

# Some Thoughts on Making Long-Term Forecasts for the World Economy

*Shahrokh Fardoust*

*Ashok Dhareshwar*

The World Bank  
Development Economics Vice Presidency  
Operations and Strategy Unit  
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## Abstract

Countries and international organizations working on longer-range development issues depend on long-term quantitative projections and scenario analysis. Such forecasting has become increasingly challenging, thanks to the rapid pace of globalization, technological progress, the interplay among them, and enhanced connectivity among people. As a result, seemingly isolated events can quickly lead to wide-ranging and lasting regional or even global consequences. This paper examines the problem of long-term economic forecasting in the face of increased complexity and uncertainty. With the benefit of hindsight, it scrutinizes past long-term qualitative and quantitative projections for the 1990s in order to draw lessons on how an institution can and should conduct long-term forecasting and policy analysis. The main conclusions are that policy makers and researchers across the world urgently need to see the big picture if they are to deal with the specific challenges and opportunities they will face over the long term as economies and global linkages undergo major structural changes under

conditions of considerable uncertainty and volatility. Global institutions need to have strong research programs that work in close collaboration with other international organizations, academic centers, and independent experts on important long-term development issues (“blue sky” issues) and megatrends. These institutions need to build on their comparative strengths and form teams of in-house researchers and global experts who work on state-of-the-art models related to globalization, technological progress and innovations, climate change, demographic shifts, population, and labor force quality and their policy implications at both the global and country levels. Researchers should be encouraged to consider how global challenges such as financial crises, climate change, and infectious diseases can lead to breaks in economic trends and regime change and how such breaks affect economic activity. Alternative scenarios need to be created that incorporate the views of contrarian forecasters, including forecasts of possible shocks.

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# Some Thoughts on Making Long-Term Forecasts for the World Economy

*Shahrokh Fardoust and Ashok Dhareshwar<sup>1</sup>*

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<sup>1</sup> Shahrokh Fardoust is the former Director of Strategy and Operations of Development Economics at the World Bank and the current President of International Economic Consultants, LLC. His email is sfardoust1@gmail.com. Ashok Dhareshwar is a visiting professor at the Indian Institute of Management, Calcutta, and a former economist at the World Bank. His email is adhareshwar@hotmail.com. Work on this paper was undertaken when the authors were at the World Bank. The authors thank Paul Armington, Uri Dadush, Nikhil Desai, Jean-Jacques Dethier, Shantayanan Devarajan, Xubei Lou, Adnan Mazarei, Hashem Pesaran, David Rosenblatt, and Elliot Riordan for useful comments, observations, and suggestions on earlier drafts. The views expressed here are the authors' and do not reflect those of the World Bank, its Executive Directors, or the countries they represent.

## Abbreviations

DECPG	Development Economics Prospects Group (World Bank)
FCCC	Framework Convention on Climate Change
FDI	foreign direct investment
GDP	gross domestic product
ICOR	incremental capital output ratio
ICT	information and communications technology
IECAP	International Economic Analysis and Prospects Division (World Bank)
IMF	International Monetary Fund
IPCC	Intergovernmental Panel on Climate Change
MUV	manufactures unit value
NIC	National Intelligence Council (of the United States)
NIE	newly industrializing economy
NIESR	National Institute of Economic and Social Research (of the United Kingdom)
OECD	Organisation for Economic Co-operation and Development
PAC	Planning Assumptions Committee (World Bank)
QE	quantitative easing (of monetary policy)
SITC	Standard International Trade Classification
TFP	total factor productivity
WDI	World Development Indicators (World Bank)
WTO	World Trade Organization

*Unusual interest attaches now to long-term forecasts... possibly 10–25 years longer. A primary reason for this interest is the contemporary series of problems associated with energy, the environment, other resources, and food. The shape of the economic environment in terms of requirements and related supplies are of central interest to technical planners. Decisions have to be made today about processes that will come into full use in two or three decades; therefore long-term forecasting is essential, regardless of the fact that it is very shaky for such long horizons.*

—Lawrence R. Klein, Nobel Laureate in Economics, 1983

*Some analysis of megatrends is mainly about anticipating dangers and preparing for them in a timely fashion. Conventional models of deterministic processes are not useful for this. The analysis is essentially non-linear and deals with the likelihood or necessity of unanticipated, chaotic transformative change in systems. Governments should surely aim to avoid Random Destruction, while they may well try to manage Creative Destruction with a light hand. The “tipping points” cannot be predicted, but this doesn’t matter much because the forecaster is not required to produce a time path. The policy implications take effect in the present and continue indefinitely.*

—Paul Armington, Chief, International Economic Analysis and Prospects Division, World Bank, 1987–92

*Because we really did not do well enough in anticipating crises. One lesson that I would try to bring out is the need to listen more closely and systematically to contrarian forecasters—especially those unfettered by bureaucratic or political considerations.*

—Uri Dadush, Director, Prospects Group, Development Economics, World Bank, 1992–2008

## **1. Introduction**

Long-term quantitative projections and scenario work are essential for developing long-range national or organizational development strategies. They are critical to analyzing fiscal and environmental sustainability and assessing the macroeconomic implications of climate change and demographic shifts, such as population aging. Macroeconomic forecasting is challenging, however, particularly over a long-term horizon (10 years or longer), where it can be akin to throwing darts at a moving target in the dark. The challenge has become particularly difficult in recent years, as a result of the rapid pace of economic and financial globalization; technological progress; and enhanced connectivity, including through electronic social networks. Small and seemingly isolated events can have wide-ranging regional or even global consequences. The self-immolation of street vendor Mohamed Bouazizi in December 2010 sparked the Tunisian revolution and subsequent major political upheavals in other countries in that region, for

example; the filing for Chapter 11 bankruptcy protection by Lehman Brothers in September 2008 led to one of the largest single-day drops in the history of the U.S. stock market and subsequently to a global financial crisis.

Juxtaposed against these longer-term trends, the 2008–09 global crisis fundamentally changed the landscape for finance, trade, and growth over the next decade, if not longer. The immediate outlook is severely affected by the downside risk that the Euro area, which has been struggling with sovereign debt crises in several of its member countries, will fall into yet another recession. Recently released reports by international financial institutions, such as the World Bank, the International Monetary Fund (IMF), and the Organization for Economic Co-operation and Development (OECD), and many private international forecasters warn that the global recovery remains fragile and that many advanced economies are likely to face a long period of slow growth, high unemployment, and significant excess capacity in key economic sectors, as they face large fiscal deficits and high debt levels.<sup>2</sup>

Using these trends to form a baseline forecast (albeit a highly uncertain one) about the world economy, a low-case scenario could look very bad. A lost decade of growth and prosperity could result.

Mohamed El-Erian (2012), the CEO of PIMCO, a global investment company, recently identified four major downside risks facing the global economy in the short to medium term:

- endemic lack of bipartisan consensus on macroeconomic policy in the United States
- the deepening of the sovereign debt crisis in Europe
- geopolitical risks in the Middle East, North Africa, and the Pacific region
- the economic slowdown and changes in political leadership in China.

To this list one should add the much larger risks stemming from climate change, natural disasters, and infectious-disease pandemics and unpredictable (“black swan”) events.

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<sup>2</sup> IMF (2012) provides five-year forecasts (which the IMF considers long term) beginning in April 2011; see also OECD (2012a) and World Bank (2013b).

Gordon (2012), in an influential recent paper, argues that growth in the technological frontier country, the United States since 1906, has been slowing and that even if innovations continue at a steady rate, the U.S. economy faces headwinds from several directions, including demography, education, inequality, globalization, energy, unemployment, and debt overhang. He believes that the strongest headwind results from the interplay between globalization and modern technology, which has led to an acceleration of the process of catching up by the emerging economies and downward pressure on wages and real incomes in advanced economies.

Using recently compiled income inequality data for a large number of advanced and developing countries, Jaumotte, Lal, and Papageorgiou (2013) find evidence that globalization of trade reduced within-country income inequality and that financial globalization and foreign direct investment (FDI) increased it. They conclude that the main factor driving the rise in income inequality in the last two decades was technological progress, particularly in developing countries. Financial globalization and technological progress widened inequality because they increased the relative demand for skills and education.

There are also plenty of upside risks to the world economy. Technological developments related to green investments could lead to marked improvements in mitigating the risks of climate change. Revolutions in biotechnology and genomics could lead to vastly improved delivery of health services. And educational advancements could lead to social and political changes that in turn reduce income, gender, ethnic, and racial inequality (Franklin 2012).

This paper is concerned with the problem of long-term economic forecasting in the face of increased complexity and uncertainty. Its main objective is to identify lessons learned from past attempts at making long-term economic forecasts by focusing on selected exercises undertaken at the World Bank and other institutions. The paper uses “A Long-Term Outlook for the World Economy: Issues and Projections for the 1990s” (Fardoust and Dhareshwar 1990), which presented forecasts for the global economy in the 1990s, as the case study. We compare actual economic outcomes with the forecasts we made in 1990 in order to draw lessons about and seek guidance on conducting long-term forecasting.

A key novelty of the 1990s (and 2000s) was the very important interaction between the forces of globalization and modern technology. Many researchers believe this interaction brought an end

to the “great divergence,” as the pace of economic growth in China and India soared, but increased income inequality, particularly in the advanced economies.

Like the 1920s, the 1990s was a decade of optimism and financial excess that was followed by a sense of reality (see Box 3). The events of the 2000s—9/11, the dot.com crisis, the 2008/09 crisis—contributed to the swing back to realism following the optimism of the 1990s. This pattern was reinforced in the 2000s by 9/11, the dot.com crisis, the 2008/09 crisis, and a number of major weather-related natural disasters during the decade. We believe that both the positive trends witnessed in the past two decades (including continued globalization, strongly linked with technological progress and the spread of social media) and the negative ones (including the growing intensity and frequency of financial crises and climate change) are precursors of what is to come.

The rest of the paper is organized as follows. Section 2 briefly examines recent developments in the global economy. Section 3 describes the issues involved in long-term forecasting and the approach we adopted in our 1990 work. Section 4 compares, both qualitatively and quantitatively, our forecasts with actual outcomes—not to assess the accuracy of the exercise per se but to draw lessons regarding what to focus on and how to organize long-term forecasting efforts in the future. We address this issue in Section 5 in light of the major pressure points envisaged in the global economy in the coming decade.

## **2. Recent Developments in the World Economy**

Over the past two decades, the world economy has continued to become more integrated, through trade, finance, workers’ migration, and various modes of outsourcing, offshoring, and supply chains. The globalization process accelerated at an unprecedented pace, as a result of the policies of liberalization and deregulation of markets pursued by both advanced and emerging economies and technological advancements that improved communication and transport and reduced the costs of doing business over long distances. Between the early 1990s and 2007, just before the onset of the 2008–09 crisis, world merchandise trade as a share of world gross domestic product (GDP) rose from less than 20 percent to more than 30 percent; cross-border financial flows rose even faster, from less than 4 percent of world GDP to about 20 percent. The pace of trade integration has been even more rapid in emerging and developing economies. For

these countries as a group, the exports-to-GDP ratio rose from 26 percent in the mid-1990s to about 52 percent in 2007. South-South trade emerged as one of the more dynamic elements of the global economy, its contributions to international trade more than tripling in the same period, to nearly 25 percent of world trade.

The world economy has been undergoing massive shifts, underpinned by the rapid rise of emerging economies, such as Brazil, China, and India. In 2011, emerging and developing economies as a group accounted for nearly 50 percent of world GDP in purchasing power parity (PPP) exchange rates, up from 35 percent in the mid-1980s, and for nearly 70 percent of world GDP growth. These economies are growing much more rapidly than advanced economies; their weight in global production, trade, investment, and finance has also risen. They now account for 42 percent of world trade, 45 percent of foreign direct investment (FDI) inflows and 26 percent of outflows, and nearly two-thirds of total foreign exchange reserves (World Bank 2011a).

Although the advanced economies are still tentative in weathering the after-effects of the Great Recession and the financial crisis, many developing countries have shown resilience in dealing with the effects of the global crisis, at least as of mid-2013. Their initial policy response resulted in improved economic performance and provided the world economy a vitally needed stimulus. Major emerging economies also acquitted themselves credibly as participants in forums of international cooperation and policy coordination, such as the G-20, which, through its coordinated policy response early on, played a critical role in preventing the Great Recession from turning into a worldwide depression (Fardoust, Kim, and Sepulveda 2010).

On the negative side, as of mid-2013, the global economic situation remained fragile, with slow economic growth and high unemployment in many advanced countries, still looming debt crises in several European countries, and a slowdown of growth in a number of emerging economies. Although many developing economies have proven to be resilient to the economic slowdown in advanced economies, continuing to grow at relatively rapid rates, a number of developing countries, most of them in fragile and post-conflict states, have not yet been able to launch their economies on a sustainable, faster track of growth and development. Even among many of the countries that have adapted successfully to the increasingly globalizing world and a rapid economic recovery, concerns remain regarding slowing growth and rising inequality—concerns that also extend to a number of advanced economies.

With the slowdown of growth in advanced economies, world trade has slowed significantly. Although there has not (yet) been a major protectionist backlash of the kind the world witnessed in the wake of the Great Depression, with tighter global markets and increased competition, trade tensions have been on the rise. The Doha Round of international trade talks has stalled, and agreement for responding to climate change appears elusive.

Along with financial globalization and freely moving capital, the financial innovations of the past two decades and the emergence of the shadow banking system have increased the complexity of modern economies manifold. The interconnections between the real economy and financial markets have created crucial feedback loops. The vicissitudes of financial markets can have long-lasting impact on the evolution of real variables.

As a result, macroeconomic policy making is facing growing uncertainty in terms of transmission channels and effectiveness, with many advanced and emerging economies running out of fiscal space and facing mounting debt, making another round of fiscal stimulus to maintain aggregate demand less likely. Traditional monetary policy response has proven ineffective in several large advanced economies, as nominal interest rates have approached the zero lower bound, which has important implications for the formulation and implementation of both national and international monetary policy. In the United States, for example, because the Federal Reserve cannot cut nominal interest rates below zero, savers do not spend enough, and the economy is stuck with high unemployment (Eggertsson and Krugman 2011). This phenomenon has led to a policy of quantitative easing (QE) of monetary policy to stimulate consumption and investment. The policy, however, has had important ramifications for the international monetary system, as near-zero short-term interest rates have caused massive “hot money” outflows from the United States into emerging economies in Asia and Latin America. The central banks of these emerging economies have had to buy dollars to prevent their currencies from appreciating, entailing a loss of monetary control over inflation. It has been argued that this higher inflation in the periphery will eventually increase inflation in the United States (McKinnon 2011).

These unprecedented developments and massive global shifts raise a number of questions about the future of the world economy. Has there been a significant change in longer-term global

economic prospects? Is the era of sustained economic growth over? Will the process of globalization be reversed? What are the prospects for development and poverty reduction?

Although some recent developments were predicted, many others caught even experienced policy makers and economic observers by surprise. These developments render the task of macroeconomic policy making much more challenging and heighten the importance of sound forward-looking economic analysis, forecasts, and scenario analysis as crucial inputs into the policy-making process at both the national and international levels. Because macroeconomic policies have medium- and long-term implications, increased uncertainty makes it imperative to try to judge the likely consequences of alternative policies under key possible scenarios that focus on particular aspects of the global economy.

Given this *tour d'horizon* of the current scene, it would be instructive to step back and analyze significant past exercises in long-term forecasting as an input into policy. What were the hits and misses? What lessons can be drawn?

### **3. Long-Term Economic Projections: A Case Study from the World Bank**

The international financial institutions conducted a few long-term forecasting exercises in the last three decades. One was conducted by the World Bank in 1989 (Fardoust and Dhareshwar 1990). Before the publication of *A Long-Term Outlook for the World Economy: Issues and Projections for the 1990s*, World Bank forecasts were based on mere assumptions (for a nontechnical evaluation of earlier forecasts, see World Bank 1991, Box 1.4). Bank projections systematically erred on the side of optimism: the realized growth rates of developing countries' aggregate output were lower than the projections in all the forecasts for the base-case scenario and in most of the forecasts even for the low-case scenario (Figure 1).<sup>3</sup>

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<sup>3</sup> A similar but more in-depth assessment has been made of the IMF's short- and medium-term forecasts (see section 4.2 below and footnote 6.)



particular chapter 7). The Bank's researchers had already started using Project LINK's multi-country macroeconomic models, which imposed global consistency and incorporated transmission channels through a detailed set of bilateral trade matrices (by 0–9 SITC classification), to perform a number of medium-term (3- to 5-year) and long-term (10-year) simulations under alternative scenarios related to adverse shocks and policy response, such as a sharp oil price increase and coordinated G-7 policy action.

The *Long-Term Outlook* study was the culmination of these efforts and consultations. It tried to link the various economic, financial, demographic, environmental, and technological forces in play at the global level to the underlying macroeconomic analysis and quantitative projections. It also looked at many important trends that would affect the global economic environment and resulting economic performance, such as world trade, commodity prices, and the real rate of interest in the OECD area. It fine-tuned, supplemented, and integrated the judgments of the Bank's developing country specialists regarding the prospects for their countries, consolidating them into forecasts for the developing world under alternative scenarios. It tried to draw out implications regarding key policy actions that were needed, as well as possible policy failures. It was meant both as a focus around which certain disparate activities and processes in the Bank could coalesce and as a blueprint for a periodic vision document for use by Bank staff, which could also be shared with the world.

This effort led to the launching, in 1992, of *Global Economic Prospects*, one of the Bank's flagship products. Every issue of *Global Economic Prospects* focuses on a theme of importance to the world economy, particularly developing countries, with longer-term and policy implications. The themes covered in the 1992–2010 period ranged from trade in manufactures (1992) and commodities (1993) to the East Asian financial crisis (1998, 2000); the Doha development agenda (2004); migration and remittances (2006); the next wave of globalization (2007); technology diffusion in the developing world (2008); and the Great Recession (2009, 2010, 2011).<sup>5</sup>

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<sup>5</sup> In 2010, the Bank launched a new flagship with a medium- to long-term range, *Global Development Horizons*. *Global Economic Prospects* became an Internet-only publication focusing on short-term forecasts and analysis.

#### **4. How Accurate Was the Bank's Forecasting?**

A crucial part of learning from the past is assessing what worked and what did not—or in this case, what we got right and what we got wrong. A forecast is not just a set of numbers or an armchair exercise in contemplating the future. It is a narrative on the initial conditions of the world economy and how that economy is likely to evolve over time, based on trends that have an objective basis and the ways in which these trends fit into a comprehensive framework in a consistent and complementary manner. The numerical projections are important in imparting discipline to thinking about the future. Thus, the forecast is an integrated whole in which qualitative and quantitative aspects are equally important.

Our assessment of our forecast for the 1990s covers both these aspects. We start by assessing the quality of the forecast (how accurate it was) by comparing forecasted and actual economic growth rates. We then discuss how the decade of the 1990s turned out in terms of key trends and assess the extent to which our analysis captured them. We then examine the numerical projections of various facets of the world economy and compare them with projections by other forecasters as well as with actual outcomes. We conclude with a methodological exercise that examines whether we could have done better if we had used more sophisticated tools.

##### ***4.1 Key Growth Forecasts***

Table 1 highlights our assumptions and forecasts regarding aggregate GDP growth in high-income OECD countries and developing countries.

The projected growth rates for the high-income countries of the OECD were assumptions, based on a detailed analysis of the trends in the world economy and the OECD countries as of 1989. They reflected our judgment and the judgment of other Bank staff at the time.

The aggregate growth rates for developing countries reflect forecasts for a large number of individual countries by the Bank's country economics staff, based on a coherent set of assumptions regarding the global economic environment, complemented and integrated by the forecasting team in the International Economic Analysis and Prospects Division of the Bank, now the Development Economics Prospects Group. (See Box 1 for a description of the forecasting process and Box 2 for descriptions of the model used.)

**Table 1 Projected and Actual Real GDP Growth Rates for Developing and High-Income OECD Countries, 1965–2000**

(annual percentage change)

<i>Income level</i>	<i>Historical average annual growth</i>		<i>Projection for 1990s</i>		<i>Actual (1990–2000)</i>	<i>Forecast error<sup>a</sup> (percent)</i>	
	<i>1965–88</i>	<i>1980s</i>	<i>Baseline</i>	<i>Low case</i>		<i>Baseline</i>	<i>Low case</i>
All low- and middle-income countries	5.2	4.3	5.1	4.3	4.9	–4.2	13.6
All low- and middle-income countries except China and India	4.8	2.8	4.5	3.8	3.7	–18.0	–2.9
High-income OECD Countries	3.1	2.8	3.0	2.6	2.5	–15.6	–2.7

*Source:* All data except actual data and forecast error are from Fardoust and Dhareshwar 1990. Data for 1990–2000 are from World Development Indicators.

*Note:* The country coverage for the actual data is slightly different from the coverage for the projections. It excludes Myanmar and Taiwan, China, data for which were not available. Instead of Yugoslavia, the GDP data for Croatia, Macedonia, Serbia, and Slovenia are used; data were not available for Bosnia-Herzegovina, Kosovo, or Montenegro.

<sup>a</sup> Calculated (using unrounded values) as  $[(y^a - y^f)/y^f] * 100$ , where  $y^a$  is the actual growth for the 1990s and  $y^f$  is the growth for the 1990s forecast in 1989.

### **Box 1 The Forecast Process at the World Bank in the Late 1980s and 1990s**

Box figure 1.1 shows a skeletal view of the annual forecast process at the World Bank in the 1990s and early 2000s. The cycle begins with the formulation of planning assumptions—projections of variables characterizing the external economic environment for developing countries over a 10-year horizon. These variables include growth and inflation in high-income OECD countries; real and nominal international interest rates; aggregate global trade; and prices of energy, major nonenergy commodities, and manufactures (the “MUV index”). The Bank does not forecast exchange rates. Instead, it makes the technical assumption that real exchange rates of major currencies remain the same as their values at the beginning of the forecast period.

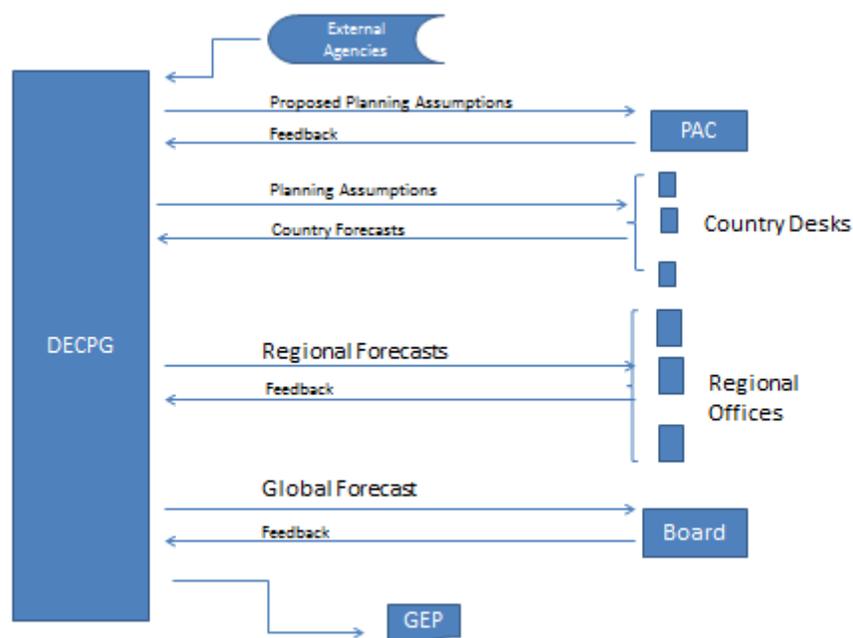
The Development Prospects Group (DECPG) (earlier the Economic Analysis and Prospects Division [IECAP]) proposed draft projections of these variables, based on in-house models; projections by various external agencies (including the IMF, the OECD, and the LINK Project, as well as consensus forecasts); and a judgmental reading of the global economy. The draft projections were reviewed and discussed by the Planning Assumptions Committee (PAC), which consisted of representatives from the Development Economics Vice Presidency (VPDEC) and the chief economists of regions, the International Finance Corporation (IFC), and other parts of the Bank.

The Bank thus did not have a single grand unified model of the world economy. It used a suite of models for energy, nonoil commodities, and capital flows as well as models for a large number of individual economies. The country models are not meant to be used to generate primary baseline forecasts (except in the case of a few countries in which forecasts by country desks are not available). They were used mainly

to check for consistency and to produce alternative scenarios. The suite of models was periodically augmented with special-purpose models for examining bespoke scenarios as needed.

The World Bank’s final projections regarding the external economic environment are key inputs into the Bank’s Unified Survey process, in which country economists generated projections for developing economies, based on a combination of models and their implicit knowledge of the economies. The Development Economics Prospects Group (DECPG) conducts consistency checks and aggregates these country-level projections in two stages, regional and global. First, developing country regions presented aggregate projections to regional offices; these projections represent the baseline. They were accompanied by narratives as well as alternative scenarios meant to capture possible downside risks to the baseline projection. Next, after incorporating their feedback, DECPG created global baseline projections, the storyline, and alternative scenarios. After presentation to the World Bank’s Board and incorporation of their feedback, these figures were published as *Global Economic Prospects*.

**Box figure 1.1 The World Bank’s Forecasting Process in the 1980s and Early 1990s**



*Note:* DECPG = Development Economics Prospects Group. GEP = Global Economic Prospects. PAC = Planning Assumptions Committee.

**Box 2 Global Modeling for Forecasts at the World Bank in the 1980s and Early 1990s**

In the 1980s and early 1990s, the Bank’s Economic Analysis and Prospects Division (IECAP) produced forecasts of several key macroeconomic indicators in the major industrial countries. These forecasts were used as inputs into the capital flows model, which was used to produce projections for some 90 developing countries. Several divisions in the financial and operations complexes of the Bank used the industrial country forecasts as inputs in their work. At the time, IECAP did not have a fully linked macroeconomic model of industrial country forecasts. It did have cooperative research arrangements with other groups or organizations that used fully linked world econometric models, such as the OECD’s Interlink Model, the University of Pennsylvania’s Project LINK (later moved to the United Nations Secretariat), and the Wharton Econometric World Model.

In the late 1980s, the main global model used by the Bank was the capital flows model. Later, IECAP developed a close relationship with the National Institute of Economic and Social Research (NIESR) in London on its Global Economic Model. The two models are described below.

The capital flows model was a model of debt, creditworthiness, and borrowing for about 90 countries in which the import capacity of most developing countries was determined as a residual in their balance of payments identity. Creditworthiness indicators as well as domestically imposed financing constraints played crucial roles in determining the levels of private and nonconcessional official flows and debt services. GDP growth was affected through a reduced-form relationship with imports and investment. The model was not a fully linked system; it was solved as a set of separate small-country models. The model comprised about 900 equations and was installed in the TROLL system (an econometric software). It was used to prepare the base case and alternative scenarios the *World Development Reports* (and in the 1990 Fardoust and Dhareshwar study).

The global economic model was a 640-equation macroeconomic model. It covered the world economy but focused on the seven major industrial countries. It was authored by and maintained at NIESR in London. A copy of the model, which was maintained by the then International Economics Department (IEC) at the World Bank, was used to produce forecasts and analyze events and policy options in the world economy. The model was divided into 16 sectors. Each of the G-7 country sectors contained about 60 variables, covering individual components of demand, price indexes, exchange rates and interest rates, and data on the trade and current accounts. The remaining sectors cover the other industrial countries, the Organization of Petroleum Exporting Countries (OPEC), Asia, Latin America, Africa, the centrally planned economies, and miscellaneous developing countries. These sectors contained equations for trade volumes and prices, which depended on five commodity price indices.

DECPG, which replaced IECAP in the late 1990s, uses a number of more sophisticated global models, such as the Global Linkage Model, iSimulate, MAMS, ENVISAGE, and the Global Income Distribution Dynamics Model. For descriptions of these models and more recent model developments see the World Bank website:

<http://web.worldbank.org/WBSITE/EXTERNAL/EXTDEC/EXTDECPROSPECTS/0,,contentMDK:20279477~menuPK:538204~pagePK:64165401~piPK:64165026~theSitePK:476883,00.html>

The key assumption of the baseline was that the twin U.S. deficits of the 1980s would be resolved over the longer term in an orderly manner, primarily through disciplined fiscal policies, and that the macroeconomic policy mix in Europe and Japan would accommodate relatively healthy growth rates. These developments, along with deregulation and other investment-friendly policies, especially in the United States, led us to assume an annual growth rate of 3.0 percent for the 1990s. Although lower than the trend rate influenced by the postwar “golden age,” this rate was higher than the anemic growth that characterized the 1970s and 1980s. Our low-case projection (2.4 percent) sought to capture an alternative scenario, not of a crisis or hard landing but of continued failure to deal with the fiscal and balance of payment imbalances, leading to lower growth in the industrial countries, mainly as a result of higher interest rates and lower private investment and private consumption.

The actual aggregate growth rate of the industrial countries 1990s was 2.5 percent a year—very close to our low-case forecast. But aggregate figures mask substantial variations in growth performance within the industrial country group. As discussed later, qualitatively, most of the trends we projected for the 1990s were more or less realized. During the two terms of President Clinton—whose team of economic advisers included Janet Yellen and Joseph Stiglitz—the U.S. fiscal deficit moved into a surplus. The relatively low actual growth rate of industrial countries in the 1990s is attributable almost exclusively to a development that we, along with most economic observers, missed: the drawn-out recession in Japan, which at the time was projected to last no more than two to three years. If we exclude Japan, the group of remaining OECD industrial countries grew 2.9 percent a year in the 1990s—a rate very close to our baseline projection (3 percent a year).

Our baseline forecast for the aggregate GDP growth of developing countries was keyed to the finding that through outward orientation and market-friendly economic policies, a subgroup of these countries had positioned themselves to benefit from an uptick in the economic environment while some others had, through a policy of inward orientation and dependence on debt, placed themselves on a low-growth trajectory (this aspect is explored further below). Over the 1990s, developing countries grew at an annual rate of 4.9 percent—remarkably close to our baseline forecast of 5.1 percent. But, as we discuss later in the context of forecasts by developing regions, the accuracy of the aggregate figure veils two offsetting misestimations on our part. The high-performing group of developing countries, including China and India, grew considerably faster than our projections, which—ironically in hindsight—were considered optimistic at the time they were made. In contrast, growth in many countries in the low-performing group was weaker than our estimates. The actual growth rate of developing countries excluding China and India was just 3.7 percent a year, markedly lower than our forecast of 4.3 percent (a forecasting error of 16 percent), bringing it close to our low-case forecast. The contrast would have been even starker but for the currency crisis of the late 1990s that affected many high-performing countries in East Asia. Our analysis anticipated a financial crisis caused by large balance of payments imbalances and deregulation of the financial sector in most advanced economies, as well as a number of emerging economies, but it did not pinpoint its timing or identify the way in which it would unfold.

## *4.2 Lessons from the 1990s Forecasting Experience*

Now that the new millennium is more than a decade old, we have a much fuller perspective on the last decade that preceded it. What were the main developments in the 1990s, and how successful were we in the late 1980s in anticipating them?

A number of retrospective analyses of the 1990s have appeared in recent years. A 2005 World Bank study analyzes the policy and growth experience of the 1990s, a period characterized as a decade of reforms. This volume is complemented by a volume of reflections on the 1990s development experience by influential policy makers (Besley and Zaghera 2005) and by firsthand experiences of senior staff of the Bank (Gill and Pugatch 2005). Also of interest is the incisive review by a prominent economist and development intellectual (Rodrik 2006). A good retrospective account of the 1990s from a broader world economy standpoint can be found in *The Global Economy in the 1990s: A Long-Run Perspective*, in which the editors, Paul W. Rhode and Gianni Toniolo, and a number of economic historians present their analyses of important facets of the decade (Rhode and Toniolo 2005). The main features of the decade identified in this study have been helpful in structuring our account of the decade of the 1990s.<sup>6</sup>

Eight key developments of the 1990s set the stage for the 21st century:

- a. The continued spread of globalization. (In the event, globalization became deeper in the 2000s.)
- b. The consolidation of China's rapid economic growth, the beginning of India's catch-up, and the contrast offered by the continuing poor performance of Africa. (Rapid growth in China and India, as well as in Brazil and a few other emerging economies, continued in

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<sup>6</sup> In addition, the IMF has conducted several assessments of its economic and financial forecasts, which are published twice a year in the *World Economic Outlook (WEO)*. The forecasts are short term (and not comparable to those in this paper) and typically one to two years ahead of the current year, often based on incomplete data. However, the analysis provided in the *WEO* is often set in a medium-term context of potential major economic/financial threats to the global or regional economies. These assessments have generally found the IMF forecasts to be consistent with forecasts prepared by other international organizations and the private sector. They also find that the IMF's short-term forecasts tend to be on the optimistic side (Boughton 2001; Masi 1996; IMF 2001; Timmermann 2006).

the 2000s, leading to the emergence of a multipolar growth in the world economy. Africa's performance also improved in the 2000s.)

- c. The information technology–based productivity surge in the United States, relative to the sluggish period of the two preceding decades. (Knowledge-based productivity growth played an increasingly important role in advanced and emerging economies in the 2000s.)
- d. The end of the postwar productivity catch-up of Western Europe and Japan with the United States. (Productivity in emerging and developing economies began to catch up with advanced economies in the 2000s—the so-called “Great Convergence.”)
- e. The resilience of the welfare state in the advanced countries. (The welfare state came under attack in advanced economies after the Great Recession of 2008–09 and the resulting mounting fiscal deficits and public debt.)
- f. Distinct improvement in the monetary macro-management of the economy (the so-called Great Moderation). (In the second half of the 2000s, the Great Moderation, particularly low interest rates, led to the financial crisis of 2008–09.)
- g. A mixed record of international policy making, especially in designing and managing international institutions adapted to operating in a context of floating exchange rates, free capital mobility, and the emergence of substantial new players. (Cooperation and coordination among advanced economies continued to be weak in the 2000s.)
- h. Increased concern over environmental issues and somewhat reduced concern regarding the depletion of natural resources. (Climate change issues and the need to address them moved to the top of the international agenda in the 2000s.)

**Table 2 Hits and Misses in Forecasting the 1990s**

<i>Factor</i>	<i>Assessment by Long-Term Outlook</i>	<i>Actual importance</i>
<i>Globalization</i>		
Early integration trends (trade/GDP, financial flows/GDP)	Captured	Moderate, perhaps less important than thought in 1990s and early 2000s
Full-scale effect on thinking and policy as a named trend	Missed	Moderate, perhaps less important than thought in 1990s and early 2000s
Growth of intraindustry trade	Captured	Moderate
Rapid growth of labor migration and worker remittances	Insufficiently recognized	Important
<i>Multipolar world</i>		
Emergence of other actors, especially China, India, and the G-20	Insufficiently recognized	Important
International policy cooperation	Insufficiently recognized	Important
<i>Development trajectories</i>		
Two-track growth hypothesis	Captured	Important
<i>Development lessons</i>		
Outward orientation	Captured	Important
Savings and investment	Captured	Important
Human capital	Captured	Important
Nonreliance on external debt	Captured	Important
Foreign direct investment	Captured	Important
Institutions and governance	Insufficiently recognized	Important
Research and development	Captured	Important
<i>Environment, natural resources, and energy</i>		
Brown issues (air and water pollution, cross-border issues)	Captured	Moderate
Climate change	Insufficiently recognized	Important
Ability of depletable resource issues to lead to price spikes	Captured	Moderate
Energy market trends	Captured	Moderate
Importance of environment-friendly investment	Missed	Important
Scope for tension between rich and developing economies	Captured	Important
<i>Technology</i>		
Information and communications technology (ICT) generally	Captured	Important
Internet	Missed	Important
Biotechnology	Perhaps overemphasized	Moderate
Nanotechnology	Perhaps overemphasized	Moderate
Importance of investment	Captured	Important
Dynamism of services sector	Captured	Important
Importance of science-based products in trade and production	Captured	Important

<i>Factor</i>	<i>Assessment by Long-Term Outlook</i>	<i>Actual importance</i>
<i>OECD economies</i>		
Decline of Japan	Missed	Important
Deregulation and privatization	Perhaps overemphasized	Important
Monetary management	Insufficiently recognized	Moderate
Fiscal and external imbalances	Captured	Nature of issues changed
<i>Financial sector</i>		
Scope for instability	Captured (but exact location missed)	Important

Source: Based on authors' research.

We use these points to structure the evaluation and discussion of the analysis in *A Long-Term Outlook* that underpinned our forecast for the 1990s. Table 2 summarizes how well that study predicted the importance of these factors.

*a. Globalization*

Globalization became a buzzword in the 1990s. It is also a rubric under which erstwhile disparate advocacy groups, both for and against, have coalesced. In 1989, we predicted the continued deepening of globalization and built it into our forecasts, but we thought of it as a synonym for increases in trade and finance among countries. We did not identify the emergence of globalization as a named intellectual or socioeconomic and political construct as a central theme.

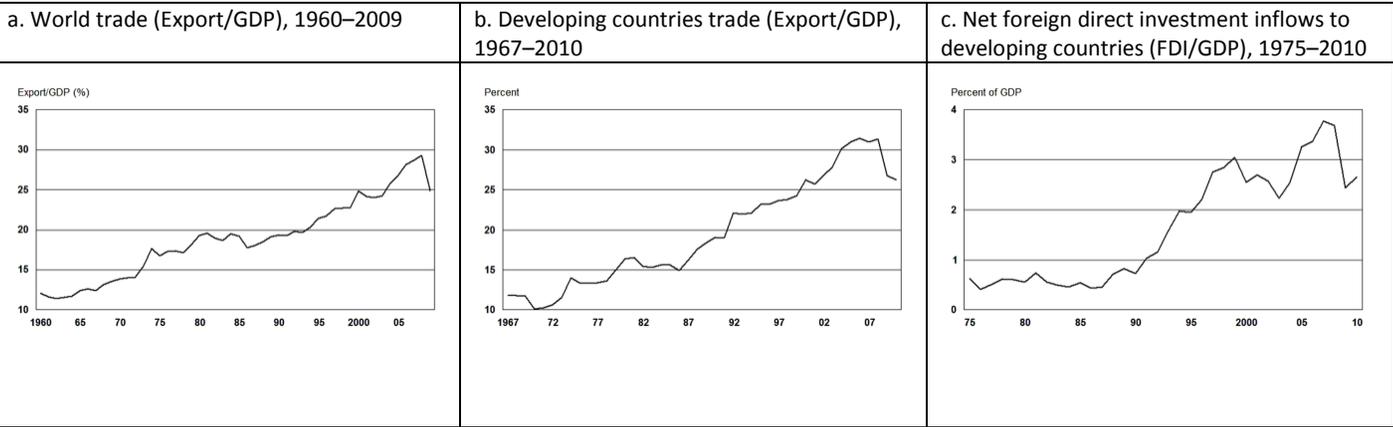
To understand globalization, it is best to unpack the concept into its main ingredients—flows of goods, capital, and labor (Figure 2)—as we did in 1989. Doing so reveals that globalization is not a new phenomenon: all the key aspects of globalization had played out on the world economic scene once before, from the late 19th century until the onset of World War I.

Globalization in all its aspects suffered a setback in the interwar period. After World War II, institutional arrangements were put in place to facilitate the orderly growth of world trade.

Although many developing countries experimented with inward-looking, import substitution-based policies in the early postwar decades, the remarkable growth of East Asian countries that followed an outward-oriented policy had already precipitated a change of thinking in the 1970s and the 1980s, a process that continued in the 1990s. The culmination of the various rounds of trade talks in the formation of the World Trade Organization (WTO) in the early 1990s can be

considered the capstone of this trend. Our projections in 1989 captured well the principal quantitative and qualitative aspects of growth of world trade, namely, the increase in outward orientation in the developing world and its importance for growth and poverty reduction and the growth of intra-industry trade, a key feature of trade globalization.

**Figure 2 Evolution of Trade and Foreign Direct Investment**



Source: World Development Indicators.

We underestimated the importance of a few key aspects of growth and trade in the developing world. One is the phenomenal growth in services trade and the attendant issue of outsourcing and its implications for both the developed and developing world. Another is the pressure put on the existing international institutional arrangement—the emergence of the G-20 as a forum and more generally the increased need for broader international cooperation, particularly at the time of crisis.

As for the flow of capital, there were already signs that restrictions on the movement of capital were becoming unwieldy (the breakdown of the Bretton Woods system in the early 1970s and the emergence of the euro currency market in Western Europe and Japan). The trend of liberalizing the capital account started in the 1980s. What we and many other observers of the world economy failed to predict was the sharp acceleration of this trend in the 1990s in East Asia and Latin America. We did foresee and point out the possibility of instability caused by deregulation and marked deepening of international financial markets. The turbulence in the currency market in Western Europe and the United Kingdom in the early 1990s can be considered examples of this instability. We pointed out that it was a financial crisis that was responsible for the Great Depression of the 1930s and for the developing country malaise in the

1980s, but our admonitions were too general. In developing countries, we focused on the orderly resolution of the sovereign debt crisis of the 1980s, not on the financial crises stemming from capital account openness and contagion that affected Mexico in the middle of the decade and many countries in East Asia, Latin America, and Eastern Europe later in the decade. The challenge posed by financial openness and sovereign debt issues to the design of appropriate international financial architecture still remains with us.

Regarding labor flows, the current phase of globalization lags the earlier phase. The increased flow of labor holds immense promise for the developing world, but it also represents a challenge in terms of immigration policy in the developed countries. It calls for increased international cooperation and the creation of appropriate international institutions. Our forecasts did not predict the large increase in the number of immigrants from developing to developed countries and the resulting sharp rise in remittance flows, which rose from about \$50 billion in 1989–90 to about \$120 billion in 2000.

*b. China, India, Africa, and the two development tracks hypothesis*

When we were preparing our long-term projections, the emerging economies that received most of the attention from both scholars and journalists were the group of newly industrializing economies (NIEs), particularly the four East Asian “Tigers”: the Republic of Korea; Taiwan, China; Hong Kong SAR, China; and Singapore. We recognized and took account of China’s rapid growth and integration in the world economy. We projected that India would grow well above its historical average but at a much slower pace than the average for East Asia, mainly because of major infrastructure bottlenecks, severe shortages of energy, and lagging social indicators. Its sustained and rapid growth was not on the radar screen given its fiscal and balance of payments problems and the slow pace of structural reforms.

Our forecast not only captured continued rapid growth in China in the 1990s, it also highlighted India as being part of the small group of countries poised for strong growth in the coming decade. Our forecasts were made before India’s external payments crisis of 1991 and the subsequent initiation of major structural reforms. They were based on a moderate acceleration of the strong growth and investment performance of the 1980s and the gradual opening up of the

economy, with stronger merchandise export performance over 1980–88 (4.7 percent a year) than in 1965–80 (3.7 percent a year).

Although we predicted the strong growth of China and India and recognized its significance for global poverty reduction, our baseline projections were conservative and did not anticipate the extent of the impact on various structural aspects of the global economy, especially the role China would come to play in the 1990s and beyond. More important, we did not foresee the eventual emergence of China in the 2000s as a diverse manufacturing hub for the entire world and the consequent “supply shock” for the OECD countries, which led to the gradual deindustrialization of their traditional and light manufacturing industrial subsectors. Although increased demand from China was built into the commodity price projections, our projections of China’s growth underestimated the pressure China’s growing demand would place on global commodity markets. In sum, our picture of the world of the 1990s was a continuation of the world of previous decades, with the OECD countries in general, and the G-7 countries in particular, representing the major economic drivers and their policies shaping the global environment for growth. We did not predict the much more rapid rise of China as an important growth pole or the fact that its policies (for example, export orientation and an undervalued exchange rate) would have a key bearing on the world economy.

According to Uri Dadush, Director, Global Economic Prospects Group at the World Bank (1992–2008), “the transformational impact of China became evident early in the decade 1990s.” Armington and Dadush (1992) anticipated “the durability of the Chinese expansion and its huge effect on Asia and on the terms of trade in favor of commodity producers.” Dadush argues that the same can be said about “the big reforms to come in the former planned economies of Eastern Europe following the fall of the Berlin Wall, and their far-reaching and broadly successful efforts at integrating into the global market economy.”<sup>7</sup>

Overall, Dadush argues, the 1990s (and the 2000s) essentially confirmed the optimism about the convergence process of developing countries exhibited in the early long-term forecasting

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<sup>7</sup> Based on written comments by Uri Dadush on an earlier draft of this paper.

exercises at the end of the 1980s and early 1990s. What was less understood in the late 1980s and early 1990s was the strong interplay between globalization and modern technology, which markedly accelerated the process of catching up of emerging economies and had adverse effects (including depressed wages) on advanced economies (see Gordon 2012).

Our forecast for Sub-Saharan Africa is virtually a mirror image of our forecast for Asia. Although our projection of below-par performance by the region was borne out, the growth slowdown was considerably worse than we projected. The principal factors for pessimism were the low ratio of exports to GDP, the collapse of investment, the high rate of inflation, the small base of manufacturing and consequent reliance on commodity exports, the heavy dependence on debt, the small size of the economy, the high rate of population growth, sociopolitical strife, and the devastation caused by HIV/AIDS.

A key insight of *A Long-Term Outlook* was the hypothesis of two development tracks. Economic performance across countries has always been uneven, and a small group of high-performing NIEs could be identified in the 1970s. In the postwar period through the 1970s, however, there was no evidence for the emergence of two groups with very different growth trajectories. Signs of such divergence emerged in the 1980s, which witnessed not only sharply different growth performance but also vast differences in countries' ability to respond to changes in the international economic environment.

A principal characteristic of the high-performing group is robust and rising investment ratios, which enabled these countries to increase supply capacity to respond to changes in external demand without excessive inflation. In contrast, the low-performing group is characterized by reliance on import substitution policies financed by external borrowing, which led to heavy indebtedness and inefficiency. A consequence of such policies was a "decoupling" of their economies from those of high-income countries, as a result of which low-performing countries became unable to take advantage of the stimulus provided by high international demand.

A clear implication of the hypothesis of two development tracks is that the overall distribution of growth rates of developing countries tends toward a bimodal distribution, with clusters of high-performing and low-performing groups. The economic outcomes of the 1990s have borne out this hypothesis. Steven Durlauf and Danny Quah (1998) analyze this phenomenon (Figure 3). Figure 4 shows how the phenomenon was anchored empirically as of the late 1980s.

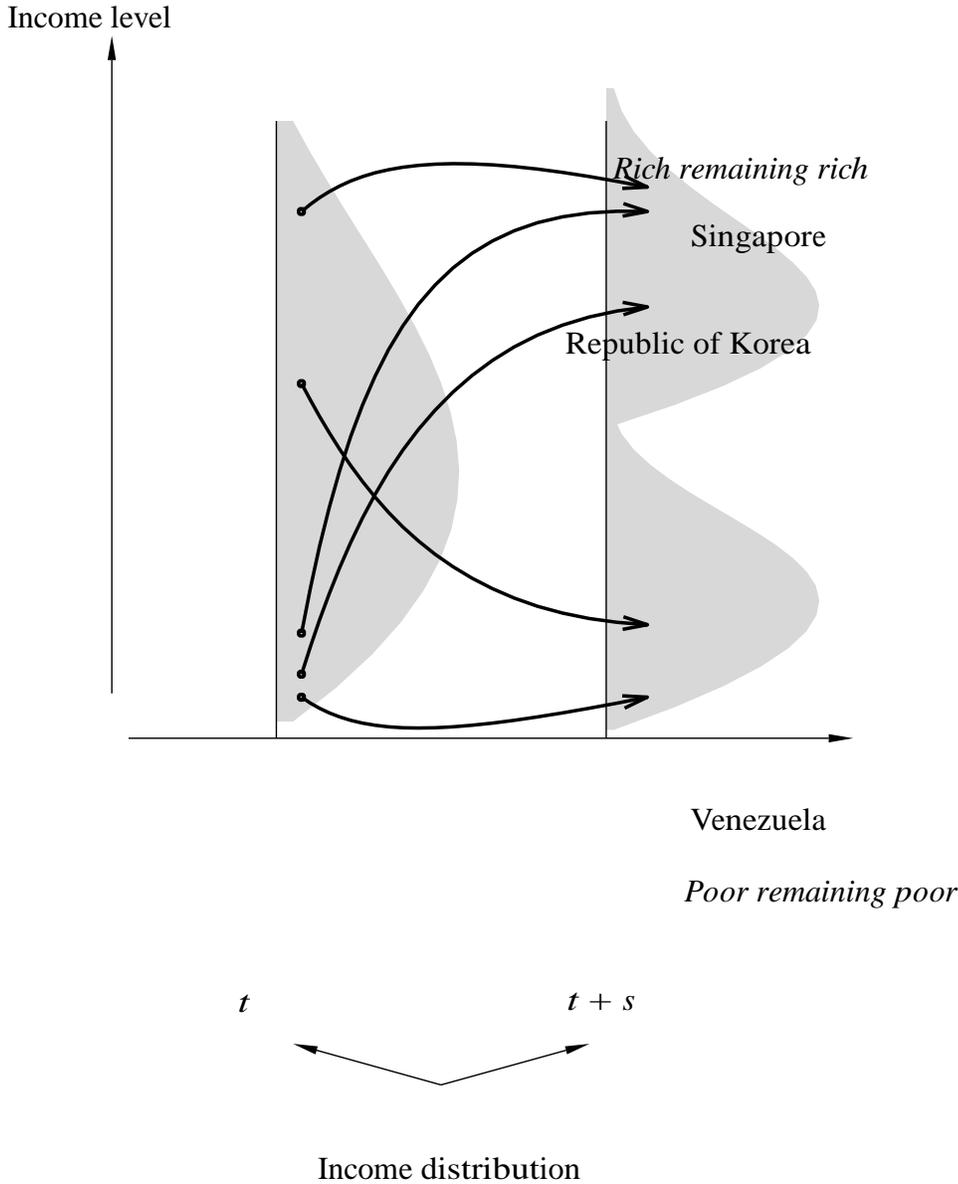
Several key messages emerge from the recent literature on economic growth and development, surveyed by Spolaore and Wacziarg (2013): that technology and productivity tend to be highly persistent even at very long horizons, long-term persistence holds at the level of populations rather than locations, and long-term genealogical links across populations play an important role in explaining the transmission of technological and institutional knowledge and the diffusion of economic development. The recent literature, taken together, also implies that there are limits to what policy makers can do to significantly alter the growth paths that ultimately determine the wealth of nations. By themselves, these findings do not explain the development and persistence of two (or more) distinct (high and low) growth paths for developing countries or how they should be modeled. It is also not clear whether there could be significant mobility across these distinct groups over time, engineered through policy changes and improvements in the quality and quantity of human capital endowments through migration and reforms of the educational system.

The two development tracks hypothesis has positive and negative aspects. On the positive side, many developing countries are acting as engines of growth for their regions. The negative aspect is captured by Paul Collier (2008) in his formulation of “the Bottom Billion.” Although his emphasis is on failed states, the countries he discusses form a large subgroup of our low-performing country group. Governance issues, which were not yet a focus in the 1980s by international financial organizations, are an important dimension of development. The challenge posed to the development agenda by this group of low-performing countries is unique, calling for measures beyond “development business as usual” (see, for example, World Bank 2011b).

*c. Technological change, total factor productivity growth, and the embodiment hypothesis*

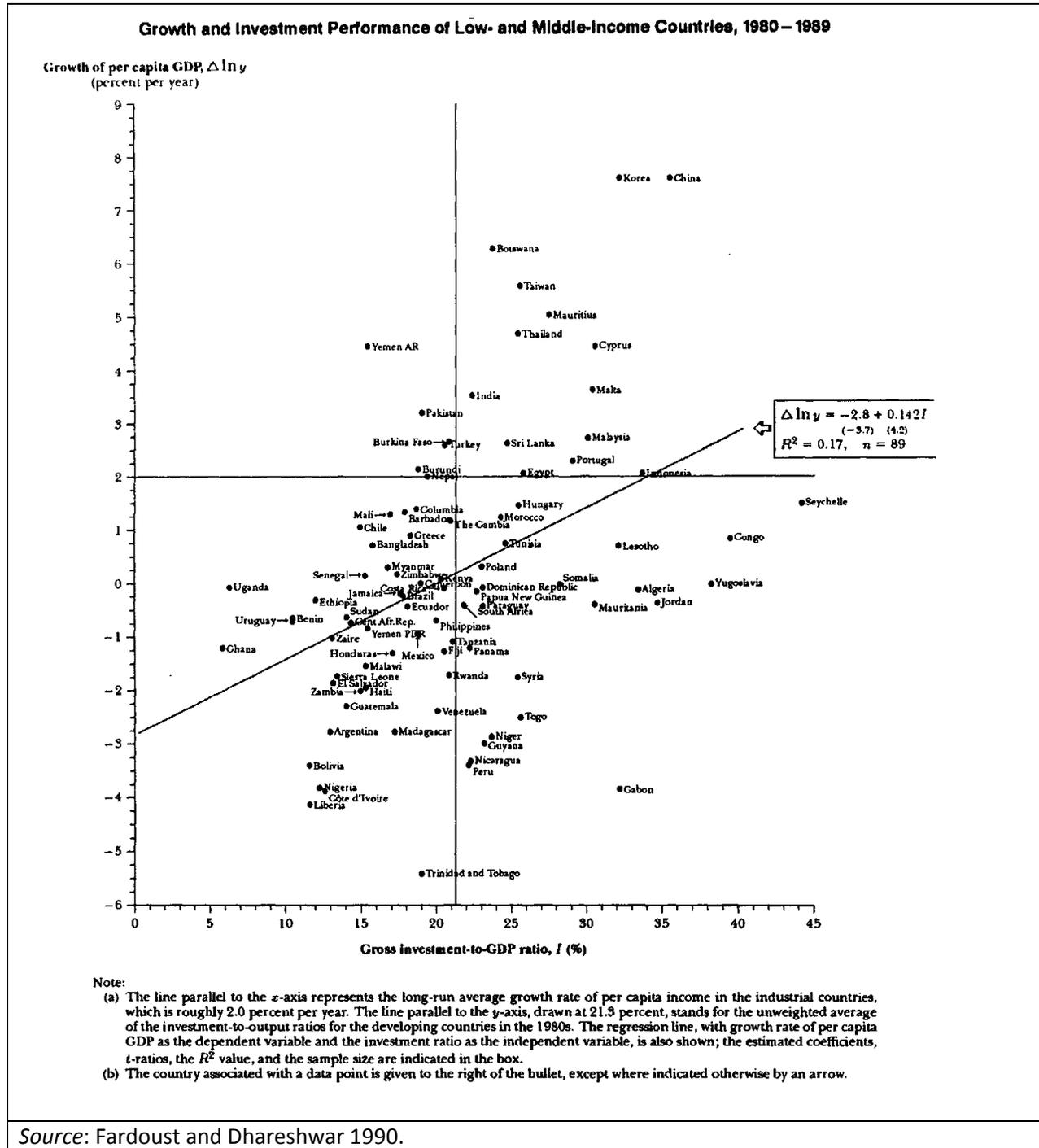
In the early decades of the postwar period, the industrial countries experienced healthy growth of productivity, thanks to the commercialization of military technological developments in the United States and the catch-up phenomenon in Western Europe and Japan. However, in the interest of stability, the industrial countries opted for a restrictive regulatory environment. As a result, a number of rigidities developed in these economies, which had a dampening effect that began to be felt in the early 1970s. These effects, together with the oil price shocks and the policy response to them, led to a serious slowdown in productivity growth and rising inflation and unemployment in the OECD countries in the 1970s and early 1980s.

Figure 3 The “Two Development Tracks” Hypothesis



Source: Durlauf and Quah 1998.

**Figure 4 Empirical Evidence of Two Development Tracks: Growth and Investment Performance of Low- and Middle-Income Countries, 1980–89**



By the late 1980s, there was a change of stance regarding the policy environment. The emphasis was on deregulation and increased competition in factor, goods, and services markets, especially

in the United States and United Kingdom but also in many other industrial countries. The change led to a surge in investment.

We assumed the validity of the embodiment hypothesis, which states that technological progress takes place principally through its embodiment in new equipment and machinery (that is, improved technology that allows output to increase without increased inputs or investments in new equipment) rather than in a “disembodied” fashion, as assumed in standard neoclassical growth models. Thus, new investment is the vehicle through which labor productivity increases output beyond the capital-deepening effect. Accordingly, we predicted an acceleration in total factor productivity (TFP) growth in many industrial countries, as well as in the NIEs. We also predicted that the services sector, then considered a laggard in productivity growth, would be as dynamic as manufacturing.

These predictions were borne out by the developments of the 1990s. Although not reaching the heights attained in the so-called golden age of the early postwar years, productivity growth in the OECD countries as a group was higher than in the sluggish 1970s and 1980s (Table 3). Furthermore, the services sector experienced higher TFP growth than manufacturing in the United States (Table 4).

Increases in productivity in the services sector since the 1990s were smaller in the EU economies than in the United States. Moroto-Sánchez (2010) shows that productivity in the European Union accelerated more slowly in the service sector than in other sectors, except in some progressive sectors, such as communication, transportation, financial intermediation, and some business and professional services. To be sure, these are important sectors, and productivity growth in these sectors is critical to these countries’ ability to participate in globalization. The fact remains, however, that unlike the United States, the European countries did not witness broad-based productivity growth in the tertiary sector.

Regarding the specific technological clusters underpinning the positive change, our study highlighted information and communications technology (ICT), new biotechnology, and new materials technology. Although in a broad sense this assessment was valid, it may have failed to do justice to the significance of ICT and its direct and indirect contributions to productivity and economic growth acceleration.

**Table 3 Sources of Growth, by Region, 1960–2000**  
(average annual percent)

<i>Region/period</i>	<i>Output</i>	<i>Output per worker</i>	<i>Contribution of</i>		
			<i>Physical Capital</i>	<i>Education</i>	<i>Factor productivity</i>
<i>World (84)</i>					
1960–70	5.1	3.5	1.2	0.3	1.9
1970–80	3.9	1.9	1.1	0.5	0.3
1980–90	3.5	1.8	0.8	0.3	0.8
1990–2000	3.3	1.9	0.9	0.3	0.8
1960–2000	4.0	2.3	1.0	0.3	0.9
<i>Industrial countries (22)</i>					
1960–70	5.2	3.9	1.3	0.3	2.2
1970–80	3.3	1.7	0.9	0.5	0.3
1980–90	2.9	1.8	0.7	0.2	0.9
1990–2000	2.5	1.5	0.8	0.2	0.5
1960–2000	3.5	2.2	0.9	0.3	1.0
<i>China (1)</i>					
1960–70	2.8	0.9	0.0	0.3	0.5
1970–80	5.3	2.8	1.6	0.4	0.7
1980–90	9.2	6.8	2.1	0.4	4.2
1990–2000	10.1	8.8	3.2	0.3	5.1
1960–2000	6.8	4.8	1.7	0.4	2.6
<i>East Asia less China (7)</i>					
1960–70	6.4	3.7	1.7	0.4	1.5
1970–80	7.6	4.3	2.7	0.6	0.9
1980–90	7.2	4.4	2.4	0.6	1.3
1990–2000	5.7	3.4	2.3	0.5	0.5
1960–2000	6.7	3.9	2.3	0.5	1.0
<i>Latin America (22)</i>					
1960–70	5.5	2.8	0.8	0.3	1.6
1970–80	6.0	2.7	1.2	0.3	1.1
1980–90	1.1	-1.8	0.0	0.5	-2.3
1990–2000	3.3	0.9	0.2	0.3	0.4
1960–2000	4.0	1.1	0.6	0.4	0.2
<i>South Asia (4)</i>					
1960–70	4.2	2.2	1.2	0.3	0.7
1970–80	3.0	0.7	0.6	0.3	-0.2
1980–90	5.8	3.7	1.0	0.4	2.2
1990–2000	5.3	2.8	1.2	0.4	1.2
1960–2000	4.6	2.3	1.0	0.3	1.0
<i>Africa (19)</i>					
1960–70	5.2	2.8	0.7	0.2	1.9
1970–80	3.6	1.0	1.3	0.1	-0.3
1980–90	1.7	-1.1	-0.1	0.4	-1.4
1990–2000	2.3	-0.2	-0.1	0.4	-0.5
1960–2000	3.2	0.6	0.5	0.3	-0.1
<i>Middle East (9)</i>					
1960–70	6.4	4.5	1.5	0.3	2.6
1970–80	4.4	1.9	2.1	0.5	-0.6
1980–90	4.0	1.1	0.6	0.5	0.1
1990–2000	3.6	0.8	0.3	0.5	0.0
1960–2000	4.6	2.1	1.1	0.4	0.5

Source: Bosworth and Collins 2003.

Note: Regional averages are weighted by GDP. Figures in parentheses are number of countries.

**Table 4 Productivity Growth in the United States, by Sector**

(annual percentage change)

<i>Sector</i>	<i>1987–95</i>		<i>1995–2001</i>	
	<i>Total factor productivity</i>	<i>Labor</i>	<i>Total factor productivity</i>	<i>Labor</i>
Private nonfarm business	0.6	1.0	1.4	2.5
Goods	1.2	1.8	1.3	2.3
Services	0.3	0.7	1.5	2.6

*Source:* Triplett and Bosworth 2004.

It is perhaps no surprise that we underestimated the game-changing and revolutionary nature of ICT, which is a very good example of what has come to be characterized as general purpose technology (GPT), like electricity. Of course, overestimation of the significance of ICT led to unrealistic expectations—the euphoria about the New Economy—and the technology bubble, which burst in 2001. Nevertheless, it is likely that the new information technology has not peaked, that there remains considerable scope for harnessing it for productivity growth and the empowerment of people worldwide.

The significant role of technological progress can be illustrated using the classic formulation of Solow (1957), which augments the standard Cobb-Douglas production function (constant returns to scale) with a parameter for technical change:

$$Y_t = e^{\tau t} K_t^\alpha L_t^{1-\alpha} \quad (1)$$

where  $Y_t$  is output of a country in year  $t$ ,  $K_t$  is the capital stock in year  $t$ ,  $L_t$  is labor force in year  $t$ ,  $\alpha$  is the parameter representing returns to capital as a factor of production, and  $\tau$  is a parameter representing technical change.

The equation can be reexpressed in per labor terms ( $y = Y/L$ ) to bring out the role of capital deepening and productivity:

$$y_t = e^{\tau t} k_t^\alpha \quad (2)$$

where  $y_t$  is output per labor employed in year  $t$  and  $k_t$  is the capital per labor employed in year  $t$ . In growth rate (log-linear) terms

$$d \ln y_t = \tau + \alpha d \ln k_t. \quad (3)$$

Thus, the growth rate of output per labor employed is the sum of TFP growth and capital deepening.

In its simple form, the Solow model suffers from a few shortcomings. Its biggest weakness is its implication that countries with identical savings rates and technology can, through the catch-up effect (the notion that countries with lower capital stock initially grow faster) experience converging growth paths over the longer term and eventually achieve identical levels of per capita income (that is, absolute convergence). Cross-country empirical evidence does not support this hypothesis.

One way to address these issues is to broaden the concept of capital to include human or knowledge-based capital. Mankiw, Romer, and Weill (1992) use the following model:

$$Y_t = e^{\tau t} K_t^\alpha L_t^\beta H_t^{1-\alpha-\beta} \quad (4)$$

where  $H_t$  is a measure of human capital and  $\beta$  is the return to raw labor as a factor of production. Alternatively,  $H_t$  can be interpreted as knowledge-based capital in national output, as in Hulten and Hao (2012).

If all the factor inputs into production are properly measured, the parameter  $\tau$  in the above formulations can be interpreted as a measure of growth of TFP. Although less intuitive, TFP is a more sophisticated measure of productivity than labor productivity, because it indicates the efficiency with which all factors of production are utilized in the economy.

Three remarks are in order here. First, the above formulation assumes that TFP is exogenous and disembodied. In contrast, the embodiment hypothesis holds that investment in newer machinery and equipment is the form in which improvements in production processes and technological advances take place. Thus, such investments contribute to growth over and above the effect of capital deepening.

Second, analogous to labor productivity, another, less sophisticated measure of economic efficiency is the incremental capital output ratio (ICOR). Its popularity in efficiency analysis perhaps stems from the difficulty of measuring the capital stock of an economy. We recognized the merits of TFP and embodied technical progress and incorporated their effects in our projection results, but the analytical work nevertheless relied on ICORs, which were utilized in the macro models at the World Bank and elsewhere in the 1970s and 1980s. It was in the 1990s that Vikram Nehru and his associates created an original and reliably estimated cross-country database of physical and human capital stock and estimated TFPs for a large set of developing and developed countries (Nehru and Dhareshwar 1993, 1994; Nehru, Swanson, and Dube 1995).

Third, recent research has shown that investment and growth in advanced as well as emerging economies is increasingly driven by knowledge-based capital, such as computerized information, including software and databases; innovative property (patents, copyrights, designs, trademarks); and economic and financial competencies (brand equity, firm-specific human capital, networks joining highly skilled people and specialized institutions, organizational know-how that raises firms' and other agencies' efficiency and productivity). In some advanced economies, firms now invest more in knowledge-based capital than they do in physical capital. For firms such as Google, Microsoft, and Yahoo, investment in physical capital constitutes a small fraction of their total annual investments. By 2009, business investment in knowledge-based capital, at about 14 percent of GDP, exceeded business investment in physical capital, which amounted to less than 10 percent of GDP. According to a recent OECD report, between 1995 and 2007, knowledge-based capital investments explain as much as 27 percent of labor productivity growth in the United States but just 20–25 percent in Europe (OECD 2012b).

According to Hulten and Hao (2012), knowledge-based capital explains between 17 percent (China) and 30 percent (United States) of output growth per worker in the 2000–06 period. Including knowledge-based capital reduces the traditional estimates for labor productivity and TFP growth.

#### *d. The convergence hypothesis: Limits and potential*

The convergence hypothesis states that in the long run, productivity and income levels of less developed countries converge to levels prevailing in the leading economy. This hypothesis arose

out of the postwar economic performance of Western European countries and Japan, as they made rapid strides in productivity and per capita income to come closer to the levels of the United States, the technology leader. A similar process held out great promise for developing countries.

Our study showed that, although the catch-up phenomenon worked for Western European countries and Japan through the 1960s, the scope for convergence was thereafter limited, except for the NIEs, as countries approached the technological frontier of the leader. Furthermore, and of particular importance to developing countries, the process of catch-up is not automatic; it is conditional on an appropriate policy environment, in particular one that is conducive to investments in physical and human capital, which leads to faster capital accumulation, innovation, and acquisition of newer technologies. This could be an additional explanation of the emergence of the two development tracks growth process within the developing country group discussed in section 4.2b above.

The experience of the 1990s bears out our reading of the convergence hypothesis. The growth rate in the United States was higher than in the major Western European countries, and Japan remained in the throes of recession followed by slow growth, indicating that the process of postwar productivity convergence among the OECD countries was nearly over. The future paths of these economies would depend on their economic fundamentals and their ability to exploit newer technologies. Among developing countries, only a small number, mainly in East Asia, had policies in place that allowed them to benefit from catch-up.

Interestingly, the 1990s saw a flood of empirical analyses of the convergence hypothesis (see, for example, Barro 1998). Their conclusions correspond to the insight in our study that there are convergence clubs and that convergence is conditional, not automatic.

In its pure form, the convergence hypothesis can be analytically expressed as follows:

$$g_i = \alpha + \beta y_i^0 \tag{5}$$

where  $g_i$  is the long-term growth rate of output per capita of country  $i$ ,  $y_i^0$  is the initial level of output per capita of country  $i$ , and  $\alpha$  and  $\beta$  are parameters to estimate. Empirically, the convergence hypothesis implies that  $\beta$ , the convergence parameter (that is, the speed with which a country can approach the productivity frontier) is significantly negative: the lower the initial

output per capita of a country relative to that of the technological leader, the faster it grows. Backwardness thus has its advantages.

The convergence hypothesis in its pure form has some empirical basis, but the estimates improve considerably if an extended form incorporating policy parameters, such as openness (measured by the ratio of trade and finance to GDP, with higher ratios indicating greater openness) is used:

$$g_i = \alpha + \beta y_i^0 + \boldsymbol{\gamma} \mathbf{x}_i, \quad (6)$$

where  $\mathbf{x}_i$  is a vector of country-specific parameters and  $\boldsymbol{\gamma}$  is a vector of parameters. This formulation implies that convergence is better interpreted as a process that is conditional on policy and other features. For example, for many developing countries, especially in Sub-Saharan Africa and Latin America, because of a significant slowdown in their rate of capital accumulation, the productivity gap between them and the high-income countries widened in the 1980s and 1990s—a process that was reversed in the 2000s in many countries.

The convergence hypothesis—and its limitations—had several direct implications for economic prospects in the 1990s, as envisaged at the time of our earlier study. Because the major industrial countries had pretty much exhausted the potential advantages of backwardness, as their labor productivity in manufacturing converged toward that of the leader, it became increasingly difficult for them to significantly improve their economic performance just by playing catch-up. New leaders could be expected to emerge in specific subsectors; the process would depend on factors such as general as well as targeted investment in research and development to speed technological progress and its adoption. That catch-up is not automatic increases the onus on developing countries, because it means that they have to become competitive in the more dynamic segments of the global marketplace, where frontier technology would be key. FDI was thought to play an increasingly significant role in transferring technology from leading economies to developing countries. In sum, the policy-conditional nature of convergence led us to emphasize actions such as stabilizing the domestic macroeconomic environment, creating incentives for saving and investment, reducing government's unproductive consumption, increasing investment in human capital, and improving the quality of economic and financial management.

Although the convergence experience of developing countries in the 1990s and beyond has been uneven, the convergence idea has considerable heuristic potential as a framework for thinking about growth strategies as well as for modeling prospects for long-term growth. In its report, the Commission on Growth and Development (consisting of 22 leading practitioners from government, academia, business, and policy making) analyzed the experience of 13 developing countries that can be considered as well on the path of successful convergence to draw lessons on do's and don'ts (World Bank 2008). The book by the chair of the commission, Michael Spence, based on his insights during his tenure on the commission, is entitled *The Next Convergence* (Spence 2011). The commission identifies five basic factors that characterize countries that have been successful in embarking on convergence: openness to the world economy, macroeconomic stability, high levels of saving and investment, market allocation, and leadership and governance. Lin (2012) argues that his new structural economics and the associated growth identification and facilitation framework incorporate the insights of the Growth Commission with proper emphases. The three pillars of the new structural economics are an understanding of a country's comparative advantage, defined as the evolving potential of its endowment structure; reliance on the market as the optimal resource allocation mechanism at any given stage of development; and recognition of a facilitating role of the state in the process of industrial upgrading, not excluding an active industrial policy.

Two recent exercises—by the OECD and the Carnegie Endowment for Peace— tap the potential of the convergence idea for forecasting long-term growth prospects. In its study of sources of growth in member countries, the OECD (2003) uses country- and industry-specific convergence equations based on technological and organizational catch-up with the frontier country. The convergence equations are estimated using a co-integration framework. More recently, the OECD extended its economic outlook to include medium- and long-term growth and imbalance scenarios and expanded its country coverage (to include non-OECD countries in the G-20) (OECD 2012a). The enhanced OECD model uses a conditional convergence framework to project potential GDP. In this model, the speed of convergence for a country depends on both the GDP gap with the leading country as well as structural and policy factors.

In the forecasting model that underpins their scenarios for how emerging markets are reshaping globalization, Dadush and Shaw (2011) use a country-specific convergence factor to project

future evolution of TFP for each country in their study. The convergence factor for a country is derived from a convergence conditions index, which is an aggregate of three components: human capital and infrastructure, business climate, and governance.

Finally, in the “new sources of growth” approach to conducting growth accounting and explaining convergence among the most advanced and dynamic economies in the world, knowledge-based (intangible) capital expenditures are likely to play an increasingly important role, as less advanced economies move up the value chain and move closer to the frontier of technology and knowledge. In this emerging world economy, it will be critical to explicitly take into account knowledge investments in models that attempt to generate long-term growth forecasts based on the new formulations of convergence path that would be underpinned by investments in both physical and intangible investments.

*e. Employment, inequality, and social welfare*

In the 1980s and 1990s (and 2000s), globalization, technological change, and a substantial increase in the size of the global work force (as China, India, and other emerging economies opened up their economies) reduced demand for lower-skilled workers in advanced economies as a result of outsourcing of manufacturing and service sector jobs. In the 1990s, as the process of globalization intensified and economic growth became technologically driven, a number of social concerns emerged in rich as well as many developing countries. Employment in the traditional sectors declined, and workers with lower skill levels found it difficult to remain in the labor force. In many but not all countries, within-country income inequality increased, induced to a large extent by the distributional impact of technological progress. For the OECD countries, this trend was a reversal of the continuous postwar rise in equality.

The strongest headwind facing advanced economies, particularly the United States, as the technological frontier country, comes from the interplay between globalization and technology progress, as emphasized by Gordon (2012). This interplay has accelerated the process of catching up by the emerging economies and put downward pressure on wages and real incomes in the advanced economies. However, as Jaumotte, Lal, and Papageorgiou (2013) show, as a result of the interplay between globalization and technological progress, in advanced economies, where the Gini coefficient rose by an average annual rate of 0.65 percent between 1981 and 2003

(their sample period), the impact of globalization on inequality was smaller than the impact of technological progress but much larger than the effect of globalization in developing countries. In developing countries, where the Gini coefficient rose by about 0.27 percent a year over the 1981–2003 period, technological progress was the main driving force behind rising inequality (increasing the Gini by 0.83 percent). Inequality rose because both financial globalization (particularly inward FDI) and technological progress increased the relative demand for skills and education.

Worries also surfaced that social welfare schemes in the developed countries might be seriously eroded as countries engaged in a “race to the bottom” in order to maintain their competitiveness. These issues remain of concern in the new millennium. As counterexamples of Scandinavian countries and the Republic of Korea demonstrate, unemployment and increased inequality are not the necessary outcomes of modern trends.

These social issues point up an important omission in the Long-Term Outlook study. Although we focused on labor-saving technological progress and economic growth, we did not explicitly investigate the impact of such technological progress (or the emergence of China as a major manufacturing hub for the world) on labor markets and employment across developing and advanced economies and its interaction with financial globalization. In particular, we missed the rising youth unemployment rates in many countries, although we did predict wider use of robots and other labor-saving technologies.

*f. Macroeconomic policy making and the financial sector in advanced economies*

The decade of the 1990s and beyond was bookended by two moderate recessions in the United States. The period of 1993–2000 represents the longest postwar interval of continuous growth with low inflation. Even the recessions appeared to have been handled competently by the monetary authorities, so that the impact was more benign than in earlier episodes.

These developments led many observers to conclude that the monetary macroeconomic management of the economy had improved significantly—what Ben Bernanke characterized as the “Great Moderation.” Exaggerated claims suggested that the business cycle had been

conquered. Rhode and Toniolo (2006) were sober but very positive about monetary macroeconomic management. The events that transpired within the next few years—the subprime mortgage crisis and the Great Recession—made such a sanguine assessment untenable. As will be clear from the quantitative evaluation of our forecasts, our forecast for the inflation rate in the G-5 countries in the 1990s was too high, partly because we failed to account for the near-deflation in Japan and the strength of the U.S. dollar. We did not forecast the shift to a low-inflation regime in the United States. We did foresee the possibility of instability emanating from the financial sector, however. Although we viewed the deregulation that was taking place in the industrial sector as positive, we predicted that the risks to the real economy posed by the deregulation movement would extend to the financial sector. Similarly, although we were bullish on the technological innovations underway in the real economic sectors, we pointed out the risks inherent in the regulation deficit with respect to financial innovations, such as securitization, exotic derivatives, and the shadow banking system, although we did not identify the precise nature of the problem. Several recent studies (for example, Reinhart and Rogoff 2011 and Quiggin 2012) elaborate on these risks.

In sum, we (and many other forecasters) missed important changes in advanced countries, particularly the so-called lost decade in Japan in the 1990s. Many institutions, including the World Bank, the IMF, and the OECD, as well as private forecasters, also missed the 2008-09 Great Recession in advanced economies and the ongoing Euro crisis. These forecasting errors partly reflected misspecification in the macroeconometric models used, which normally do not include sufficient detail on the interactions between the financial and the real sectors of the economy and the related feedback loops. The errors also reflected incorrect assumptions about oil and other commodity prices and fiscal and monetary policies. In addition, conventional macroeconometric models have difficulty predicting turning points and structural breaks unless these are specifically modeled (or superimposed on the results based on the intuition of the modeler).

Castle, Fawcett, and Hendry (2011) propose an approach that is built on the existing literature that uses nonlinear models to forecast regime shifts (for example, smooth transition or Markov-switching models).

A key question they raise is whether breaks that have not occurred previously can be predicted by use of additional information that captures the drivers behind breaks. They conclude that embedding the analysis with available information may eventually help forecasters predict breaks.<sup>8</sup> Regarding the possibility of predicting financial crises, the main problem is that there is no single unifying economic/financial theory with applicable regulatory and policy response that could prevent crises. The General Theory of Employment, Interest and Money (1936), Keynes argued that financial markets are inherently subject to self-reinforcing herd effects, momentum effects (putting money in equities when stocks prices are on the rise), and pure speculation that is detached from market fundamentals, which could generate self-reinforcing bubbles that destabilize markets.

In *Stabilizing an Unstable Economy* (1986), Hyman Minsky suggested that finance capitalism is inherently subject to periodic booms and busts, as good economic times are likely to lead to increased risk taking by investors, who may be less focused on hedging risks and thus moving toward more speculative investment activities that often end in sudden debt traps and major economic collapses. Most recently, in *Irrational Exuberance* (2005), Robert Shiller persuasively made the case that the U.S. economy was experiencing a housing bubble and that further rises in the stock and housing markets could lead to significant declines and eventually a global recession. Another well-known economist who warned of the coming financial crisis was Nouriel Roubini. As early as 2006, he gave talks at the IMF and the World Bank that warned that the United States was likely to face “a once-in-a-lifetime housing bust” and sharply declining consumer confidence, leading to homeowners defaulting on their mortgages and, eventually, a deep recession (Mihm 2008).

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<sup>8</sup> In a separate line of research, Pesaran, Schuermann and Smith (2009) have developed models that can trace and analyze the transmission of liquidity shocks and risk shocks to global financial system. Their Global VAR model system considers the problem of forecasting economic and financial variables across a large number of countries in the global economy. To this end, they use a global vector autoregressive (GVAR) model to generate out-of-sample forecasts one and four quarters ahead for real output, inflation, real equity prices, exchange rates, and interest rates. Forecasts are obtained for 134 variables for 33 countries, covering about 90 percent of world output (see <https://sites.google.com/site/gvarmodelling/>).

Shiller and Roubini were among a small group of economists who warned about the coming financial storm and whose contrarian forecasts were essentially ignored.

A 2011 report by the IMF's Independent Evaluation Office (IEO) found that the IMF provided few clear warnings about the risks and vulnerabilities associated with the impending Great Recession of 2008–09 before its outbreak. It went on say that “the banner message was one of continued optimism after more than a decade of benign economic conditions and low macroeconomic volatility. The IMF, in its bilateral surveillance of the United States and the United Kingdom, largely endorsed policies and financial practices that were seen as fostering rapid innovation and growth.”

This review suggests the need to take more seriously the views and analyses of contrarian forecasters in preparing baseline forecasts and developing alternative scenarios, particularly concerning the largest economies and major growth poles of the global economy.

*g. International policy coordination*

The record of the international community in coordinating economic affairs in the 1990s was mixed at best. The successful conclusion of the Uruguay Round of trade talks, which led to the formation of the WTO, was a positive development. In international finance, the track record was unsatisfactory, as demonstrated by the contagion crisis alluded to above. The principal challenge is the need to establish appropriate institutions to accommodate the arrival of important new players on the scene, not just for trade and finance but also for long-term challenges, such as environmental and climate change and population growth and aging issues. We did not explicitly anticipate the rising importance of policy coordination.

Increasing interdependence and the growing complexity of the world economy mean that policy coordination among the major economies can reduce uncertainty, avert trade and currency wars, and generally lead to more favorable outcomes, particularly during crises, than would be the case if each country acted alone. Forecasting the global economy requires careful assessment of whether cooperative policy formulation and implementation by the major economies will be likely. It is important to assess whether the international monetary system is able to withstand the possible pressures caused by economic and financial shifts that may underpin macroeconomic projections.

The post–World War II global economy has been associated with the Bretton Woods Conference, which provided a structure for addressing reconstruction and stable growth in the postwar period. Bretton Woods resulted in the birth of a group of institutions—the IMF, the World Bank, and the General Agreement on Trade and Tariffs (GATT)—that were charged with maintaining international economic cooperation.<sup>9</sup>

The adoption in the early 1970s of floating currencies in the industrial economies, along with the impact of the 1973 oil crisis, highlighted the need for a forum for economic coordination among the world’s major industrial economies. In 1974, the United States created an informal gathering of senior officials from Canada, France, the Federal Republic of Germany, Italy, Japan, the United Kingdom, and the United States called the Group of Seven (G-7). Given that the G-7 comprised about 70 percent of world GDP in 1975, it became the primary economic policy coordinating group.

The G-7 represented only 15 percent of the world’s people. After the fall of the Berlin Wall, in 1989, its leaders recognized that the economic and political landscape had started to change. They began to hold separate meetings with the Russian Federation, which formally joined the group in 1997, resulting in the creation of the G-8.

The East Asian crisis of 1997–98 and the Russian financial crisis of 1998 put the G-7/G-8 to the test, showing that the body was beginning to lose legitimacy to solve the problems facing the global economy. Both as a response to the financial crises of the late 1990s and in recognition of the fact that key emerging market countries were not adequately included in global economic discussions or governance, in 1999 the G-8 countries created the G-20. Its creation notwithstanding, the G-7/G-8 continued to be the main economic forum until the 2008–09 global economic and financial crisis.

The 2008–09 crisis brought to the forefront the growing recognition that the G-7/G-8 was a limited forum for responding to a rapidly spreading and truly global economic crisis. As a result, in November 2008, G-20 leaders convened in Washington, DC, to discuss how to cooperate to

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<sup>9</sup> The GATT, which emerged in 1947, became the World Trade Organization in 1995.

strengthen economic growth, cope with the financial crisis, and lay the foundations for reform in order to spark recovery and avoid similar crises in the future. The financial crisis triggered the November 2008 summit, but it reflected decades-long shifts in the global economy, in which emerging economies have been acquiring more economic and political preponderance at the global level.

The evolution of the international monetary system is an additional reminder of the complexity of the issues at stake in designing global governance for a globalized economy.<sup>10</sup> Additional, and equally important, new challenges also exist, such as the need for cooperation on the regulation and supervision of financial institutions through the Financial Stability Board, Basel I/II/III, the Financial Sector Assessment Program (FSAP), and other cooperative arrangements. The fact that fragility in U.S. housing finance exploded across borders is a painful reminder of how interlocked national financial markets are. The ongoing European debt distress highlights an important linkage to the “fiscal dimension” of reform of the international monetary system.

The international monetary system has been subject to periodic crises over the last two centuries. Many argue that the establishment of a more competitive set of reserve currencies could provide more stability, because it would provide central banks with a more diversified set of assets in which to invest and competition might impose discipline on macroeconomic policy makers in reserve currency countries. Given rapid movements in market perceptions, however, the significant fiscal challenges in high-income countries combined with the development challenges of emerging markets could lead to even greater regional and global instabilities than seen over the past decade. Further complicating the situation is the difficult political process involved in addressing, for example, pension and health reforms in rich countries or managing income inequality and other social stresses in emerging economies. As a result, periodic crises may very well continue in the future, accompanied by high volatility of financial flows, with potentially adverse effects on developing countries, as observed during the 2008–09 global crisis. More ambitious reforms of the international monetary system are needed to avoid repetition of this

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<sup>10</sup>This section is based on Lin, Fardoust, and Rosenblatt (2012).

outcome. In addition, reforms of the broader financial architecture—for example, banking sector and other financial regulation—will be a key part of such a policy agenda.

*h. The environment and natural resources*

By the end of the 1980s, concerns about the environmental costs of economic growth—and environmental challenges to sustainable development—had begun to receive global attention. Some of these issues—the so-called “brown” issues, relating to land, air, and water pollution from industrial and transport activities and near-term “clean up” options—had been gaining prominence at the national policy level for some time. Cross-national and cross-cutting issues such as demographics, food security, biodiversity, and the depletion of mineral resources came to be framed under the umbrella term *sustainable development*, most prominently in the 1987 UN World Commission on Environment and Development report (popularly referred to as the Brundtland Report). The report also addressed three “global commons”—oceans, space, and the Antarctic.

Our study acknowledged the possibility that intensification of environmental problems would become a binding constraint on the scale of economic activity and a source of conflict of interest between developed and developing countries. We projected that, although volatility of primary commodity prices would continue, there was no likelihood of serious shortages of physical resources, mainly because of significant substitution possibilities and the functioning of the international commodity markets. We pointed out the possibility of deterioration in environmental quality in the rapidly industrializing developing countries; we were unaware of the scale of environmental damage already done in the centrally planned economies of Eastern Europe and the Soviet Union.

Another “commons” resource became more important since our study: the atmosphere. Already in 1985, the Vienna Convention on the Protection of Ozone Layer had initiated international cooperation on the phase-out of ozone-depleting substances, with production controls negotiated under the Montreal Protocol in 1987 and various amendments throughout the 1990s. The Brundtland report acknowledged the ongoing research on the long-term climatic effects of anthropogenic greenhouse gas emissions. Recognizing “the complexities and uncertainties surrounding the issue,” it proposed immediate adoption of a four-track strategy, comprising

improved monitoring, research, internationally agreed policies for emission reductions, and strategies for adaptation to climate change impacts. The Intergovernmental Panel on Climate Change (IPCC) was established in 1988. Its first assessment report came out in 1990.

The 1992 (“Rio”) UN Conference on Environment and Development initiated a round of international agreements on global environmental issues, most significantly the Framework Convention on Climate Change (FCCC). Under this agreement, “Annex I” countries (the advanced industrial economies of the time plus the economies of the former Soviet Union and Eastern Europe) made a voluntary, aspirational pledge to hold their emissions of certain greenhouse gases in 2000 below the 1990 levels. The FCCC came into force in 1994.

In 1996, the IPCC’s Second Assessment Report claimed that “our ability to quantify the human influence on global climate is currently limited because the expected signal is still emerging from the noise of natural variability, and because there are uncertainties in key factors.... Nevertheless, the balance of evidence suggests that there is a discernible human influence on global climate” (IPCC 2006, 22). Consequently, the 1997 FCCC Conference of the Parties in Kyoto adopted a protocol in which the Annex I countries agreed to varying levels of emission reductions from the 1990 baseline over the first commitment period of 2008–12.

Although we recognized the critical importance of the accelerated degradation of the environment as a key global policy issue, we did not foresee the scientific urgency or the political significance of climate change actions, in particular the urgent need for emission reductions. As of this writing, it appears that the approach of legally binding multilateral agreements on national emission limits, gradually made tighter and extended to other countries, is facing serious troubles. That approach worked for the Montreal Protocol for the Control of Ozone-Depleting Substances, but greenhouse gases and climate change are proving to be far more complex and politically troublesome issues. Momentum toward action seems to be accelerating, however. At the most recent conference in Doha (November 2012), FCCC parties set out a timetable to adopt a universal climate agreement by 2015, designed to come into effect in 2020 (UN FCCC n.d.). World Bank President Jim Yong Kim has been speaking and writing forcefully about the urgency of climate threats faced by developing countries, declaring “If we don’t confront climate change, we won’t end poverty”(World Bank 2013a).

Climate change will affect economic growth and human well-being in myriad ways; how much, when, and how continue to be matters of debate. The Special Report (SREX) of the Intergovernmental Panel on Climate Change (IPCC 2012) discusses the issues involved in adapting to climate change. The social dimensions are analyzed in a UN multiagency draft report (United Nations 2011) and a study by the National Science Foundation (Nagel, Dietz, and Broadbent 2009). A joint study by the World Bank and the United Nations (2010) examines optimal approaches to disaster prevention. The *World Development Report 2010: Development and Climate Change* (World Bank 2009) and the 2011 *Human Development Report* (UNDP 2011) provide comprehensive accounts of the challenges of sustainable development. The World Bank's recent Energy Sector Directions Paper (July 2013) establishes that financial support for new greenfield coal power generation projects will be provided "only in rare circumstances," such as "meeting basic energy needs in countries with no feasible alternatives" (World Bank 2013d). The Bank commissioned two major reports on climate change in 2012 and 2013 (World Bank 2012c, 2013c) and is focusing its planning to help "climate proof" cities and infrastructure in some countries (Schneider 2013).

#### ***4.3 Quantitative Assumptions and Projections***

We now turn to a detailed analysis of the numerical assumptions and projections made in the 1990s. Table 5 shows our assessment of the international economic environment facing developing countries in the 1990s. We projected two scenarios for global economic environment: the baseline and a low case. The projections were calibrated to reflect the major characteristics of the global economy in the 1990s, as we perceived them in 1989. The scenario underlying the baseline could be characterized as "adjustment with growth" on the part of leading industrial countries. The low-case scenario hypothesized failure to work out the external payments imbalances that had built up in the 1980s, resulting in low growth, a weak dollar, and high interest rates.

It would be interesting to compare our forecasts with the forecasts of other organizations made at the same time (1989–90) for the same period (10 years). Unfortunately, no other forecast has a comparable horizon. Among international economic and financial organizations, the World Bank was unique in adopting a 10-year horizon for its longer-term economic projection. Many organizations produced short-term forecasts (for the current and the following year or two). A

small number of these agencies extended their short-term forecasts into the medium term (typically up to five years).

Table 6 assembles the medium-term forecasts by four organizations for similar variables. These forecasts are for the first half of the 1990s. The World Bank forecasts for the 1990s in this table are slightly different from those in Table 5, because these forecasts were produced about a year later (in 1990).

Comparison of projected and actual values reveals several salient points:

1. Annual GDP growth of the high-income OECD countries over 1990–2000 was 2.5 percent—nearly the same as our low-case projection (see Figure 5). The shortfall from the baseline projection is attributable entirely to very weak growth in Japan in the 1990s, which we did not project to last as long as it did. Japan’s annual GDP growth rate in the decade was 1.2 percent—much lower than its long-term trend growth rate of 5.7 percent or its 1980s growth rate of 4.6 percent. Excluding Japan, the remaining high-income countries grew at 2.9 percent a year—very close to the baseline forecast of 3.0 percent a year. Thus, although we projected a growth slowdown in Japan, actual growth turned out to be much lower. It is worth recalling that optimism regarding Japan’s prospects was nearly universal in the 1980s. As evident in Table 6, only the Project Link forecast was closer than our baseline to the actual value; the forecasts of the other agencies were even farther off than ours.

**Table 5 Assumptions about the International Economic Environment in the 1990s: Projections and Actual Values**

(annual percentage change)

<i>Income level/indicator</i>	<i>History</i>			<i>Projection for 1990s</i>		<i>Actual</i>	
	<i>1965–88</i>	<i>1980–87</i>	<i>1988</i>	<i>Baseline</i>	<i>Low case</i>	<i>1990–2000</i>	<i>2000–10</i>
<i>High-income countries</i>							
Real GDP	3.3	2.6	4.8	3.0	2.4	2.5 (2.9) <sup>a</sup>	1.4
Inflation	5.6	4.8	2.6	4.0	4.4	1.5	1.4
Manufactures unit value	6.2	3.2	6.5	3.9	5.0	-0.3	1.9
Real rate of interest	3.1	5.7	4.6	2.7	3.8	3.2	0.4
Nominal rate of interest	8.7	10.5	8.1	7.8	9.6	5.4	2.7
<i>Low- and middle-income countries</i>							
Export value in dollars	10.0	4.2	11.6	11.0	9.7	9.6	13.7
Export volume	5.0	5.6	6.2	5.5	4.2	7.0	8.9
Real price of oil	6.2	-5.0	-19.4	3.5	3.0	2.4	8.4
Real price of 33 nonoil commodities	-3.5	-4.0	11.0	0.6	0.0	-0.8	8.2

*Note:* This is table 16 from *A Long-Term Outlook* (Fardoust and Dhareshwar 1990), to which actual figures for the 1990s and the 2000s were added. Actual values for the 1990s for commodity prices are from *Global Economic Prospects* (World Bank 2001). The current commodity price data of the World Bank give a value of -1.4 percent a year for the 1990s. Values for 2010 are estimates.

<sup>a</sup>Figure in parentheses is the real average annual GDP growth of high-income OECD countries excluding Japan.

2. Our forecast for annual inflation in the G-5 countries in the 1990s (3.2 percent) turned out to be considerably higher than the actual value of 1.5 percent. A contributing factor was the near-deflation in Japan, where the GDP deflator grew at an annual rate of 0.1 percent in the 1990s, down from 1.5 percent in the 1980s. Japan actually entered a deflationary phase in the second half of the 1990s. In all G-5 countries, particularly the United States, inflation in the 1990s was lower than in the previous decade. (This feature of the 1990s was covered in some detail above in the discussion of the Great Moderation.) None of the agencies whose forecasts are shown in table 6 picked up the impending change in the inflation regime in the high-income countries.
3. The World Bank used the U.S. dollar–denominated average unit value of manufactured exports of the G-5 countries (the MUV index) as a component of the terms of trade between developed and developing countries. It is a measure of how expensive developing country imports are; a low value for the growth rate of the index represents favorable condition for growth. This variable was key to the Bank’s country economic and sector work and formed part of the Bank’s planning assumptions. Over the 1990s, the MUV index declined. Before the 1990s, it occasionally fell over the course of a year, when the U.S. dollar was unusually strong relative to other major currencies; never before in the postwar period did it decline over a decade. The relative strength of the U.S. dollar in the 1990s is only part of the explanation for the decline in the index, however. The principal cause is likely to be the general reduction in the export price of manufactures from the industrial countries as a result of increased diversification into manufactures by many developing countries, led by East Asian countries, particularly China.<sup>11</sup> This development is an indication of a major structural change in the global manufacturing sector. Thus, the assumption that developing countries export commodities to and import manufactures from the high-income OECD countries is

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<sup>11</sup> For a general discussion of recent trends in the terms of trade of developing countries, see Athukorala (1993), Ram (2004), and Erten (2010). For discussion of the China effect, see Kaplinsky (2006).

becoming increasingly tenuous. Work is currently underway at the Bank to expand the country coverage of the MUV index. Our forecast for the increase in the volume of developing countries' exports of 5.5 percent a year proved to be too low (it actually grew by 7 percent a year), partly because we underestimated both the speed of convergence of emerging economies and the strong interplay between international trade and modern technology, which led to faster economic integration, particularly in East Asia. We also did not sufficiently emphasize the emergence of regional trade agreements and evolution of supply chains.

4. Although international oil prices during the 1990s moved less dramatically than in the 1970s and 1980s and OPEC members' coordinated adjustments of oil production succeeded in reducing market volatility, hostilities in the Middle East in 1990–91 (Iraq's invasion of Kuwait and the subsequent Persian Gulf War I) as well as the East Asian financial crisis of 1997–98 brought about excessive volatility at the beginning and the end of the decade. However, a solid recovery followed in a more integrated oil market, that had adjusted to the post-Soviet world and the resulting increase in economic integration. Our baseline forecast of the real increase in the price of oil during the 1990s (3.5 percent a year) and increases in the share of OPEC in world production (from about 29 percent in 1989 to about 40 percent by 2000) proved to be only slightly overoptimistic (compared to actual increase of about 2.5 percent a year in real oil price and the actual share of OPEC in world oil production of 38 percent).
5. The World Bank used the London Interbank Offered Rate (LIBOR) on six-month U.S. dollar deposits as the principal international interest rate. The primary focus was on the real rate, defined as the nominal rate adjusted by the U.S. GDP deflator. In fact, over longer time horizons, it was the real rate that was predicted first, with the corresponding nominal rate arrived at using the inflation prediction. Our projection for real international interest rates in the 1990s was reasonably accurate: the actual annual average for the decade (3.2 percent) fell between the baseline (2.7 percent) and the low-case (3.8 percent) projections. Nominal interest rates in the 1990s, however, were considerably lower than our projections (by about 240 basis points on average in the base case). The error in predicting nominal interest rates is an immediate—one could say arithmetical—

consequence of our error in predicting the U.S. inflation rate. The forecasts of the other agencies reported in table 6 were also off, by even larger margins.

6. The main features of our projections for growth in developing countries were highlighted in the discussion of the two development tracks hypothesis (see Section 4.2). The baseline forecast for the annual aggregate growth rate of low- and middle-income countries over the 1990s (5.1 percent) was remarkably accurate (the actual value was 4.9 percent). (See Table 7 and Figure 6 for projections of real GDP growth rates and Table 8 for projections of per capita GDP growth rates. Figure 7 charts the baseline projections of GDP growth rates and actual values by developing country regions. Also of interest are the GDP levels implied by the growth-rate projections, exhibited on a logarithmic scale in Figure 8 for the developing countries aggregate and in Figure 9 by region.)
7. The accuracy in forecasting the aggregate growth of developing countries is, however, at least partially the result of two offsetting errors. Our forecast for growth in Sub-Saharan Africa turned out to be somewhat optimistic. Annual GDP growth for the region averaged just 2.6 percent in the 1990s—lower than even our low-case scenario. The trend growth for Africa in the quarter century preceding the projection period was 3.4 percent a year. The region's poor performance in the 1980s—when growth averaged less than 1 percent a year—led to pessimism regarding the region's prospects. We anticipated that the whole satisfactory resolution of the sovereign debt crisis of the 1980s and the initiation of structural reforms would lead to a turnaround in the region. Such a turnaround did not come to pass until much later.
8. Our forecast for growth in Asia erred in the opposite direction. Our baseline predicted robust growth in the region, of 6.2 percent a year, close to the then long-term trend. Actual growth in the 1990s was 7.2 percent a year. Much of the discrepancy is attributable to the faster-than-expected growth of China. A good aggregate statistic to examine is the forecast accuracy for the growth rate of developing countries excluding China and India. Here, the actual growth rate (3.7 percent) is very close to our low-case projection.

**Table 6 Historical, Projected, and Actual Macroeconomic Variables in High-Income OECD Countries**  
(annual percentage change)

Variable	History			Projections						Actual		
	Trend		Then recent experience	IMF Base-line	Project Link	Wharton Econometric Forecasting Associates (WEFA)	Data Resources, Inc. (DRI)	World Bank 1990–2000		1990–95	1990–2000	2000–10
	1965–89	1980–89	1990	1991–96	1990–95	1990–95	1990–95	Baseline	Low case			
Real GDP	3.1	3.1	2.6	3.1	2.8	3.2	3.1	2.9	2.2	1.9	2.5(2.9) <sup>a</sup>	1.4
Inflation	6.6	3.8	3.7	3.4	3.4	4.4	3.3	3.6	4.3	2.1	1.5	1.4
Real rate of interest	3.1	5.8	4.3	3.9	4.0	4.3	4.9	3.4	5.1	2.3	3.2	0.4
Nominal rate of interest	8.6	10.2	8.4	--	7.7	8.6	7.9	7.4	9.6	4.9	5.4	2.7
World trade (export volume)	4.1	4.1	5.0	--	5.6	4.3	--	5.8	4.5	6.2	7.0	3.8 <sup>b</sup>
Real price of oil	1.8	-4.2	20.0	--	0.9	0.8	-2.0	3.5	3.0	-4.6	2.4	8.4

*Source:* Projections are from World Bank 1991; actual figures are from World Development Indicators.

*Note:* Values for 2010 for the period 2000–10 are estimates from World Bank 2012b.

a. Figure in parentheses is the real average annual GDP growth of high-income OECD countries excluding Japan.

b. Data are for 2000–09.

**Table 7 Projected and Actual Real GDP Growth Rates for Low- and Middle-Income Countries, 1965–2010**

(annual percent change)

<i>Region or Income Group</i>	<i>History</i>		<i>Projections for 1990s</i>		<i>Actual</i>	
	<i>Trend 1965–87</i>	<i>Then recent experience (1980–88)</i>	<i>Baseline</i>	<i>Low case</i>	<i>1990–2000</i>	<i>2000–10</i>
All low- and middle-income countries	5.3	4.2	5.0	4.2	4.9	5.8
Sub-Saharan Africa	3.2	0.5	3.8	3.7	2.6	5.1
Asia	6.6	7.4	6.3	5.5	7.2	7.9
Europe and Middle East and North Africa	4.6	2.8	3.9	3.3	2.9	3.4
Latin America and the Caribbean	4.6	1.6	3.9	3.0	3.3	3.3
Memo items:						
All low- and middle- countries income excluding China and India	4.9	2.6	4.3	3.6	3.7	3.7
High-income OECD countries	3.3	3.7	3.0	2.4	2.5	1.4

*Source:* This is table 14 of *A Long-Term Outlook* (Fardoust and Dhareshwar 1990), to which actual figures from World Development Indicators for the 1990s and the 2000s were added.

*Note:* The country coverage for the actual data is slightly different from the projection. It excludes Myanmar and Taiwan, China, data for which were not available. Instead of Yugoslavia, the GDP data for Croatia, Macedonia, Serbia, and Slovenia are used; data were not available for Bosnia-Herzegovina, Kosovo, or Montenegro. The 2010 values are estimates.

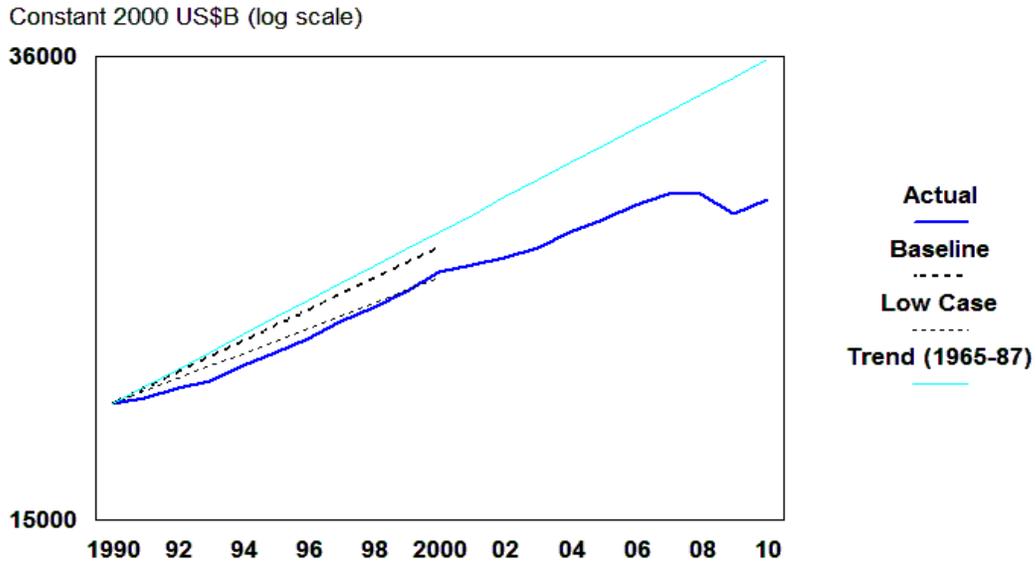
**Table 8 Projected and Actual Real GDP per Capita Growth Rates, 1965–2010**

(annual percent change, except where otherwise indicated)

	<i>History</i>			<i>Projections for 1990s</i>		<i>Actual</i>	
	<i>Per capita income (dollars)</i>	<i>Trend 1965–87</i>	<i>Then recent experience (1980–88)</i>	<i>Baseline</i>	<i>Low case</i>	<i>1990–2000</i>	<i>2000–10</i>
<i>Region or income group</i>							
All low- and middle-income countries	690	3.0	2.1	3.1	2.4	3.2	4.4
Excluding China and India	1,110	2.4	0.2	2.0	1.4	1.7	2.0
Sub-Saharan Africa	310	2.6	2.2	2.6	2.0	–0.1	2.4
High-income OECD countries	16,530	2.6	2.2	2.6	2.0	1.9	0.7
<i>Memo items:</i>							
<i>Population growth</i>							
All low- and middle-income countries		2.2	2.0	1.8	1.8	1.7	1.3
High-income OECD countries		0.8	0.6	0.4	0.4	0.7	0.6

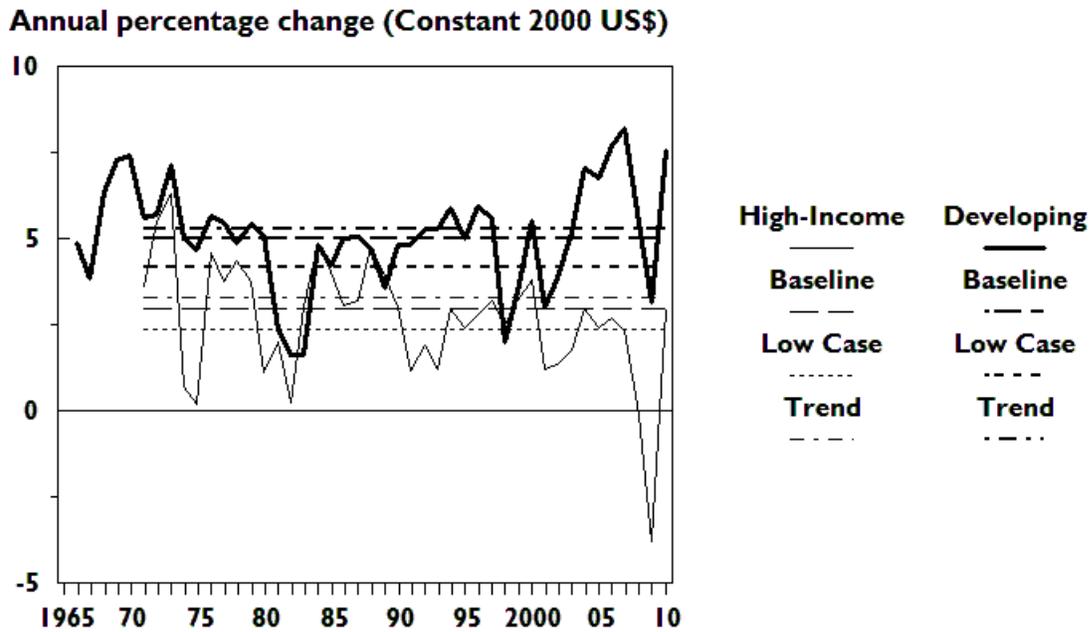
*Source:* This is table 15 of *A Long-Term Outlook* (Fardoust and Dhareshwar 1990), to which actual figures from World Development Indicators for the 1990s and the 2000s were added.

**Figure 5 GDP in High-Income OECD Countries, 1989–2010**



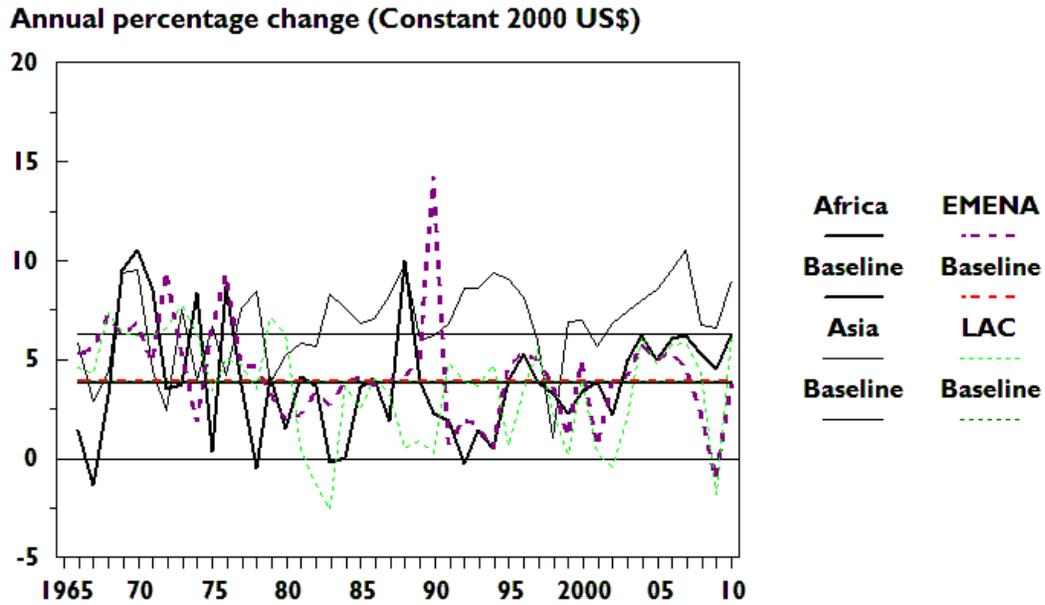
Source: Actual values are from World Development Indicators; forecasts are from Fardoust and Dharehwar 1990.

**Figure 6 Real GDP Growth Rates in Developing and High-Income Countries, 1971–2010**



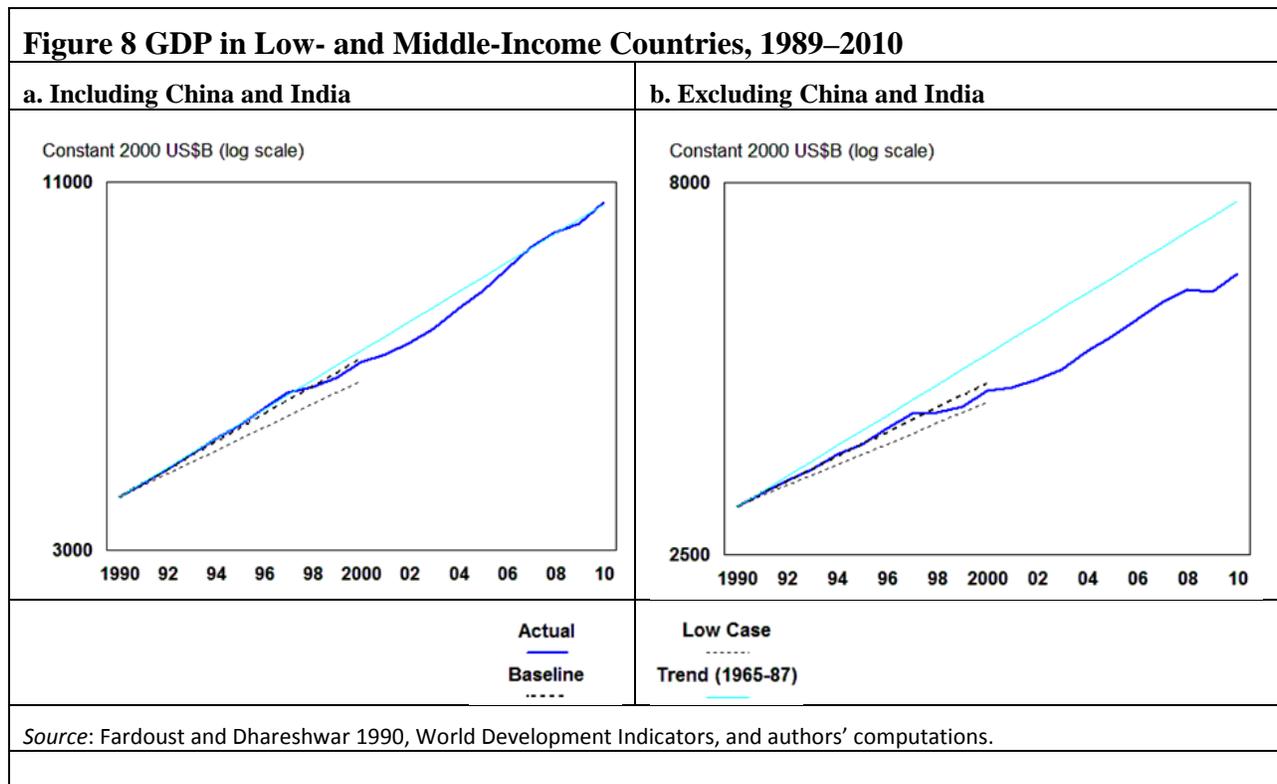
Source: Actual values are from World Development Indicators; forecasts are from Fardoust and Dharehwar 1990.

**Figure 7 Real GDP Growth Rate in Developing Countries, by Region, 1965–2010**

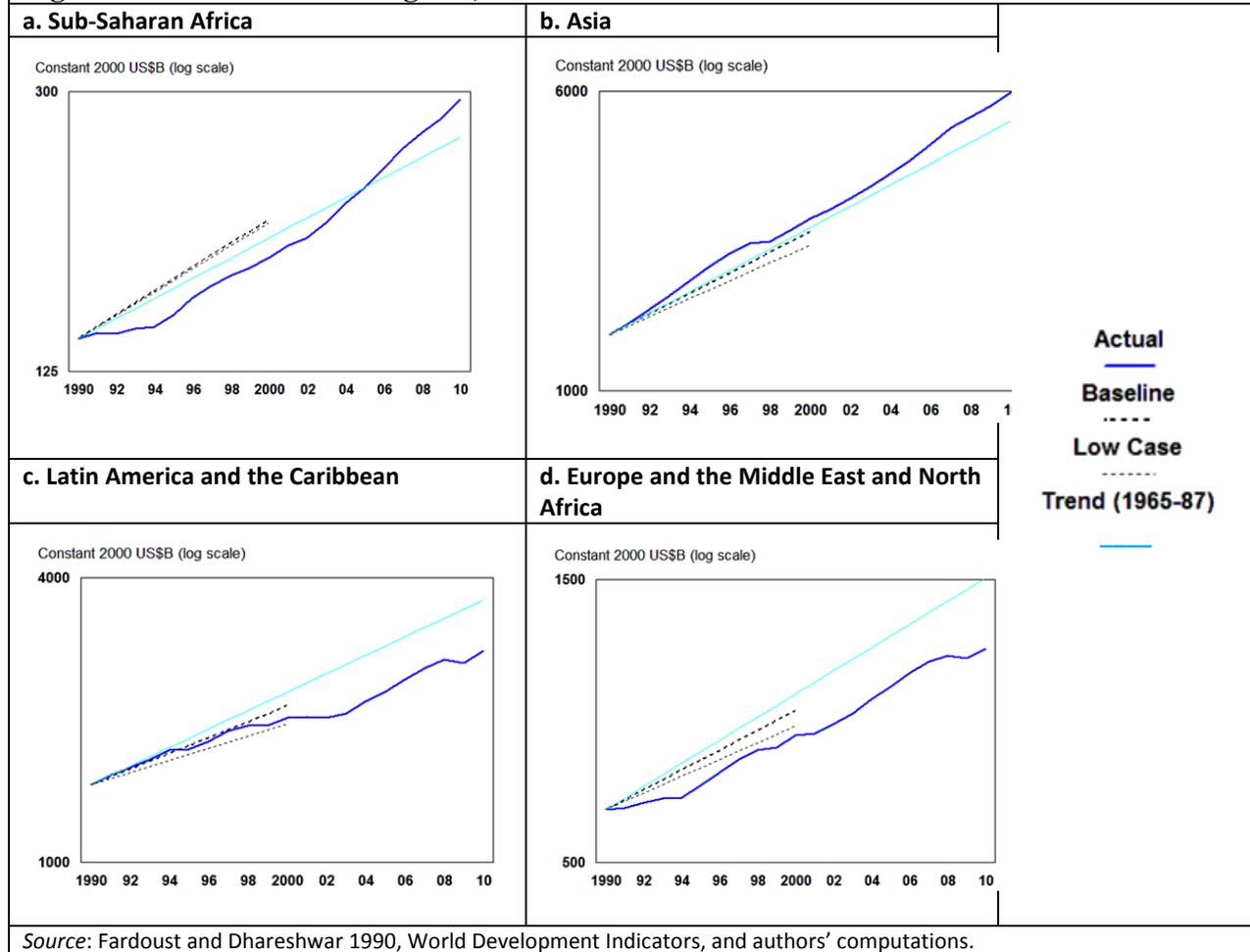


Source: Actual values are from World Development Indicators; forecasts are from Fardoust and Dharehwar 1990.

**Figure 8 GDP in Low- and Middle-Income Countries, 1989–2010**



**Figure 9 GDP in Selected Regions, 1980–2010**



## 5 Going Forward: By Way of a Conclusion

This section presents a brief forecasters' view of the key trends at work in the world economy today. It draws some lessons about how best to deploy scarce organizational resources to position and use a forecasting team that works closely with a team of experts in research centers around the world.

In recent years, researchers and international organizations have built a number of long-term forecasting models that focus on productivity, convergence, technological progress and catch-up, and economic growth (see, for example, Bergheim 2008; Dadush and Shaw 2011; Hughs and

others 2009; OECD 2012b; Poncet 2006; World Bank 2008; and World Bank 2011, 2013; *Global Development Horizons*, a World Bank flagship report that replaced *Global Economic Prospects* in 2011, focuses on medium- to long-term development issues). These models are used mainly to investigate the long-term consequences of policy scenarios relating to specific issues, such as public sector debt, the business climate, patterns of human development and poverty, trade reform and globalization, the international monetary system, and climate change. Another set of studies focuses on emerging megatrends and to a lesser extent on productivity and growth modeling. Only a few studies have attempted to combine growth- and productivity-based forecasts with analysis of megatrends in a meaningful way to construct a vision of the future.

Analysis of megatrends is mainly about anticipating dangers and preparing for them in a timely fashion. Conventional models of deterministic processes are not useful for doing so, because the analysis is essentially nonlinear and deals with the likelihood of unanticipated, chaotic transformative change in systems. The fact that “tipping points” cannot be predicted does not matter much because the forecaster is not required to produce a time path.<sup>12</sup>

A number of recent studies offer thoughtful analysis of emerging megatrends that can be deployed in deepening work in specific areas. Scholarly studies as well as popular books that stand back in order to take a global, historical, and forward-looking perspective of the planet are to be encouraged, reviewed, and discussed by governments, business people, academics, and international organizations such as the World Bank.

Among the many books and studies that have been published in this area in recent years, we focus on a few of them that include lists of issues similar to the ones we identified more than two decades ago. These studies tackle the big picture from different angles and with varying success.

In *Megachange: The World in 2050*, edited by Daniel Franklin (2012) and his colleagues at *The Economist*, 20 essays under four headings (people and relationships, heaven and earth, economy

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<sup>12</sup> Based on written comments by Paul Armington, who headed the World Bank’s International Economics Analysis and Prospects Division from 1987 to 1992.

and business, and knowledge and progress) identify the trends that are currently transforming the world and predict how they may shape the world in 2050. The book offers a straightforward survey of the world, together with a cautiously optimistic outlook for the global economy. According to one of the contributors, “There is every chance that the world in 2050 will be richer, healthier, more connected, more sustainable, more productive, more innovative, better educated, with less inequality between rich and poor and between men and women, and with more opportunity for billions of people” (Franklin 2012). Despite a relatively optimistic view of the long-term future of the world, the contributors acknowledge that enormous challenges lie ahead, ranging from managing climate change and conflicts over scarce resources to feeding another 2 billion people and dealing with growing security threats from extremists and failed states.

At the core of *Megachange* lie two important assumptions (simple projections). First, the slowing of global population growth takes the form of a baby-boomer bulge that moves from west to east (except in China) and from north to south. As a result, while growth will slow over the next 40 years in the West, it will likely accelerate in Asia and Africa. Second, the pace of economic growth experienced over the past decade is likely to continue, implying greater convergence between today’s advanced economies and developing countries and a more equitable distribution of income across countries. The volume’s contributors expect extensive ecological restoration and profound shifts that will underpin a move toward a risk management approach to dealing with climate change, as well as “revolutions” in genomics and health care delivery in a manner that will alter the dynamics of disease. On economic matters, the contributors argue that the rise of inequality in today’s advanced economies may reverse in coming decades and that fiscal and financial reforms will reverse the rising public debt trends, resulting in smarter and fitter states. China’s spectacular growth in recent decades will slow sharply to about 2.5 percent a year by 2050. Nevertheless, a shift in economic fortunes and political and military power toward the East is likely to take place over the next three to four decades, as Asia will account for more than half the world economy.

*Global Trends*, by Adrian Done (2011), identifies and analyzes a dozen major long-term global trends that he thinks will mold the 21st century world. He argues that each of these trends has the

potential to have major adverse effects on businesses and people's lives if not dealt with in an effective and timely manner.

Done highlights several important trends. The repercussions of the economic crisis are not going to disappear in the short term. Geopolitical power will continue shifting away from Europe and the United States toward emerging economic powerhouses such as China, India, Russia, Brazil, and others. Technology will continue to develop, bringing new sources of "creative destruction." The world will continue to warm up, and the climate will change. The worsening problem of water scarcity will continue to affect food production for the foreseeable decades, especially as nonrenewable groundwater is used up or polluted. The importance of sound education will continue to increase. The world population will continue to grow, stabilizing around 2050. War, terror, and social unrest will continue and potentially increase. The world will remain by and large oil dependent in the coming decades, despite a decline in oil's share of the energy supply. Humans will continue to destroy ecosystems, and biodiversity will continue to decline. Ensuring the health and well-being of the majority of the world's population will remain an unfulfilled goal. Natural disasters will affect greater numbers of people but potentially kill fewer of them.

Done's main message is that the world needs to face up to these daunting challenges ("as human beings have always done"). Governments, businesses, and individuals that succeed will be those that take these challenges seriously and respond to the coming changes; those that remain in denial (because of inertia, comfort, vested interests, outdated bonus schemes, legacy systems, lack of conviction, or other reasons) and refuse to accept change are bound to fail.

Of course, the outcome will depend on the political and economic systems within which these agents operate. To address this pessimism constructively, the political leadership must identify and initiate a systemic transformation that resets the game of how individuals and groups win or lose. Doing so requires institutional change, not just better policies by existing institutions. Global institutions can play a critical role in addressing global issues that affect average citizens everywhere.

Another approach that has gained traction among policy makers around the world is the one taken by the National Intelligence Council (NIC).<sup>13</sup> One of the NIC's key products is a global trends report produced for the incoming U.S. president, which assesses critical drivers and scenarios for global trends over a 15-years horizon. The NIC's most recent report, *Global Trends 2030: Alternative Worlds*, was released in 2012. As the report is prepared mainly to provide the White House and the U.S. intelligence community with a framework for long-range strategic policy assessment, it does not rely on detailed numerical forecasts. Nevertheless, it provides insightful long-term predictions based on some ongoing megatrends:

- Individual empowerment will accelerate, as a result of poverty reduction, the growth of the global middle class, greater educational attainment, the widespread use of new communications and manufacturing technologies, and advances in health care.
- Power will be diffused. There will be no hegemonic power, as power shifts to networks and coalitions in a multipolar world.
- The demographic arc of instability (the large proportions of young people in some regions and high levels of unemployment) will narrow, and economic growth may decline in “aging” countries. Sixty percent of the world's population will live in urbanized areas. Migration will increase.
- Demand for food, water, and energy will grow substantially, thanks to the increase in the global population. Tackling problems pertaining to one commodity will be linked to supply and demand for others. Climate change will worsen the outlook for the availability of these critical resources.

The report also predicts that “Asia will surpass the combined economic and military might of Europe and the United States.” This finding is consistent with the findings of several other megatrend-type reports and with the ongoing structural changes in the global economy toward a

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<sup>13</sup> Formed in 1979, the NIC is the center for mid- and long-term strategic thinking within the U.S. intelligence community, according to its website (<http://publicintelligence.net/global-trends-2030>).

multipolar growth world. Other important ongoing trends emphasized by the report relate to potential conflicts over access to water and the challenges posed by climate change.<sup>14</sup>

Another recent report dealing with long-term global issues is by the Oxford Martin Commission for Future Generations (2013), a group of international leaders working to identify how progress can be delivered on critical challenges such as addressing the global burden of chronic disease and the risks (and opportunities) associated with the hyper-connected world. The report, entitled *Now for the Long Term*, highlights the deep global inequalities that persist in access to food, adequate sanitation, vaccines, and health care and aims to shift government and business priorities toward longer-term challenges that will shape the world's future. The report looks at several megatrends, including large, aging populations; urbanization; the growing middle class in developing countries; inequality and unemployment; geopolitical power transitions; sustainability and resource insecurity; the shifting burden of diseases; and the information and communications revolution. It argues that in the face of complex problems, institutions are inadequate, confidence in the ability of politicians to deal with problems is low, and short-termism is entrenched. The report suggests a range of innovative long-term ideas, including creation of a coalition of the G-20, 30 companies, and 40 cities to lead the fight against climate change.

Studies about long-term futures serve an important purpose when they build on current megatrends and draw logical implications based on the continuation of those trends. The policy implications and their feasibility serve as an important and valuable public good and a necessary input for policy debate at both the national and international level.

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<sup>14</sup> For an overview of a large-scale research project (“Towards a Better Global Economy”) as well as a recent review of global economic forecasts for the first half of the 21st century, see Behrman and Fardoust (2013).

The analysis, however, could go further. It could suggest how important agents (national governments, multinational organizations, multinational corporations, military and security establishments, and universities) are likely to react to their perception of these problems and then analyze whether the reaction functions and feedback loops tend to ameliorate or exacerbate the problems and whether they could lead to desirable transformative change.

The discussions and findings of megatrend-type studies should make everyone, particularly political and economic leaders, think about two important broad lessons. Although it is impossible to predict specific events with precision (particularly over a long period of time), it is possible to construct multiple scenarios around ongoing demographic and economic trends and assign judgmental probabilities to each. Less uncertain but much more difficult to envision and model are the needed (or implied) institutional changes at both the national and international level to deal with a vastly different world of multipolar growth and decentralized empowerment compared with the current set-up.

Even the most well-specified and sophisticated models will never be able to predict anything with accuracy over the long term. For complex systems, it is impossible to make accurate predictions beyond the short run, mainly because the endogenous variables (for example, economic growth or per capita income) are very sensitive to the determining variables, which are changing constantly, based on their own dynamics or on (unpredictable) policy changes. Moreover, major “exogenous” shocks (wars, revolutions, major terrorist acts, and so forth), including black swan–type events, could seriously affect (or even reverse) some or all ongoing major economic and demographic trends. Box 3 provides an example of this phenomenon.

As a result of the geopolitical shocks of the early 20th century, economic development followed a very different path from the trend (or that predicted by forecasters). By 1949, GDP of the G-5 was almost 300 billion in 1990 international dollars below the lower-bound prediction—an amount equivalent to 13 percent of actual output—highlighting the substantial and persistent effects of large, adverse geopolitical events.

### **Box 3 The Challenge of Geopolitical Shifts for Long-Term Economic Forecasting: What Are the Lessons of History?**

The economy does not exist in a vacuum; the political, historical, and social context in which economic agents act affect it in myriad ways. Ignoring this geopolitical context can lead the economic forecaster astray.

As the 20th century began, Europe and its offshoots (such as the United States) enjoyed booming economies. Globalization was marked not by computers and cellphones but by the steamship, small power generators, and the railroad. This prosperity, which can be dated to the decline of protectionism in the United Kingdom in the 1840s or the end of the first “great depression” in the 1890s, represented the bounty of several historic changes.

Thanks to the Pax Britannica and the likes of Metternich, Castlereagh, and Bismarck, a balance of power existed in Europe, which enjoyed relative peace. Suffrage, liberal constitutionalism, mass primary education, and other equity-fostering institutions had expanded. The Industrial Revolution brought new technologies. In the previous three centuries, economic growth had been almost nil; per capita income in Western Europe grew by 1.1 percent a year between 1820 and 1896 and by an unprecedented 1.5 percent between 1896 and 1913. These were the years of the *La Belle Epoque*.

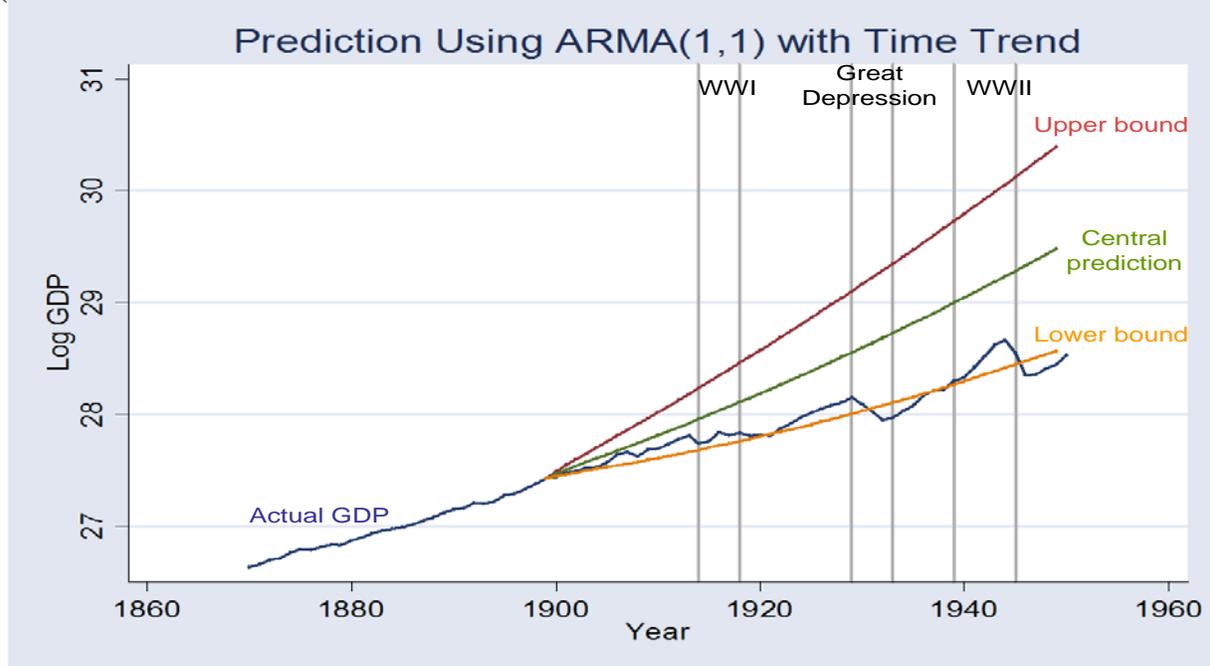
This rapid economic growth was accompanied by important political, social, ideological, and military changes. New powers—Germany, Japan, and the United States—were catching up to and even surpassing the United Kingdom, the dominant economic and military power in the 19th century.

By 1913, there was a growing sense that war was inevitable. In Europe, especially in Germany, modernism and romanticism combined into new nationalistic ideologies that could be contained neither by Britain’s ebbing leadership nor by the weak international institutions of the time. The Industrial Revolution and the globalization of the 19th century meant that the economies of different countries were growing very quickly and at different rates.

At the end of the 19th century, how might one have projected GDP during the first half of the 20th century? The prevailing mood at the time was one of optimism and confidence. Box figure 3.1 shows projections of the combined GDP of five countries (the United States, the United Kingdom, Germany, Japan, and France) for 1900–49 based on GDP in the 30 years before 1900.

The central prediction and the upper and lower bounds are calculated by assuming annual shocks similar in nature to those observed between 1870 and 1899 and responses to them that were similar way to those in the previous 30 years. The model projects relatively strong growth for the following 50 years, along a stable trajectory, implicitly on the strength of economic dynamics generated by continued globalization and technological progress.

**Box figure 3.1 Projected GDP in the G-5, Based on Performance in the Previous 30 Years (millions of 1990 international dollars [ln])**



Source: Fardoust and Goldberg 2006, based on data from Maddison 2001.

Note: The G-5 includes the United States, the United Kingdom, Germany, Japan, and France. A first-order autoregressive moving average ARMA (1,1) model with constant and time trend term can be written as  $y_t = \beta x_t + \gamma (y_{t-1} - \beta x_{t-1}) + \delta \varepsilon_{t-1} + \varepsilon_t$ , where  $y_t$  is GDP growth at time  $t$  and  $\beta$  and  $x_t$  are the constant and time trend. The “central” prediction, along with its confidence interval represented by the upper and lower bounds, is made using a Monte Carlo experiment. First an ARMA(1,1) model was used based on historical data, regressing GDP growth on a time trend and a constant, with auto-correlation. The estimated parameters in the regression are used to predict future GDP levels based on a set of randomly generated errors for recent history. These errors come from a normal distribution with variance equal to the estimated variance of the distribution of observed errors from the historical regression. This process is repeated for 1,000 sets of randomly generated errors. The median prediction for a given year as the central tendency and the 87.5 and 12.5 percentile as upper and lower bounds.

The causes of these “shocks” are complicated and much debated by historians. World War I arose out of some combination of nationalism; new and misunderstood warfare technologies that would help spark, exacerbate, and prolong what many thought would be a minor war; changes in the balance of power that left the world without an active and powerful keeper of the peace; and undemocratic political and poor policy choices by some governments. The Great Depression arose from a severe real economic shock that was exacerbated and propagated worldwide by

inappropriate monetary institutions, including the gold standard, poor policy, and an unprepared financial system.

In the long run, the forces pushing worldwide economic integration forward dominated the adverse impact of political shocks, and globalization recovered powerfully after World War II, though the ongoing massive global economic shifts and the resulting changes in geopolitical forces have diluted and weakened global economic governance and its leadership. This history reveals that making accurate long-term predictions is all but impossible. However, if conducted carefully and responsibly, such predictions can still play a useful role in preparing strategies and prioritizing policies and investment/spending interventions at both the national and international level and in building synergies between the public sector and the private sector.

Assessment of the long-term forecasts and scenario work we did in 1989 for the 1990s yields useful lessons. Overall, our forecasts of average economic growth were satisfactory—actual economic growth in the advanced and developing economies fell somewhere between our base case and low-case scenarios. However, we missed Japan’s decade-long economic slowdown, underestimated China’s economic growth, and overestimated Africa’s growth. Regarding megatrends, we correctly identified acceleration in the pace of technological progress and its effect on productivity; the increased chance of regional or global financial crisis as a result of the rapid globalization of finance, deregulation, and large trade and payments imbalances; the increased intensity of environmental problems; and the evolution of two-track economic growth among developing countries (fragile states versus the rest) and the conditional convergence of the productivities of emerging economies with those of advanced economies. We failed to foresee the rise and increasing importance of the Internet (and, of course, the invention of social media). We underestimated the importance of the interplay between globalization and technological progress and its implications for income inequality, both between and within countries. And although we recognized the increasing importance of climate change, we did not foresee the disastrous effects of frequent weather-related natural disasters on the global economy, developing countries, and poor people.

Despite the many challenges facing long-term economic forecasting and its mixed track record, econometric models have proven to be a useful framework for understanding our rapidly

growing knowledge of economic behavior, the political economy of policy formulation, the increasingly complex world economy, and the overall consistency of the relations and linkages among countries and sectors. These models remain the best tool for long-term forecasting of economic outcomes and scenario analysis. The recent resurgence of interest in and research on econometric techniques and models and vast improvements in the quality and breadth of data on an increasing number of countries provide reason to hope that the accuracy and robustness of models will continue to improve. (For a review of different models, see Carnot, Koen, and Tissot 2011, pp. 396–462; for a discussion of modeling volatility, see Diebold 2008, pp. 329–54.) However, the increased likelihood of unanticipated breaks and unprecedented shocks (both positive and negative) will continue to make long-term forecasting of economic growth a highly speculative venture.

Three sets of complementary activities would help improve longer-term forecasting outcomes in a unit tasked with national or global long-term forecasts and scenario analysis:

- Deeper research should be conducted on the determinants of economic growth and productivity, particularly technological innovation. This work should examine the interactions and synergies with globalization and among key economic, financial and labor market-related variables.
- Using the latest quantitative techniques, researchers should conduct sophisticated scenario and sensitivity analysis to deal with the inherent uncertainty of the structure of macroeconomic models and their key parameters. Credible contrarian forecasts should be included in alternative scenarios.
- Researchers should review and assess global megatrends to identify emerging challenges and opportunities and assess their implications for the key drivers of economic growth and employment generation as well to inform policy making over the long run.

Global institutions such as the World Bank need to build on their current strengths (such as the Global Development Horizons work program at the World Bank) and enhance their collaboration with other international institutions and with major academic centers on potentially important long-term development (“blue sky”) issues. This collaborative work should be done in an efficient and cost-effective manner, within each institution’s resource envelope. It should rely on

open data and open knowledge on the Internet to the extent possible. Strong, collaborative virtual teams of researchers and high-level experts should be formed to work on state-of-the-art models related to climate change, demographic shifts, population and labor force quality, technological progress and innovations, and the process and evolution of trade and financial globalization and their interactions with each other and economic growth and employment. Researchers should attempt to model how financial crises, climate change, infectious diseases, and other key global and regional challenges can lead to breaks in economic trends and regime change and how such breaks affect economic activity. Using nonlinear models combined with deep political and social analysis, they should develop global, regional, and national measures of uncertainty of long-term forecasts based on technological progress and demography and their interaction with globalization in a hyper-connected world.

Policy makers and researchers across the world urgently need to see the big picture if they are to deal with the specific challenges and opportunities they will face over the long term as economies undergo major structural changes. The World Bank, in close collaboration with other international institutions, such as the IMF and OECD, could play the role of a trustworthy intermediary that coordinates; convenes; listens; shares knowledge; learns; and conducts, publishes, and disseminates research on long-term outlook for the world economy.

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