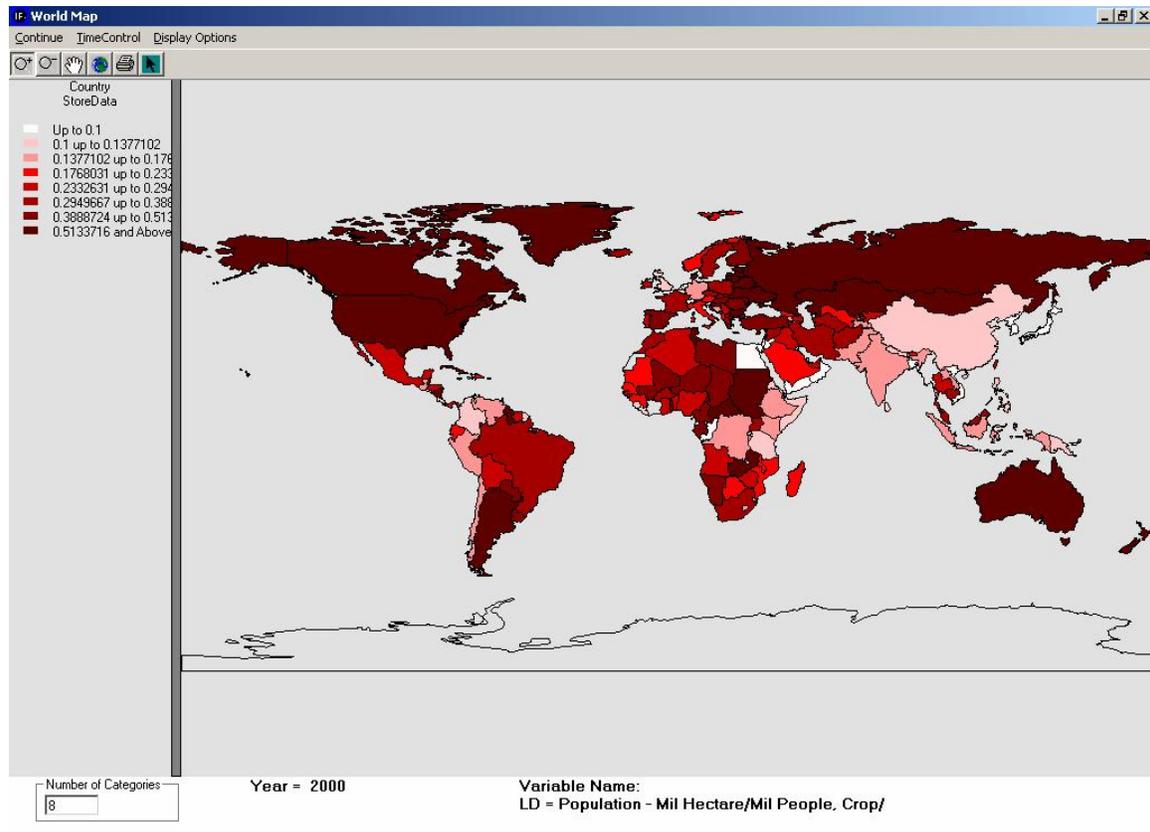


The map below shows that it is not, of course, just that region that will be under increasing stress with respect to water supplies. The Horn of Africa and the country of South Africa are also likely to face very great challenges, with South Asia, the Sahel, and China not too far behind.



The map below supplements the discussion of water stress by showing cropland per capita. Cincotta, Engelman, and Anastasion (2003) emphasize both water and cropland availability as useful indicators of demographic stress. A quick examination of the two maps, however, suggests that water may be a better stress indicator than cropland.

Whereas Egypt and Yemen appear potentially stressed in the cropland map below, so do South Korea and Japan. The water stress map above has more initial face validity in identifying societies with longer-term socio-political challenges.

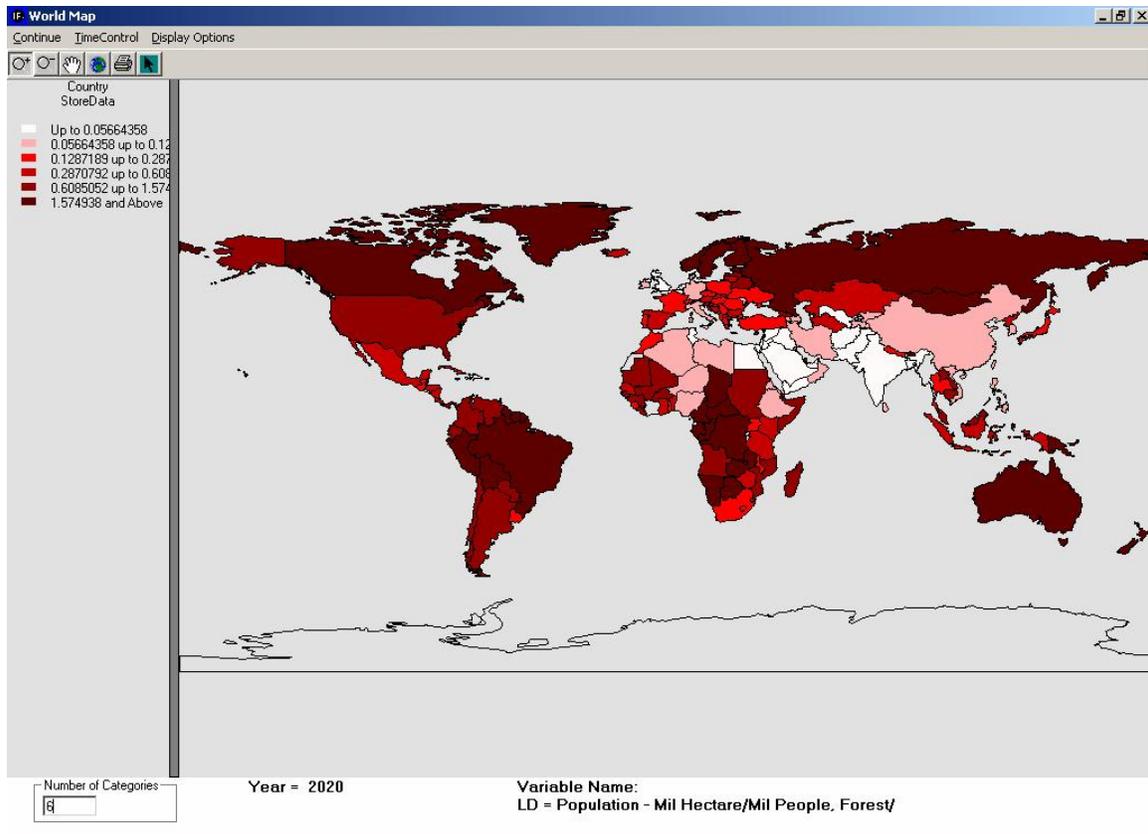


### 5.3 The Pressure of Humans on Forest Area

Deforestation is continuing around much of the world, especially in tropical forest regions. The rate has begun to slow and the process may even reverse by about the middle of the century. Yet the figure below suggests the clear possibility that something close to an additional 5% of global forest cover in 2000 could be lost by 2020, with all of the implications that has for watershed management, species loss, and timber availability.

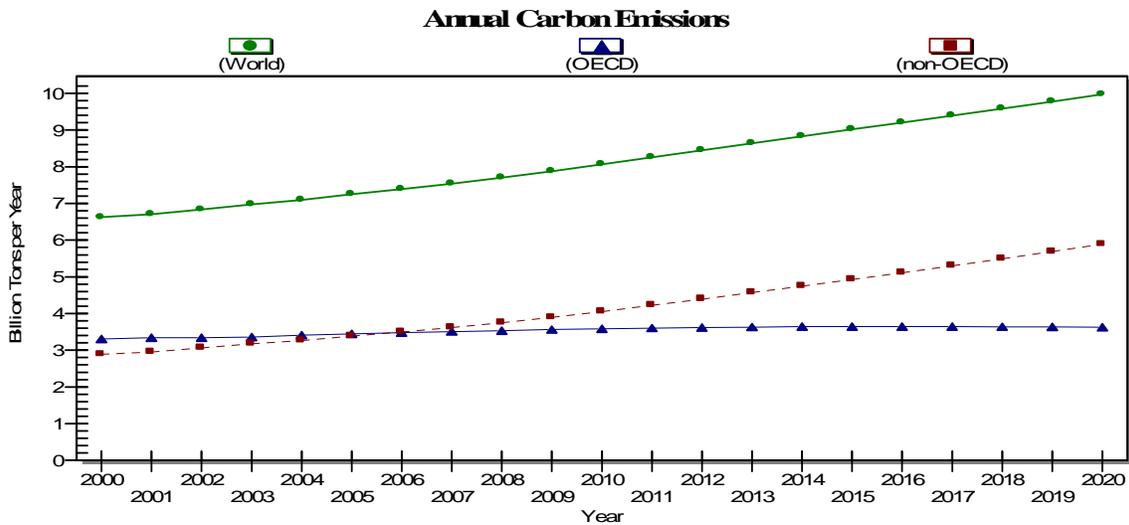
LD[2]	
World	
Forest	
Year	Mil Hectare
2000	4,165.9980
2001	4,159.8910
2002	4,151.8350
2003	4,143.5710
2004	4,135.7620
2005	4,127.6090
2006	4,118.9900
2007	4,109.6120
2008	4,099.4810
2009	4,088.6930
2010	4,077.3750
2011	4,065.7440
2012	4,054.0350
2013	4,042.6460
2014	4,031.8880
2015	4,021.9960
2016	4,013.0720
2017	4,005.0400
2018	3,997.7950
2019	3,991.1330
2020	3,984.8320

The discussion of deforestation normally focuses on the speed of forest loss, especially tropical forest. Not surprisingly, volume of and even rate of loss is typically highest in countries where there is the greatest natural forest cover, such as Brazil or parts of Central Africa and Southeast Asia. Another way of looking at the problems of deforestation is, however, to look at forest per capita. That view has some similarities to the water stress map shown earlier, because forest cover pr capita tends to be low in North Africa and the Middle East. But it also shows a slightly different picture, giving more weight to pressures in South Asia and the core of Northern Europe, where populations have pressed over centuries against forested areas.



#### 5.4 The Pressure of Carbon Emissions

There are two key aspects of the pressures and imbalances of the global system with respect to carbon emissions. The first is the growing total level, which barring unforeseen and probably disastrous change in the global system is likely to continue its significant upward march. The second is the shifting source of those emissions. Emissions by OECD countries are actually likely to be relatively stable through 2020, but emissions from non-OECD countries are growing rapidly and will soon substantially outstrip those of OECD countries. The graph below suggests how both of those dimensions might unfold.



The pressures and imbalances created by the patterns above are fairly obvious. On one hand, the growth of global emissions will continue to increase the pressure for action relative to the greenhouse effect, which hardly any scientists continue to challenge, even while they argue about its speed, the dangers of tipping points, and the relative costs of adapting versus mitigating). On the other hand, both the leverage for action and the locus for action need is continuing to shift towards the global South. That fact has been the crux of the key battle over implementing the Kyoto Protocol, which places limited demands on developing countries relative to those where stability in emissions is already beginning to appear. The pressures and imbalances in these patterns will likely continue to grow.

## 6. Considering Uncertainty Explicitly

This chapter does not undertake scenario analysis with IFs under uncertainty. Instead it describes how the IFs modeling system facilitates such scenario analysis.

### 6.1 Scenario Typology in IFs

The first chapter of this report elaborated the following framework of scenario building blocks:

- Framing scenarios formulations.
- Aggregated global, regional, and country behavior.
- Elaborated agent interventions.
- Shocks, surprises, wild cards.
- Changes in causal understandings.

### 6.2 Scenario Development Tools in IFs

Given the above identification of building blocks of scenarios, a tool for helping undertake global scenario and/or policy analysis should ideally have mechanisms for

- helping the user specify uncertainties in any of the above categories and introduce them into runs of the model
- facilitating combination of the building blocks into flexibly simple or complex scenarios
- allowing the user to save and retrieve scenarios for continued development, elaboration, and analysis
- simplifying the comparison of results from different scenarios with each other and with the base case

IFs includes forms that allow the user of it to change any parameter or initial condition in the model and, in the case of parameters, to specify any time-variant series for the parameter that the user desires. For advanced users that form can be highly useful. But for most users the window below is more useful. The form shown below is called the IFs scenario tree. It has several main trunks (imagine a banyon tree) and each trunk has several main branches. Each branch takes the user to a set of “scenario drivers,” namely the parameters and initial conditions of the model.

Scenario Development and Change: Untitled

Continue Scenario Files Delete Selected Driver/Dimension Use Groups Annotate Scenario

Technological Change  
   Agriculture/Food  
   Demographic/Population  
   Economic  
   Energy  
   Military

Environmental Uncertainties  
   Agriculture/Food  
   Energy  
   Carbon Systems  
   Water Systems

Household/Individual  
   Agriculture/Food  
   Demographic/Population  
   Energy  
   Environment  
   Ethnicity  
   Networking  
   Transportation  
   Values  
   Work Force

Government/Socio-Political  
   Demographic/Population  
   Energy  
   Economic-Domestic  
   Economic-International  
   Environment  
   Fiscal - Expenditures  
   Fiscal - Revenues  
   Global Financial  
   Governance System  
   Infrastructure  
   Intl Politics, Conflict  
   Intl Politics, Cooperation  
   Intl Politics, Democracy  
   Intl Politics, Other

Firms/Business  
 Selected Initial Conditions  
 Relationship Parameters

**Typical steps in scenario development:**

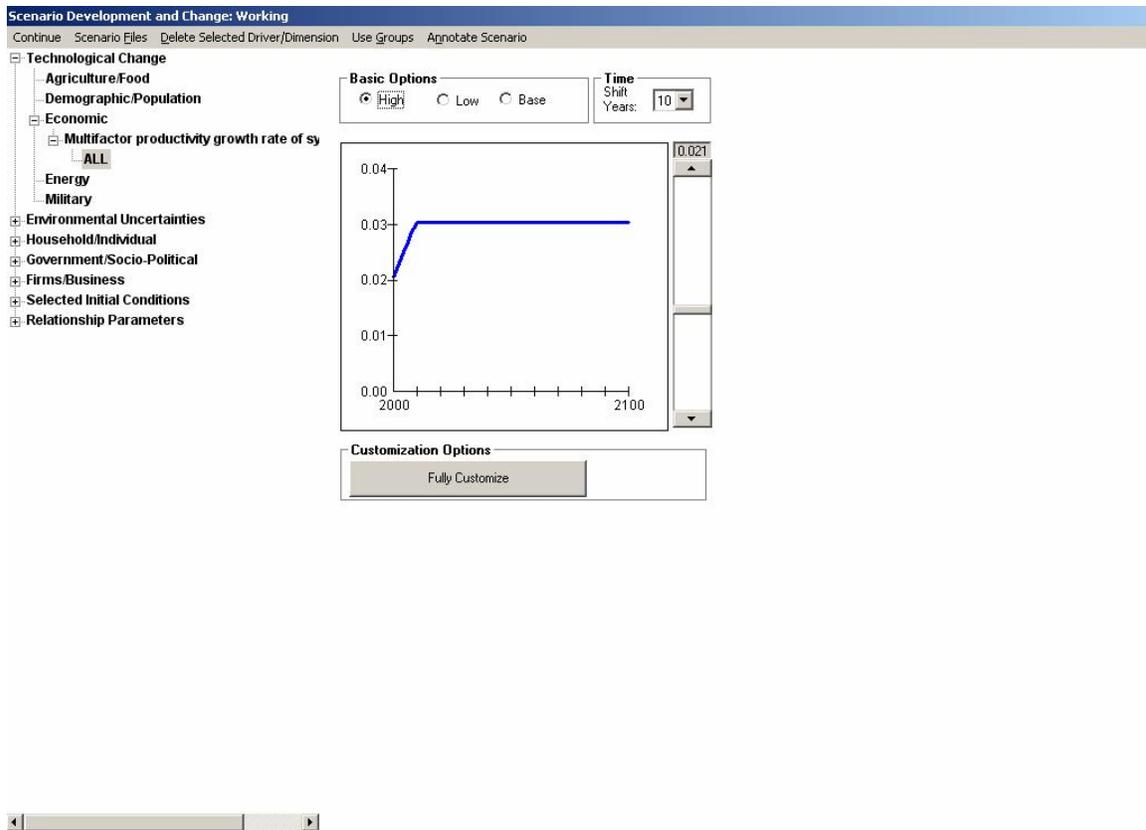
1. Select an issue area from the tree to the left.
2. Add or delete drivers and regions (use the menu option and follow instructions)
3. Repeat issue and driver/region selection to build your scenario.
4. Save your scenario.

**Pick Driver**

Multifactor productivity growth additive factor

Multifactor productivity growth rate of system leader

One of the key features of the scenario tree is that the first two trunks represent the kind of technological and environmental uncertainties that are heavily used in framing scenarios. For instance, a click on the economic branch of the technological change trunk brings up the box of drivers shown above. The second of those is a specification of multifactor productivity growth in the global system's technological leader (currently the United States). Clicking on it and selecting it brings up a graphic on the screen like that shown below, with high, medium, low and customization options. The customization allows any pattern over time desired for the parameter underlying the driver selected; (in this case, focused on multifactor productivity growth in the United States, customization would allow even the introduction of long cycles of technological advance. The option chosen in the figure below was an acceleration of technological/multifactor productivity advance from 2% to 3% annually over 10 years.



These two trunks of the scenario tree are often used also for scenarios that are not as broad in sweep as the typical framing scenario, but tend to be above the level of specific agent-class action. In the listing of building blocks earlier, these were identified as global, regional, or country scenarios. In addition to introducing assumptions that might affect a geographic area, they may focus on a specific issue area such as demographic change or energy demand in Europe.

The time-specific tracing of an intervention over time like the one in the figure above can apply to any element on the tree, including agent-class interventions and relationship parameters. Many surprise or wild-card scenarios are facilitated by a sudden change in a parameter (such as the introduction of oil export limits by OPEC).

Moving beyond the first two trunks of the scenario tree, the next three were created to hold agent-class intervention points for Households/Individuals, Governments/Socio-Political Systems, and Firms/Businesses. The reality is that some of the interventions on the branches of these trunks are rather aggregated and not always the kinds of micro-actions these agents could actually take; but they are close to such actions as the structure of the model allows.

Scenario drivers chosen on these and other trunks can be chosen for individual countries or for groupings of countries (Europe, OECD countries, the World, etc.). The screen below, for example, shows the selection of the trunk on Governments/Social Systems and the branches or drivers on Fiscal Expenditures. It would be possible to use that branch to

build a scenario element that called for increased education spending of Zimbabwe or for increased foreign aid by all OECD countries.

The screenshot shows the 'Scenario Development and Change: Untitled' interface. On the left is a tree view with categories like 'Technological Change', 'Environmental Uncertainties', 'Households/Individuals', 'Governments/Socio-Political Systems', 'Firms/Businesses', 'Selected Initial Conditions', and 'Relationship Parameters'. The 'Governments/Socio-Political Systems' category is expanded, showing sub-categories like 'Demographic/Population', 'Energy', 'Economic-Domestic', 'Economic-International', 'Environment', 'Fiscal - Expenditures', 'Fiscal - Revenues', 'Global Financial', 'Governance System', 'Infrastructure', and 'Intl Politics, Conflict'. The 'Fiscal - Expenditures' category is highlighted. On the right, a 'Pick Driver' pop-up box is open, listing several drivers such as 'Aid (foreign) donations as % of GDP', 'Government expenditures on education by level, multiplier', 'Government expenditures by destination multiplier', 'Government expenditures multiplier', 'Government to household pension transfers', 'Government to household welfare transfers', 'Government revenues multiplier', 'Nuclear force military spending, portion of total spending', and 'Wagner's law coefficient: annual growth in govt expenditures'.

**Scenario Development and Change: Untitled**  
 Continue Scenario Files Delete Selected Driver/Dimension Use Groups Annotate Scenario

**Technological Change** Typical steps in scenario development:  
 1. Select an issue area from the tree to the left.  
 2. Add or delete drivers and regions (use the menu option and follow instructions)  
 3. Repeat issue and driver/region selection to build your scenario.  
 4. Save your scenario.

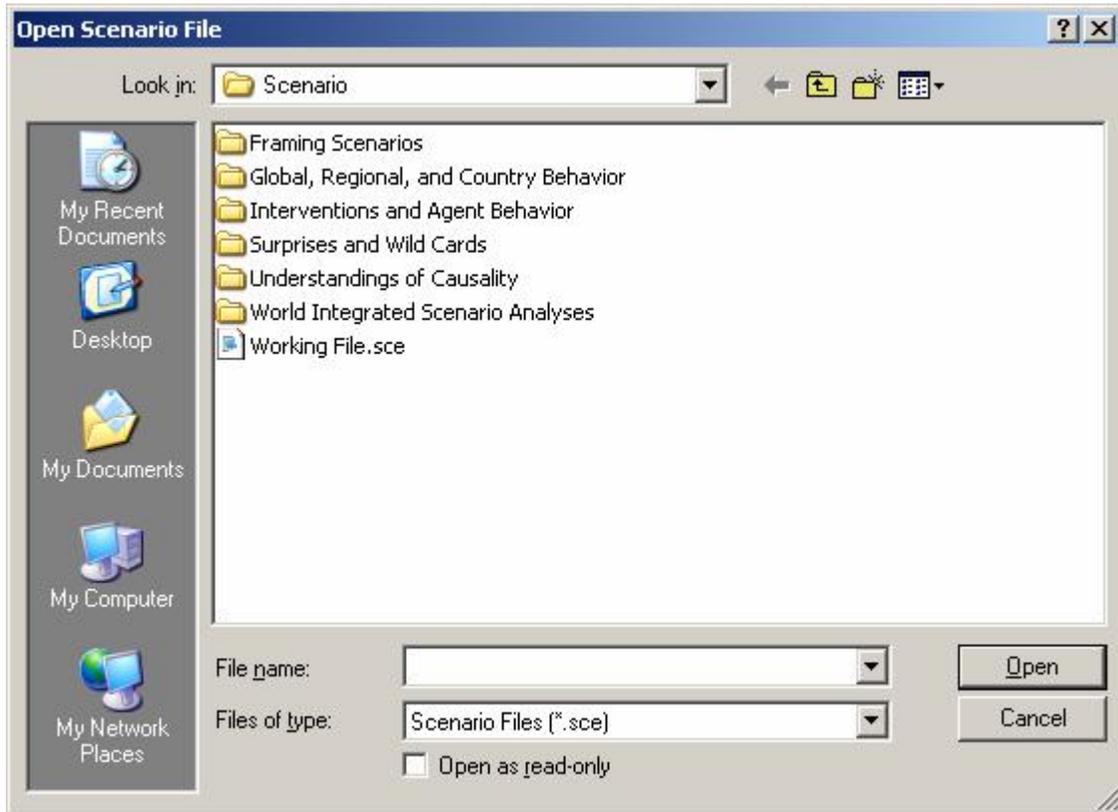
**Pick Driver**  
 Aid (foreign) donations as % of GDP  
 Government expenditures on education by level, multiplier  
 Government expenditures by destination multiplier  
 Government expenditures multiplier  
 Government to household pension transfers  
 Government to household welfare transfers  
 Government revenues multiplier  
 Nuclear force military spending, portion of total spending  
 Wagner's law coefficient: annual growth in govt expenditures

Clicking on the name of any specific driver, such as those in box of the screen above produces a pop-up box that allows the user to Select the option, including specification of countries or country groupings to which it should apply or of other sub-dimensions. The box also contains other options, however, that help the user explore the links between the parameter identified and other parameters/variables in the model, that provide definitions and basic information about the parameter/driver, or that show the actual equations underlying the relevant section of the model.

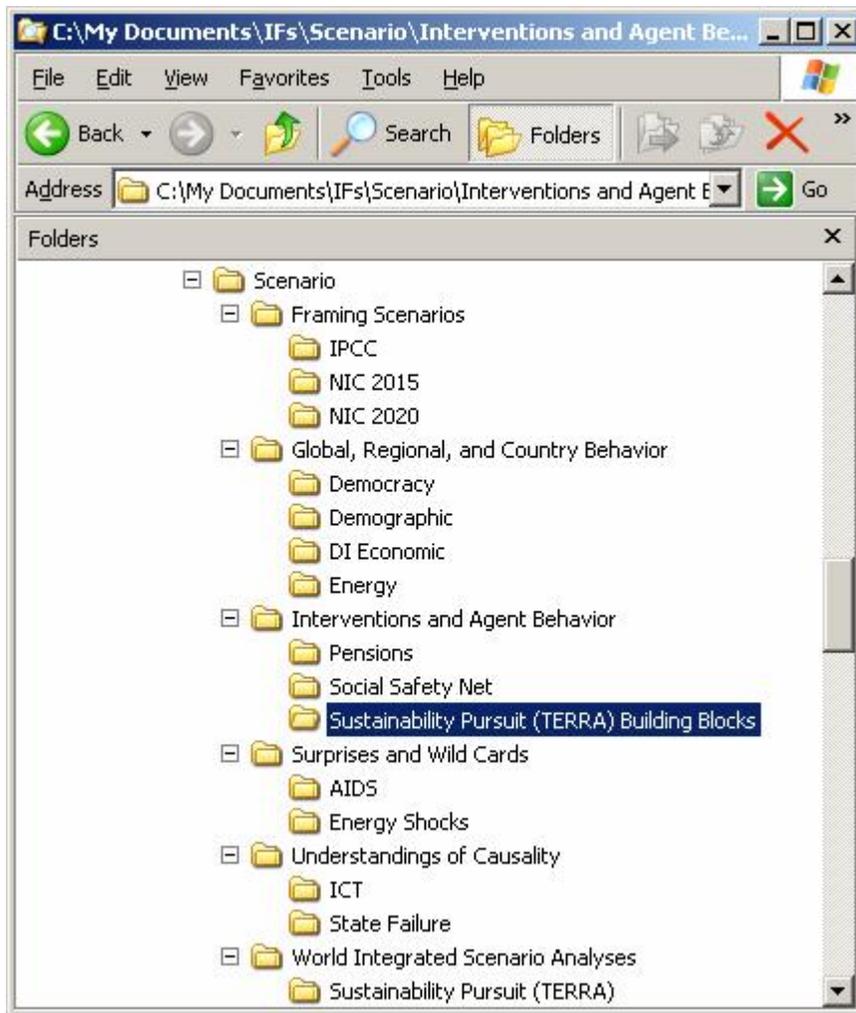
Moving still further down the trunks of the scenario tree, note Selected Initial Conditions and Relationship Parameters. The former allows access to some initial conditions only, because most are firmly rooted in data. The latter allows access to literally every parameter in the model. These were earlier identified as still another building block of scenarios.

Thus the branches and sub-branches (or twigs) of the scenario tree trunks facilitate building of scenarios through the mixing and matching of framing scenario interventions, agent-class behaviour interventions, or relationship parameters. Another feature of the model's interface also allows changing of the form of selected relationships in the model – this could also be used as a scenario tool, but is generally more of interest to those who have specific insight into such relationships.

The building of scenarios from a collection of interventions is facilitated by a second tool linked to the scenario tree, specifically the directory structure for stored scenarios. The figure below shows the screen that appears when the user selects the Scenario Files menu option, Open sub-option from the scenario tree. Note that the directory structure again roughly parallels the typology of scenario types or building blocks laid out earlier.



The user of the scenario tree can store a scenario built with the tree in these directories or retrieve pre-built ones from it. The figure below (using Windows Explorer) shows more detail of the tree than can be seen in the dialogue box above. Note the subdirectories in each of the scenario categories. For instance, within the Framing Scenarios directory is a sub-directory called IPCC (Intergovernmental Panel on Climate Change). Clicking on that would list four scenario files named IPCC1Sce, IPCC2Sce, IPCCB1Sce and IPCCB2Sce. These files in turn contain specifications for the scenario tree that roughly parallel the four scenarios developed by the third round of the IPCC studies. If the IPCC1Sce file were selected and opened, it would populate the scenario tree with a set of appropriate drivers. The user could check the Annotate Scenario option from the Scenario Tree's menu to see if a verbal explanation of the scenario were available.



Going one step further, the scenario specifications in the above directories can be added to each other. Thus after loading the IPCC A1 framing scenario, it would be possible to go to the Demographic directory under Global, Regional, and Country Behavior so as to load a high fertility global population scenario to A1, to go to the Pensions folder and find a scenario on high welfare and pension spending on unskilled workers in LDCs, and/or to go to the AIDS folder under Surprises and Wild Cards to add a set of assumptions about more rapid and extended HIV/AIDS. Such a random combination is obviously of unlikely interest, but different users will find it useful to build combinations of specific interest to them.

The packaged scenarios in the above directory are, to some degree, at the frontier of current analysis work with IFs. The project is seeking to elaborate and test scenario blocks across the trunks and branches of the tree, in order to build integrated scenario analyses. The last category of folders in the tree above will increasingly include large-scale scenarios like the sustainability scenario for the TERRA project (Hughes and Johnson, 2004). The scenario in the Sustainability Pursuit Scenario is fundamentally built up from a substantial list of agent-class interventions; those are, in turn, shown

individually in the folder of Sustainability Pursuit (TERRA) Building Blocks under Interventions and Agent Behavior.

Another critical part of the scenario and policy analysis process is obviously re-running the model after such a scenario is built/loaded, and then comparing the results with the base case to assess the impact of the chosen interventions. That process is documented in the Help system of the model and will not be elaborated here.<sup>18</sup>

### 6.3 Drawing on Other Scenario Analysis Efforts

In order to continue developing the file structure of scenario blocks discussed above, it will be important for the IFs project to monitor other longer-term, global scenario efforts and, when possible to add the representation of the key interventions of those efforts into the model and file structure. The remainder of this chapter is an initial look at such projects as a foundation for doing that.

There are relatively few organizations or individuals that attempt to do global forecasting across multiple issue areas. One of these, the United Nations, occasionally draws together analysis by others from multiple issue areas, sometimes under the rubric of “Critical Trends.” The Department of Economic and Social Affairs published *Global Challenge, Global Opportunity: Critical Trends in Sustainable Development* in support of the 2002 Johannesburg Summit. The useful portraits in different issue areas are, however, largely hung together, not fully integrated in the sense of explaining how the various issue areas interact and collectively create global futures.

Most truly integrated forecasting tends to grow out of efforts to look at futures that extend to the environment, to the socio-political system, or both. Because forecasting in either of these two areas requires attention to technological, demographic, and economic drivers (and to energy and agricultural systems, at least for environmental forecasting), those whose interests extend to the environment or to the socio-political system are almost required to provide broadly ranging and quite integrated images of the future.<sup>19</sup>

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<sup>18</sup> An extension planned for IFs is the creation of a large number of scenarios already run (storing the large .run or result file for each) that users will be able to call up at will. Frederick Pardee has urged this direction of development so that users can avoid the time-consuming process of model runs.

<sup>19</sup> The International Energy Agency (IEA 2003) volume on Energy to 2050 reviews very well many integrated scenario efforts, especially those that build to the energy-environment nexus. In addition to those studies reviewed in this chapter, the volume presents snapshots of scenario studies emerging from Canada, the Netherlands, and the UK. The Hart/Rudman Commission’s Study Addendum (US Commission on National Security/21<sup>st</sup> Century 1999b) also provides a very good review of most integrated scenario analyses to the time of its release, especially those with an emphasis on socio-political futures. Among those discussed by Hart/Rudman that are not reviewed here are the U.S. Air Force 2025 study (1996); see especially the monograph on *Alternative Futures for 2025: Security Planning to Avoid Surprise*, with some wonderfully-named and nicely developed scenarios for the future. Hart/Rudman also summarize Khalilzad and Lesser’s (1998) three scenarios across global regions and attempt to identify some key wild cards. And they outline the Project 2025 of the Institute for National Strategic Studies at the National Defense University. Beyond the coverage of Hart/Rudman and the discussion here, there are periodic surveys, somewhat in the spirit of this report, produced by a wide range of global forecasting projects. The UK Defence Evaluation and Research Agency undertook such a review of *Strategic Futures*

The complexity of such integrated forecasting generally gives rise to (1) group efforts for their creation and (2) multiple scenarios to portray the possibilities.

Many such efforts look to computer simulations, not for the full richness of the scenarios, which must retain substantial qualitative content, but at least for the provision of some quantitative foundation and some consistency across the wide range of issue areas. A useful study by the International Centre for Integrative Studies (ICIS 2000) for the European Environment Agency assesses critically both scenario analysis and the modeling underpinnings of it.<sup>20</sup>

In the environmental arena, the reports of the Intergovernmental Panel on Climate Change (IPCC) are good illustrations of integrated analysis.<sup>21</sup> The IPCC has drawn upon inputs from hundreds of scientists and used scenarios to frame its reports. And it has used a variety of simulation tools in support of the analysis. To summarize the scenario families of the third IPCC report briefly:

- **A1.** Rapid economic growth, global population decline after mid-century, rapid technological change. Convergence among regions, capacity building, increased cultural and social interactions, reductions in regional differences in per capita income. Within the A1 family there are three groups that represent different energy technologies (fossil-fuel intensive, balanced, and predominantly non-fossil fuel).
- **A2.** Very heterogeneous world. Self-reliance and preservation of local identities. Continuously increasing global population. Economic development and per capita income more fragmented.
- **B1.** Convergent world with global population decline after mid-century. Rapid changes toward service and information economy, reductions in material intensity and introduction of clean, resource-efficient technologies. Global solutions to economic, social, and environmental sustainability, including improved equity.
- **B2.** Local solutions to economic, social and environmental sustainability. Continuously increasing global population (lower than A2), intermediate levels of economic development, less rapid and more diverse technological change than in B1 and A1.

Similarly, the Global Scenario Group (GSG),<sup>22</sup> convened by the Stockholm Environment Institute in 1995, has drawn upon the talents of many in creation of its scenarios, which

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*Thinking* in 2001. A virtue of that analysis was an explicit effort to identify wild cards associated with the key issue areas.

<sup>20</sup> A work in progress by Dale S. Rothman, formerly of ICIS, somewhat updates that effort with a focus on environmental scenarios.

<sup>21</sup> See <http://www.ipcc.ch/>; January 16, 2004.

<sup>22</sup> See <http://gsg.org/>; January 16, 2004.

cut across environmental and socio-political arenas. Moreover, it has used the Polestar modeling system in support of several scenario reports, including *Great Transition: The Promise and Lure of the Times Ahead* (Raskin, et al., 2002). Briefly, the GSG scenarios, also elaborated by Hammond (1998) are:

- **Market World.** Rapid technological innovation, economic reform, and economic growth. Integrated world markets. Widespread prosperity, peace, and stability.
- **Fortress World.** Failure of market-led growth to redress social wrongs and environmental disaster. Widening inequality, conflict, and instability.
- **Transformed World.** Power is more widely shared and social coalitions work at grass roots level. Markets are effective, but do not substitute for deliberate social choices. Fundamental change for the better in politics, social institutions and the environment.

Analyses with the Polestar model<sup>23</sup> of the Stockholm Environmental Institute have also been used in support of UNEP's Global Environmental Outlook (GEO-3), to provide some integration across the multiple issue areas of that analysis.

The World Business Council for Sustainable Development (1997, 1999, and 2000) provided additional integrated scenarios with a heavy environmental emphasis. These include (as presented in IEA 2003: 179-185):

- **FROG (First Raise Our Growth)**, a world emphasizing growth first and the environment secondarily.
- **GEOpolicy**, a world in which environmental shocks early in the century lead to global organizational restructuring, including the Global Ecosystem Organization (GEO).
- **Jazz**, a decentralized, deregulated world that brings many advantages but that ultimately cannot create a path towards sustainability.

In the socio-political arena, the Hart-Rudman Commission, more formally the United States Commission on National Security/21<sup>st</sup> Century (1999a) began in 1998 to develop reports to accomplish what it described as the "most comprehensive government-sponsored review of U.S. national security in more than 50 years." Although most of the Commission's reporting was focused on quite specific issues and geographic regions, and although it argued that the future would likely be a patchwork of elements, it concluded its Phase I report on *The New World Coming* with a brief elaboration of four scenarios:

- **A Democratic Peace.** Democratic norms predominate, there is no sharp ideological conflict, and political cooperation among states is high. The scenario

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<sup>23</sup> See <http://www.seib.org/polestar/Projects.html>; January 16, 2004.

is built on assumptions of moderate economic growth and a continuing information revolution, but also posits global inequalities and other challenges.

- **Protectionism and Nationalism.** Global economic crisis or other factors lead to the rise of nationalism and of regional power blocks. The developing world suffers economic decline in the face of decreasing trade and financial flows. Nationalism, ethnicity, and fundamentalism direct some politics and even governments.
- **Globalization Triumphant.** Rapid progress in technology and global growth in economies allows developing countries to create larger economies than those in the developed world. There is widespread commitment to more equitable income, to development of human capital, to peaceful conflict resolution, and to sustainable environmental policies.
- **Division and Mayhem.** Diffusion of dangerous technologies, breakdown of globalization processes, or environmental crisis could give rise to this world. Internationalism breaks down, with restrictions on trade, financial and information flows. Many countries fragment ethnically, culturally, or religiously. Terrorist attacks on U.S. cities reorient U.S. policy towards preventing more attacks and away from broader global engagement, giving rise to a downward spiral.

Once again reaching into the socio-political arena, the Forward Studies Unit of the European Commission (1999) put forward five possible futures with a focus on Europe:

- **Triumphant Markets.** This is essentially another victory of globalization scenario, but drawing attention to negative aspects of liberal markets for some participants within two-tier labor markets, including growing inequality as well as a loss of social benefits and support systems.
- **The Hundred Flowers.** Economically less successful globalization and the weakening of governments allows corporate excesses and growth of crime, accompanied by rising public dissatisfaction in a world of highly uneven performance and a more ominous international situation, including an introspective United States.
- **Shared Responsibilities.** Successful and extended integration of societies by the European Union set in motion a dynamics of reform, renewal and coordination in policy and the establishment of a clear European model for economic and socio-political systems, with support for European leadership in multilateralism and global systems.
- **Creative Societies.** Aggressive European reforms reduce the governmental footprint and give rise initially to backlash and socio-political problems including

slowed expansion, but suggest the possibility for an emergence of ultimately more creative government and renewed society.

- **Turbulent Neighbourhoods.** Ethnic wars, terrorism and rising criminality around the world, to which other actors and global systems respond incoherently, bring themselves to Europe's doorstep forcing Europe to narrow its geographic definition and focus on security issues, but at great cost in other arenas and without great success even with respect to security.

The Millennium Project has developed many scenarios over time, including (ACUNU 1998 as described in IEA 2003: 186-190):

- **Cybertopia.** Free trade and globalization, highly developed information/communications, low governmental profile, and high security.
- **The Rich Get Richer.** Like Cybertopia, except that income inequalities grow, environmental problems are more pronounced, and security is low.
- **A Passive Mean World.** Barriers to trade, stagnant communications, and high levels of government combine with high unemployment. Poor countries develop slowly and people turn inward within and across regions of the world.
- **Trading Places.** Open trade, highly developed information/communications, low government profile and low security. The rich countries suffer economically more than the emerging countries like China, however, who surge ahead in the system and become dominant powers.

At the Inaugural Conference of Project 2020, Ted Gordon of the Millennium Project sketched four other scenarios, which collectively place considerable emphasis on alternative technological futures:

- **Science and Technology Develops a Mind of its Own.** Scientific and technological discoveries accelerate ahead of the ability of governments to keep pace.
- **The World Wakes Up.** An individual murders 25 million people with a genetically-modified virus leading to more control of science.
- **Please Turn off the Spigot.** Science is seen as not meeting the needs, especially of the poor, and a global commission attempts to intervene.
- **Backlash.** Negative consequences of innovation lead to mass concern, unsuccessful regulation and stalled progress.

Also in the socio-political arena, the U.S. National Intelligence Council (NIC), providing integrated strategic thinking for the Director of Central Intelligence and the broader U.S. government, prepared a report on *Global Trends 2010* (1997), a second report on *Global Trends 2015* (2000) and is preparing *Global Trends 2020*. As part of its past analysis it identified demographics, natural resources and the environment, science and technology,

the global economy and globalization, national and international governance, future conflict, and the role of the United States as key drivers. Although most of its report elaborated the unfolding of those drivers globally and within specific countries and regions, the NIC, like Hart-Rudman, also concluded its 2015 report with four general scenarios:

- **Inclusive Globalization.** Technological development and diffusion, economic growth with wealth diffusion, effective national and international governance, and conflict reduction create a virtuous circle for all but a minority of the world's population.
- **Pernicious Globalization.** Population growth and resource scarcities burden many developing countries more than technological advance is able to help them, leading to a splitting of the global economy and the failure of a majority of global population to benefit from globalization.
- **Regional Competition.** Regional groupings in Europe, Asia, and the Americas emerge and compete economically and with respect to technology, also leaving other areas, such as Sub-Saharan Africa, the Middle East, and Central and South Asia behind and giving rise to overt conflicts in such regions.
- **Post-Polar World.** The U.S. economy slows and stagnates, focusing attention inward, and causing the U.S.-European alliance to deteriorate, while regional tensions in Asia and growing Chinese capabilities give rise to military tensions and possible conflict for which the U.S. has little outside support.

#### 6.4 Key Global Uncertainties in Various Scenario-Building Efforts

The scenario families of many of the above studies tend to identify similar sets of key uncertainties in mapping their scenarios. In fact, the names and characters of the large framing scenarios begin to sound much alike. How much alike are they? Some dimensions of uncertainty clearly come back from one analysis to the next, and to some considerable degree they can be categorized using the scenario typology elaborated in the paper:

##### 1. Key Framing Scenarios.

- **Pace of Technological Change and/or Economic Growth.** Essentially all scenario groupings exhibit internal variation with respect to either or both of these key underlying drivers. This is as close to a universal set of framing assumptions as there are. That fact is not surprising – great thinkers such as Marx or Toeffler have always been somewhat in the camps of technological or economic determinism. Empirically, it is difficult to find socio-political variables that are not correlated with GDP per capita.

- **Environmental Uncertainties.** Framing assumptions with respect to the environment are also quite prevalent in longer-term analyses, but tend to be more implicit than those about technology or growth. They can be seen in the IPCC scenarios, as well as those of the Global Scenario Group and the World Business Council for Sustainable Development. The IPCC focuses heavily on the material intensity of the economy and the character of the energy system, and *Which World?* creates one scenario around a environmentally pessimistic future.

## 2. Global, Regional, Country Behavior: Globalization and Culture

- **Level of Globalization (and Possibly Cultural Differences).** As with technological change and economic growth, nearly all recent groupings again make differing assumptions across scenarios with respect to the extent of globalization and many look also to the role of regional cultural differences (a la the *Lexus and the Olive Tree* juxtaposition). Although scenarios built around continued/faster/slower/interrupted globalization are very common, it still appears to make sense to distinguish these as general behavioural scenarios from the framing scenarios around technology and the environment. It is quite easy for states to manipulate trade or financial flows. It is quite difficult for them to influence technological developments or the natural resource base of oil and gas.
- **International Cooperation or Lack of Cooperation.** Many scenario sets introduce variations in behavior of the United States and sometimes of other actors in the extent of unilateralism or multilateralism in policy. Again this may be linked to the level of globalization, but it may also have broad non-economic consequences.
- **Income Distribution.** This dimension of underlying variation in scenarios is also quite common across sets; the distributional attention is primarily interstate, but can also be intrastate. In many analyses it is a logical extension of assumptions about globalization (globalization often either creates greater inequalities or enhances convergence of economic levels, depending on the belief system of the scenario builder).
- **Nationalism and other isms.** A considerable number of global political scenarios look at the intensity of national, religious or other identities and/or ideologies. Again this could be part of a globalization/regionalization scenario set, but could also be separate.

## 3. Global, Regional, Country Behavior: Other Dimensions

- **Demographic patterns.** The IPCC creates two general alternative demographic futures. Demographic futures are, however, less widely distinguished in scenario sets than many other driver sets, in part because of substantial convergence in assumptions and therefore forecasts across demographic analysts.
- **Governance Success.** In some scenarios the success or quality of governance is explicitly variable and in some analyses the size of government also varies.
- **Global power configurations.** Substantial numbers of scenarios that look at global politics explicitly differentiate possible future power distributions.

#### 4. Agent Behavior

- Aside from elements such as the U.S. role in global cooperation or some implicit assumptions about other governments' commitment to free trade and financial flows, there tend not to be many specific agent-class assumptions in most scenario sets. That is appropriate, because much consideration of agent-class behaviour is more relevant to policy analysis built on scenarios than it is the scenarios themselves.

#### 5. Wild Cards

- Many scenarios reach out for their central character to improbable but theoretically possible events, from plagues through meteor collisions with earth to specific technological breakthroughs. In short, wild cards are "all over the place." As discussed earlier in the paper, one place to look for them is in an analysis of tensions and imbalances.

This quick analysis of available scenario sets suggests that the general approach of IFs in attempting a framework for building scenarios flexibly is generally on track. It also suggests, however, that some of the building blocks of importance to such scenario sets have not yet been represented in the directory structure of the IFs scenario sets. Most prominent among the absences is a set of scenarios around globalization processes.

## **6. Conclusion**

Scenario development, policy analysis, and model development proceed hand-in-hand in a modelling project like International Futures (IFs). The purpose of this paper has been to attempt, for the first time in the history of the project, to lay out systematically the generic elements of the scenario development and policy analysis processes and to demonstrate the ability of IFs to support those elements.

It is gratifying that the structures of the IFs modelling system, the model itself, the user interface, and the database, offer much of what is needed for scenario development and policy analysis. Obviously, of course, there are many limitations. A number of those will be addressed as the NIC 2020 project continues and IFs is used in support of it.

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