

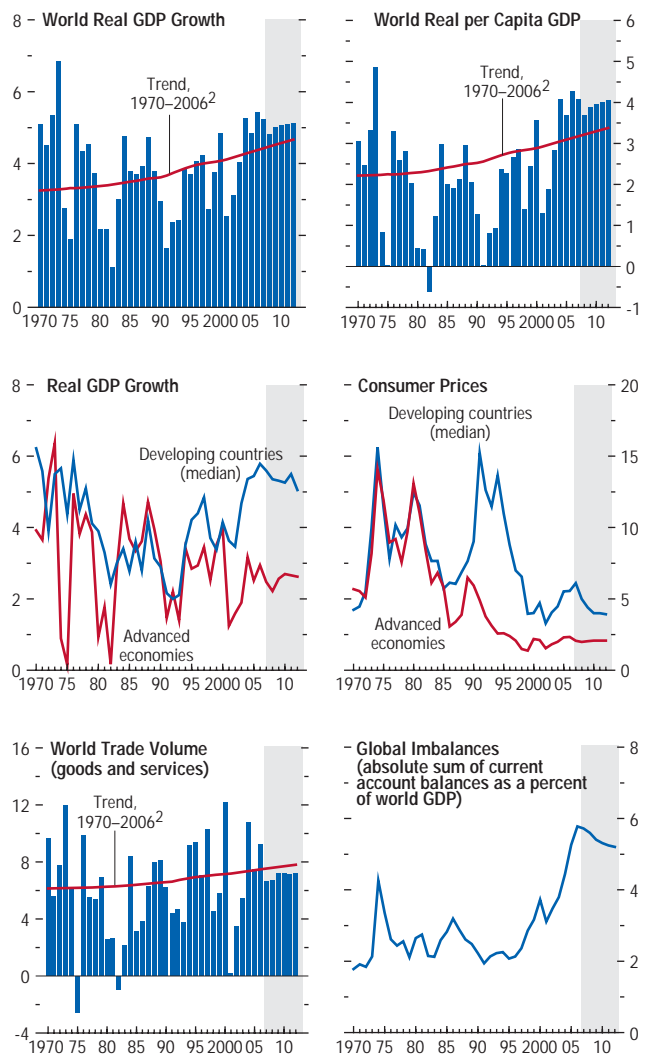
Although the global economy has sustained strong growth in recent quarters, turbulence in financial markets has clouded the prospects. The baseline projections for global growth in 2008 have been revised down by almost ½ percentage point relative to the July 2007 World Economic Outlook Update, although growth would remain a solid 4¾ percent, supported by generally sound fundamentals and the strong momentum in the emerging market economies (Figure 1.1). However, risks to the outlook lie firmly on the downside, centering around the concern that financial market strains could continue and trigger a more pronounced global slowdown. Thus, the immediate task for policymakers is to restore more normal financial market conditions and safeguard the continued expansion of activity. Additional risks to the outlook include potential inflation pressures, volatile oil markets, the impact on emerging markets of strong capital inflows, and continued large global imbalances. Key longer-term issues relate to addressing obstacles to sustained growth from population aging and the increasing resistance to globalization.

Strong Global Growth Is Being Confronted by Turbulent Financial Conditions

Global growth remained above 5 percent in the first half of 2007. China’s economy gained momentum, growing 11½ percent and, for the first time, making the largest contribution to global growth evaluated at market as well as purchasing-power-parity (PPP) exchange rates. India continued to grow at more than 9 percent and Russia at almost 8 percent. These three countries alone accounted for one-half of global growth over the past year, but other emerging market and developing countries have also maintained robust expansions. Rapid growth in these countries counterbalanced continued moderate growth in the United States, which grew at about 2¼ percent in the first half, as the

Figure 1.1. Global Indicators¹
(Annual percent change unless otherwise noted)

The global economy has been experiencing its strongest sustained period of growth since the early 1970s. The expansion is projected to remain above the long-term trend, notwithstanding recent financial market turbulence, with emerging market and developing countries leading the way. Inflation generally remains at low levels, while trade volumes continue to increase robustly, albeit at a slower pace than in 2006.



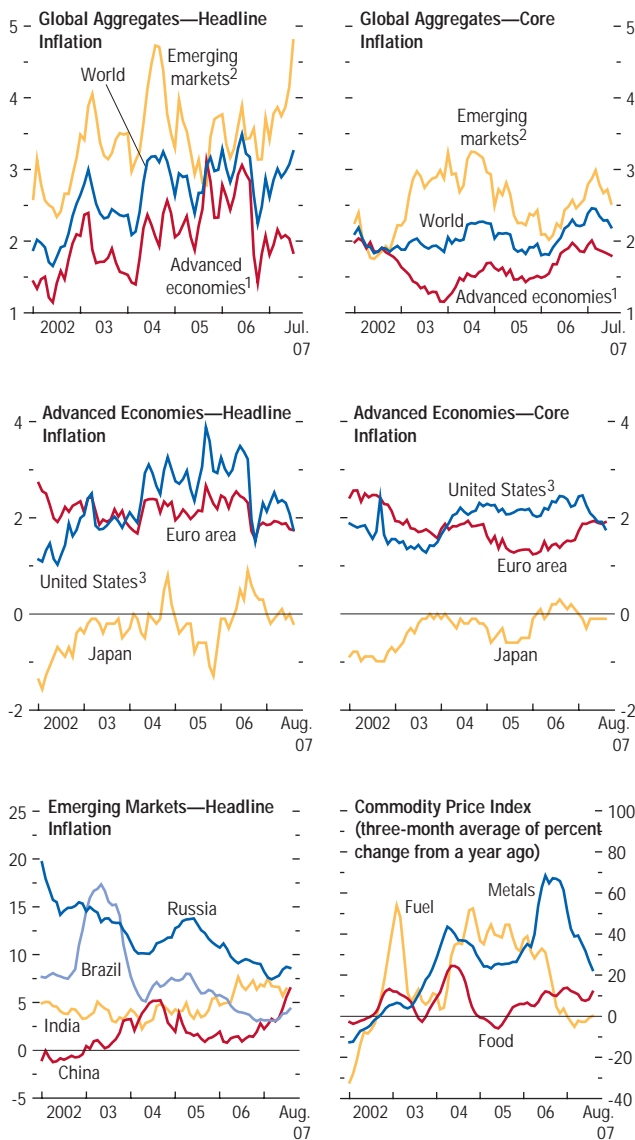
¹Shaded areas indicate IMF staff projections. Aggregates are computed on the basis of purchasing-power-parity (PPP) weights unless otherwise noted.

²Average growth rates for individual countries, aggregated using PPP weights; the aggregates shift over time in favor of faster-growing countries, giving the line an upward trend.

Figure 1.2. Global Inflation

(Twelve-month change of the consumer price index unless otherwise noted)

Inflation has been contained in the advanced economies, but it has moved up in emerging markets as oil prices have rebounded and food prices have accelerated.



Sources: Haver Analytics; and IMF staff calculations.

¹Australia, Canada, Denmark, euro area, Japan, New Zealand, Norway, Sweden, the United Kingdom, and the United States.

²Brazil, Bulgaria, Chile, China, Estonia, Hong Kong SAR, Hungary, India, Indonesia, Korea, Malaysia, Mexico, Poland, Singapore, South Africa, Taiwan Province of China, and Thailand.

³Personal consumption expenditure deflator.

housing correction continued to apply considerable drag. Growth in the euro area and Japan slowed in the second quarter, after two quarters of strong gains.

Inflation has been contained in the advanced economies in recent months, but rising food prices have contributed to heightened pressures elsewhere (Figure 1.2). In the United States, core inflation has gradually subsided to below 2 percent in significant part because of slowing shelter cost increases. In the euro area, inflation has generally remained below 2 percent this year, although energy and food price increases contributed to an uptick in September; whereas in Japan, prices have essentially been flat. However, inflation has picked up in a number of emerging market and developing countries, reflecting strong growth of domestic demand and the greater weight of rising food prices in the consumer price index. The acceleration in food prices has reflected pressure from increasing use of corn and other food items for biofuel production as well as poor weather conditions and supply disruptions in a number of countries (Box 1.1). Meanwhile, oil prices have recently rebounded to new highs, owing to stronger growth of demand than initially projected in the face of lower production by the Organization of Petroleum Exporting Countries (OPEC), a smaller-than-expected rise of non-OPEC output, and continuing geopolitical concerns (Appendix 1.1).

Global credit market conditions have deteriorated sharply since late July as a repricing of credit risk sparked increased volatility and a broad loss of market liquidity. Initially, rising delinquencies on U.S. subprime mortgages led to a spike in yields on securities collateralized with such loans and to a sharp widening in spreads on structured credits, particularly in the United States and the euro area (Figure 1.3; see also detailed discussion in the October 2007 *Global Financial Stability Report*, or GFSR). From mid-August, rising uncertainty about the amount and distribution of associated valuation losses and concerns about the off-balance-sheet exposures of financial institutions have added to

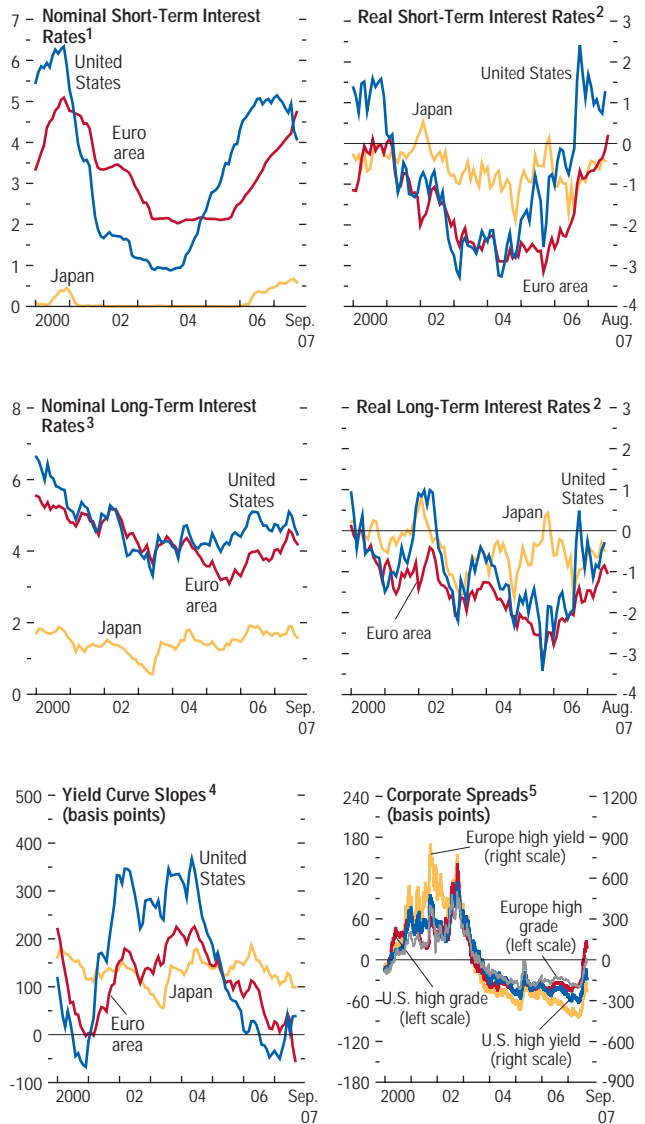
market strains. The result has been a drying up of high-yield corporate bond issues, a sharp contraction in the asset-backed commercial paper market, a dramatic disruption of liquidity in the interbank market, and stress on institutions funded through short-term money markets. Yields on government paper declined sharply as investors looked for safe havens and as expectations about future monetary policy were revised. Toward the end of September, some of these strains started to ease, following a 50 basis point cut in the federal funds rate, but credit market conditions still remain under stress with wider spreads and low issuance of riskier assets. Equity markets in the advanced economies also retreated from highs in August, led by falling valuations of financial institutions, although prices have since recovered (Figure 1.4).

Emerging markets have also been affected by these developments, with sovereign spreads widening, stock markets falling, and capital flows being scaled back (Figure 1.5). Overall, however, the impact has been less than in previous episodes of global financial turbulence, and emerging market equity prices are again reaching record highs. This resilience reflects two sets of factors. First, the turbulence has been related to setbacks in markets for innovative credit instruments and in institutional structures that are less prevalent in emerging markets. Second, most emerging market countries have reduced external vulnerabilities by strengthening their public balance sheets and policy frameworks. That said, certain countries that have received heavy short-term capital inflows experienced pressures in interbank markets as these flows started to reverse.

Prior to the recent turbulence, central banks around the world were generally pushing up policy rates to head off nascent inflationary pressures. However, in August, faced by mounting market disruptions, central banks in the major advanced economies injected liquidity through open market operations on a scale not seen since the Long-Term Capital Management (LTCM)/Russian default crisis in 1998 to stabilize overnight interest rates. They also

Figure 1.3. Developments in Mature Credit Markets
(Interest rates in percent unless otherwise noted)

Credit market conditions have deteriorated sharply since late July as rising fallout from problems in the U.S. subprime mortgage sector led to a spike in yields on high-risk investments. In this context, interest rates on government securities have declined, reflecting a flight to quality and changing expectations about the path of monetary policy.



Sources: Bloomberg Financial Markets, LP; Merrill Lynch; and IMF staff calculations.

¹Three-month treasury bills.

²Relative to headline inflation. Measured as deviations from 1990–2007 (August) average.

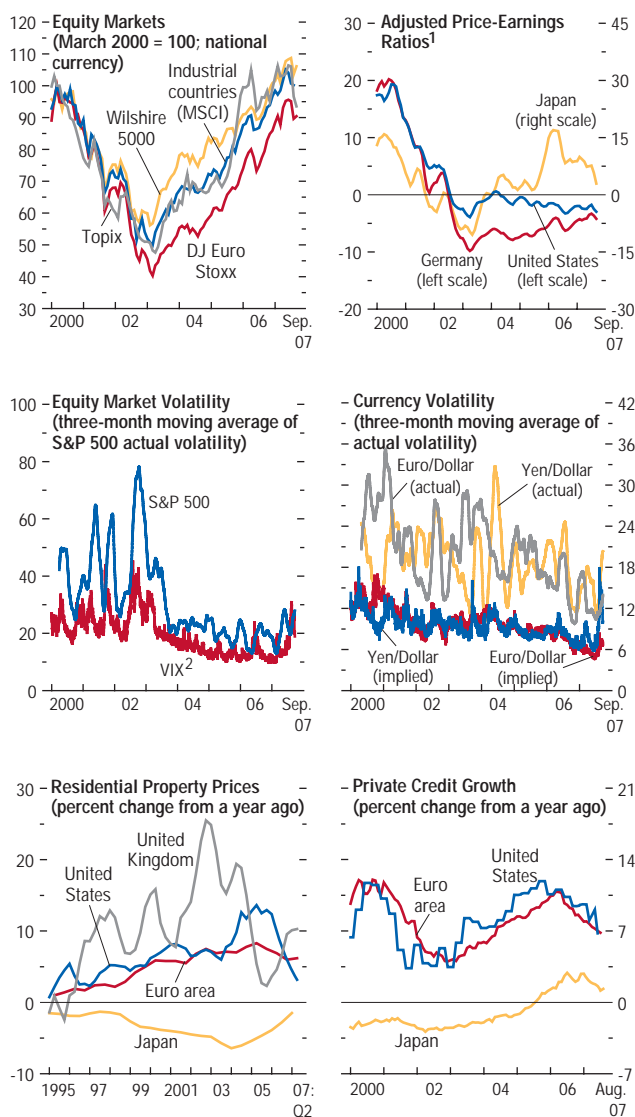
³Ten-year government bonds.

⁴Ten-year government bond minus three-month treasury bill rate.

⁵Measured as deviations from 2000–07 (September) average.

Figure 1.4. Mature Financial Market Indicators

Equity markets were initially affected by turbulent conditions in credit markets, with volatility increasing sharply. However, equity prices have regained ground in recent weeks.



Sources: Bloomberg Financial Markets, LP; Datastream; CEIC Data Company Limited; Haver Analytics; IMF, *International Financial Statistics*; OECD, *Economic Outlook*; and IMF staff calculations.

¹Adjusted price-earnings ratios are the ratio of stock prices to the moving average of the previous 10 years' earnings, adjusted for nominal trend growth. Adjusted price-earnings ratios are measured as three-month moving average of deviations from 1990–2007 (September) average.

²VIX is the Chicago Board Options Exchange volatility index. This index is calculated by taking a weighted average of implied volatility for the eight S&P 500 calls and puts.

facilitated access to their discount windows, and in the United Kingdom, the authorities extended deposit insurance coverage to reassure depositors after a bank experienced difficulties. In September, the Federal Reserve reacted to rising risks to growth by lowering the federal funds rate by ½ percentage point, and market participants expect further reductions in the coming months. Moreover, expectations of policy tightening by the European Central Bank (ECB) and the Bank of Japan (BoJ) have been rolled back. Central banks in a number of emerging market countries (e.g., Argentina, Kazakhstan, and Russia) also provided liquidity to relieve strains in interbank markets, but for others the principal challenge has continued to be addressing inflation concerns (Chile, China, and South Africa have all raised interest rates since August).

The U.S. dollar temporarily regained some ground in August in the context of recent financial turbulence, but has since resumed a weakening trend, against the background of a wide current account deficit, a slow-growing economy, and the cut in the federal funds rate (Figure 1.6). In the IMF staff's view, the dollar remains overvalued relative to medium-term fundamentals.¹ Although the euro has strengthened in effective terms, it continues to trade in a range broadly consistent with medium-term fundamentals. The pound sterling and the Canadian dollar have also appreciated in real effective terms; the pound is viewed as overvalued relative to fundamentals and the Canadian dollar to be broadly in line with fundamentals. The yen depreciated somewhat more rapidly through June, despite Japan's rising current account surplus, as continued low interest rates and a waning home bias of Japanese investors encouraged capital outflows. However, it has rebounded since then, as heightened market volatility has prompted some unwinding of yen carry trades, although the yen still remains undervalued relative to medium-term fundamentals.

¹Various approaches for assessing an exchange rate's valuation relative to medium-term fundamentals are described in IMF (2006).

The renminbi has continued to appreciate gradually against the U.S. dollar, and its real effective exchange rate has risen modestly in recent months (Figure 1.7). Nevertheless, China’s current account surplus has widened further, and its international reserves have continued to soar, reaching \$1.4 trillion at end-August. Other emerging market countries have also faced strong foreign exchange inflows from both current and capital accounts, reflected in significant exchange rate appreciations in a number of countries and a rapid accumulation of international reserves that has driven strong domestic credit growth. Emerging market currencies generally weakened in July and August, in the context of turbulent global financial markets, but have since regained ground.

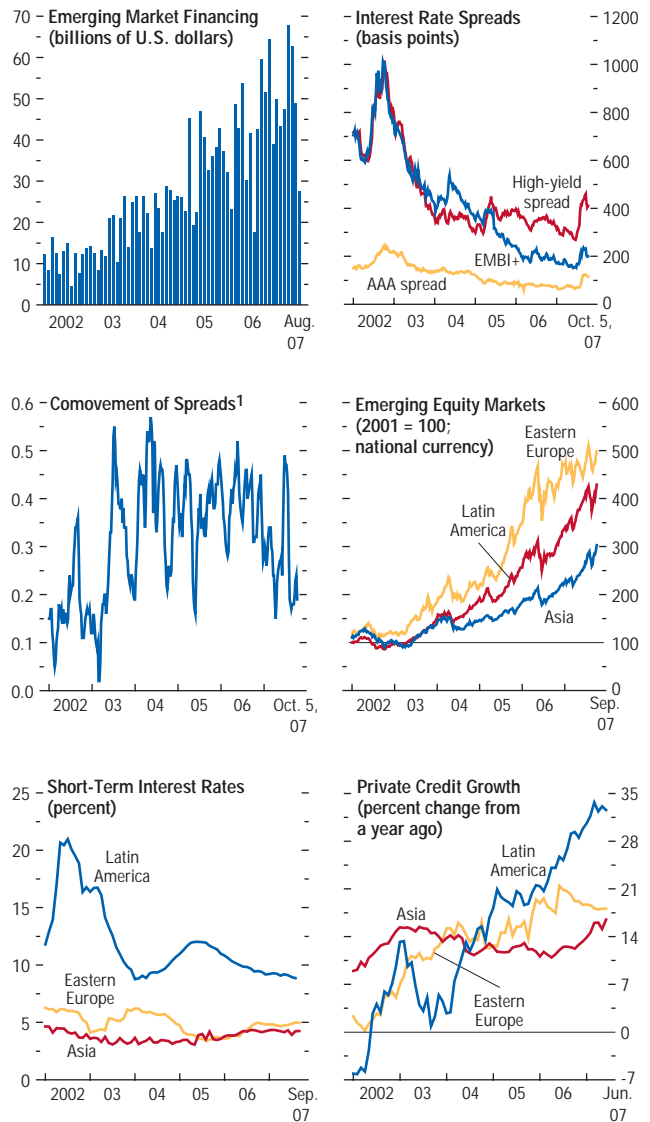
The Baseline Outlook Has Been Marked Down Moderately—And Downside Risks Have Intensified

In the face of turbulent financial conditions, the baseline projections for the global economy have been marked down moderately since the July 2007 *World Economic Outlook Update*, but growth nonetheless is expected to continue at a solid pace. According to the latest IMF forecast, global growth would slow to 5.2 percent in 2007 and 4.8 percent in 2008, down from the 5.4 percent rate registered in 2006 (Table 1.1 and Figure 1.8). The largest downward revisions to growth are in the United States and countries where financial and trade spillovers from the United States are likely to be largest (particularly Canada, Mexico, and parts of emerging Asia).

In the United States, growth is now projected to remain at 1.9 percent in 2008, a mark-down of almost 1 percentage point below the previous projections. Ongoing difficulties in the mortgage market are expected to extend the decline in residential investment, while higher energy prices, sluggish job growth, and weaker house prices are likely to dampen consumption spending. In the euro area, growth has been marked down to 2.1 percent in 2008, 0.4 percentage point lower than in July, reflecting lagged effects

Figure 1.5. Emerging Market Financial Conditions

Financial flows to emerging markets and private credit growth continued to be strong in the first half of 2007. Since July, more turbulent global financial market conditions have prompted some widening of bond yield spreads and a weakening of equity prices, but, generally, emerging market asset valuations remain near historic highs.

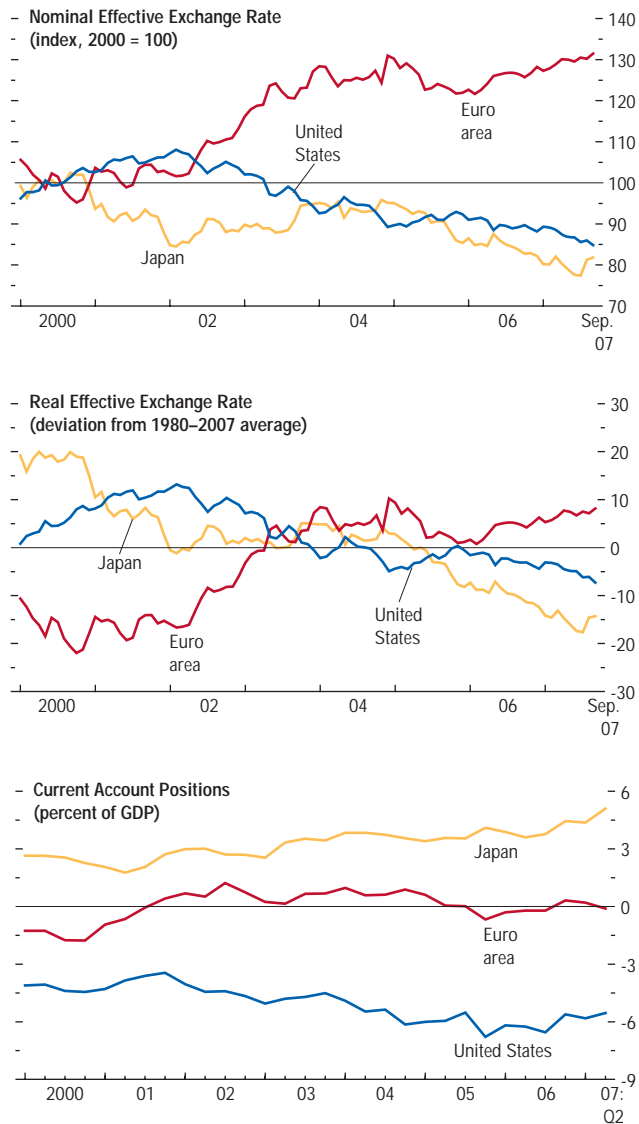


Sources: Bloomberg Financial Markets, LP; Capital Data; IMF, *International Financial Statistics*; and IMF staff calculations.

¹Average of 30-day rolling cross-correlation of emerging market debt spreads.

Figure 1.6. External Developments in Selected Advanced Economies

The U.S. dollar has continued to depreciate, while the U.S. current account deficit has come down moderately in recent quarters but remains close to 6 percent of GDP. The yen rebounded in August as turbulent financial conditions led to some reversal of carry trade flows. The euro has remained on an appreciating trend.



Sources: Haver Analytics; and IMF staff calculations.

of euro appreciation, trade spillovers from the United States, and more difficult financing conditions. In Japan, the growth projection has been reduced to 2 percent in 2007 and 1.7 percent in 2008 (0.6 and 0.3 percentage points lower than in July), reflecting the weaker-than-expected second quarter GDP outturn, slower global growth, and a somewhat stronger yen. Among emerging market and developing countries, growth is expected to remain very strong. The Chinese economy is now expected to grow by 10 percent in 2008, some 0.5 percentage point lower than in the July update.

The baseline projections assume that market liquidity is gradually restored in coming months and that the interbank market reverts to more normal conditions, although wider spreads would persist on riskier assets following a prolonged period of exceptionally low spreads, and lending standards would be tighter. These assumptions are consistent with experience following previous episodes of financial turbulence (Box 1.2). The baseline also assumes that the Federal Reserve cuts interest rates by a further 50 basis points by the end of the year, and the ECB and BoJ refrain from further interest rate increases through the end of the year.

On this basis, the IMF staff assessment is that sound fundamentals would continue to support solid global growth. In the advanced economies, sources of resilience include the strong balance sheets and capital positions of core financial institutions at the beginning of the recent episode, the high profitability and generally low leverage of the corporate sector, and the healthy situation in labor markets and household net wealth. Moreover, strong domestic demand growth in emerging market economies should continue to be a key driver of global growth, with more robust public balance sheets and policy frameworks providing scope for most countries to weather some weakening in external demand (Figure 1.9). Indeed, somewhat slower capital inflows from the torrid pace of the first half of 2007 may serve to ease concerns about excessive currency appreciation or too rapid credit growth.

However, the risks to the baseline forecast are distinctly to the downside. As shown in the fan chart in the upper panel of Figure 1.10, the IMF staff envisages a 1 in 6 chance of global growth falling to 3½ percent or less in 2008. The main sources of the increase in the downside risk since the July 2007 update come from deteriorating financial conditions and from the uncertain prospects for domestic demand in the United States and Europe, as shown in the lower panel of Figure 1.10. Risks to domestic demand in western Europe and Japan are now seen as somewhat to the downside and risks in emerging markets are seen as broadly balanced—previously the balance of risks in these economies was viewed as positive. By contrast, risks to the outlook from inflation concerns and oil market volatility are now somewhat less negative, as supply constraints and commodity market pressures would be reduced by some moderation in the pace of global growth. Risks related to persistent global imbalances remain a concern.

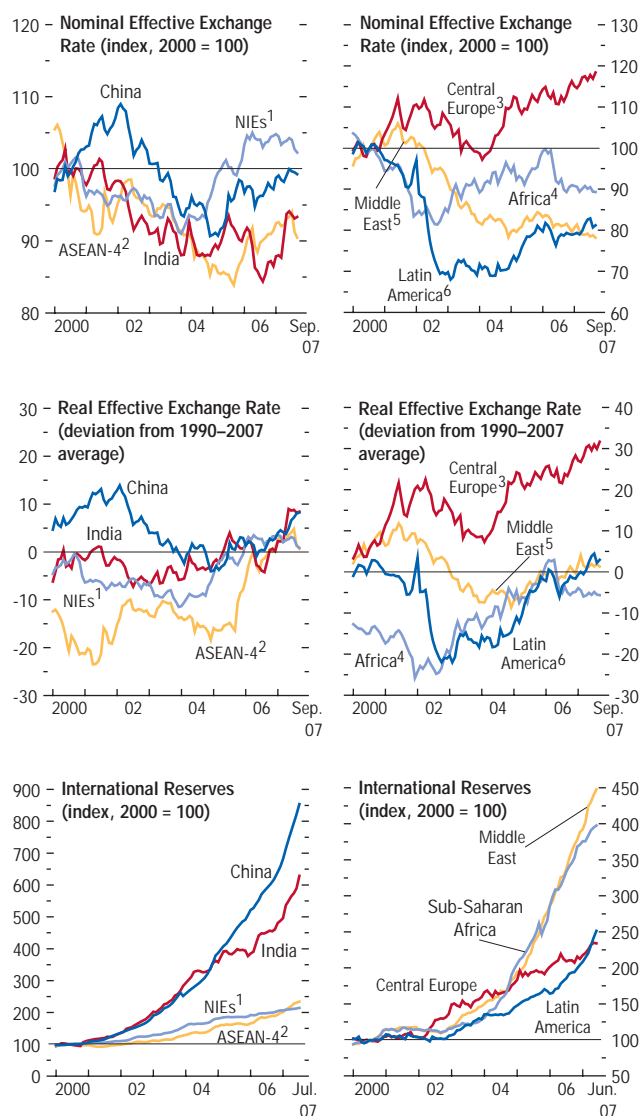
Financial Market Risks

Previous issues of the *World Economic Outlook* and the GFSR have expressed concern that heightened volatility and a widening of risk spreads from exceptionally low levels could have a significant dampening impact on economic activity. The manifestation of such risks in the recent period of financial turbulence is now reflected in some lowering of the baseline forecast. Nonetheless, financial market conditions remain a major source of downside risks to the global outlook. While the baseline assumes a return to more normal market conditions after a repricing of risk, there remains the distinct possibility that recent turbulent conditions could continue for some time and generate a deeper “credit crunch” than envisaged in the baseline scenario, with considerably greater macroeconomic impact.

As discussed in more detail in the October 2007 GFSR, recent financial market developments represent an inevitable return to greater market discipline after a period of very low

Figure 1.7. External Developments in Emerging Market and Developing Countries

Exchange rates in emerging market and developing countries have tended to appreciate, in the face of strong foreign exchange inflows and despite heavy intervention that has pushed reserves up to record levels.



Sources: IMF, *International Financial Statistics*; and IMF staff calculations.

¹Newly industrialized Asian economies (NIEs) include Hong Kong SAR, Korea, Singapore, and Taiwan Province of China.

²Indonesia, Malaysia, the Philippines, and Thailand.

³Czech Republic, Hungary, and Poland.

⁴Botswana, Burkina Faso, Cameroon, Chad, Republic of Congo, Côte d'Ivoire, Djibouti, Equatorial Guinea, Ethiopia, Gabon, Ghana, Guinea, Kenya, Madagascar, Mali, Mauritius, Mozambique, Namibia, Niger, Nigeria, Rwanda, Senegal, South Africa, Sudan, Tanzania, Uganda, and Zambia.

⁵Bahrain, Egypt, I.R. of Iran, Jordan, Kuwait, Lebanon, Libya, Oman, Qatar, Saudi Arabia, Syrian Arab Republic, United Arab Emirates, and Republic of Yemen.

⁶Argentina, Brazil, Chile, Colombia, Mexico, Peru, and Venezuela.

Table 1.1. Overview of the *World Economic Outlook* Projections
(Annual percent change unless otherwise noted)

	2005	2006	Current Projections		Difference from July 2007 WEO Update	
			2007	2008	2007	2008
World output	4.8	5.4	5.2	4.8	—	-0.4
Advanced economies	2.5	2.9	2.5	2.2	-0.1	-0.6
United States	3.1	2.9	1.9	1.9	-0.1	-0.9
Euro area	1.5	2.8	2.5	2.1	-0.1	-0.4
Germany	0.8	2.9	2.4	2.0	-0.2	-0.4
France	1.7	2.0	1.9	2.0	-0.3	-0.3
Italy	0.1	1.9	1.7	1.3	-0.1	-0.4
Spain	3.6	3.9	3.7	2.7	-0.1	-0.7
Japan	1.9	2.2	2.0	1.7	-0.6	-0.3
United Kingdom	1.8	2.8	3.1	2.3	0.2	-0.4
Canada	3.1	2.8	2.5	2.3	—	-0.5
Other advanced economies	3.9	4.4	4.3	3.8	0.1	-0.3
Newly industrialized Asian economies	4.7	5.3	4.9	4.4	0.1	-0.4
Other emerging market and developing countries	7.5	8.1	8.1	7.4	0.1	-0.2
Africa	5.6	5.6	5.7	6.5	-0.7	0.3
Sub-Saharan	6.0	5.7	6.1	6.8	-0.8	0.4
Central and eastern Europe	5.6	6.3	5.8	5.2	0.1	-0.2
Commonwealth of Independent States	6.6	7.7	7.8	7.0	0.2	-0.1
Russia	6.4	6.7	7.0	6.5	—	-0.3
Excluding Russia	6.9	9.8	9.4	8.1	0.6	0.3
Developing Asia	9.2	9.8	9.8	8.8	0.2	-0.3
China	10.4	11.1	11.5	10.0	0.3	-0.5
India	9.0	9.7	8.9	8.4	-0.1	—
ASEAN-4	5.1	5.4	5.6	5.6	0.2	-0.1
Middle East	5.4	5.6	5.9	5.9	0.5	0.4
Western Hemisphere	4.6	5.5	5.0	4.3	—	-0.1
Brazil	2.9	3.7	4.4	4.0	—	-0.2
Mexico	2.8	4.8	2.9	3.0	-0.2	-0.5
<i>Memorandum</i>						
European Union	2.0	3.2	3.0	2.5	-0.1	-0.3
World growth based on market exchange rates	3.3	3.8	3.5	3.3	-0.1	-0.4
World trade volume (goods and services)	7.5	9.2	6.6	6.7	-0.5	-0.7
Imports						
Advanced economies	6.1	7.4	4.3	5.0	-0.3	-1.0
Other emerging market and developing countries	12.1	14.9	12.5	11.3	-0.3	0.2
Exports						
Advanced economies	5.8	8.2	5.4	5.3	-0.1	-0.9
Other emerging market and developing countries	11.1	11.0	9.2	9.0	-1.5	-0.2
Commodity prices (U.S. dollars)						
Oil ¹	41.3	20.5	6.6	9.5	7.4	1.7
Nonfuel (average based on world commodity export weights)	10.3	28.4	12.2	-6.7	-2.3	1.1
Consumer prices						
Advanced economies	2.3	2.3	2.1	2.0	0.1	-0.1
Other emerging market and developing countries ²	5.2	5.1	5.9	5.3	0.5	0.6
London interbank offered rate (percent)³						
On U.S. dollar deposits	3.8	5.3	5.2	4.4	-0.2	-0.9
On euro deposits	2.2	3.1	4.0	4.1	0.2	0.4
On Japanese yen deposits	0.1	0.4	0.9	1.1	0.1	-0.1

Note: Real effective exchange rates are assumed to remain constant at the levels prevailing during August 22–September 19, 2007. See the Statistical Appendix for details on groups and methodologies.

¹Simple average of prices of U.K. Brent, Dubai, and West Texas Intermediate crude oil. The average price of oil in U.S. dollars a barrel was \$64.27 in 2006; the assumed price is \$68.52 in 2007 and \$75.00 in 2008.

²Excludes Zimbabwe; see Table 2.7 for more details.

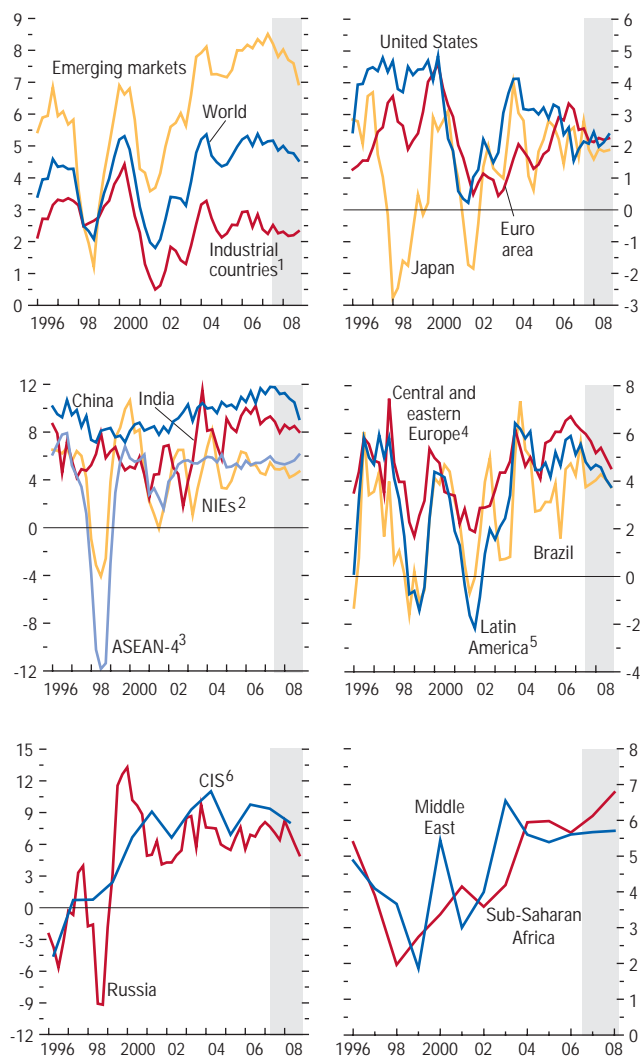
³Six-month rate for the United States and Japan. Three-month rate for the euro area.

risk spreads and lax credit conditions, which should ultimately strengthen the foundations of global growth. However, the correction has been extremely turbulent because of uncertainties about the distribution of valuation losses and the drying up of money market liquidity. As markets work their way through the repricing and the uncertainties are reduced, the initial strong capital and profitability of core financial institutions and the dispersion of losses across investors should limit systemic risks. Thus, the most likely outcome built into the baseline scenario is a gradual return to more normal market conditions after a repricing of credit risk and a tightening of credit standards. Some financial market segments are likely to shrink very substantially—notably the subprime mortgage market and riskier forms of asset-backed securitization—while risk spreads for nonprime corporate borrowing are likely to be persistently higher. However, the impact on interest rates for lower-risk borrowers may be quite limited. It is noteworthy that amid the turmoil, the effect on interest rates for conforming mortgage loans and high-grade corporate borrowers has been small, as some widening in spreads has been at least partly offset by lower benchmark government bond yields.

Nevertheless, at the time of writing, conditions in financial markets remain volatile, and the stress in credit markets may continue despite efforts by central banks to ensure adequate market liquidity and calm market sentiment. A key element of uncertainty is the extent to which a drying up of demand for securitized assets could drive the reintermediation of credit into the banking system, limiting capacity for new credit growth. Moreover, continued stress in interbank and other short-term funding markets could add to pressure on bank liquidity and profitability. Such an outturn could imply not only a sustained setback for riskier market segments, but also tighter credit conditions for even high-grade borrowers in the household and corporate sectors. Although the impact would likely be greatest in the United States and western Europe—where the use of, and investor exposure to, structured credits has been most

Figure 1.8. Global Outlook
(Real GDP; percent change from a year ago)

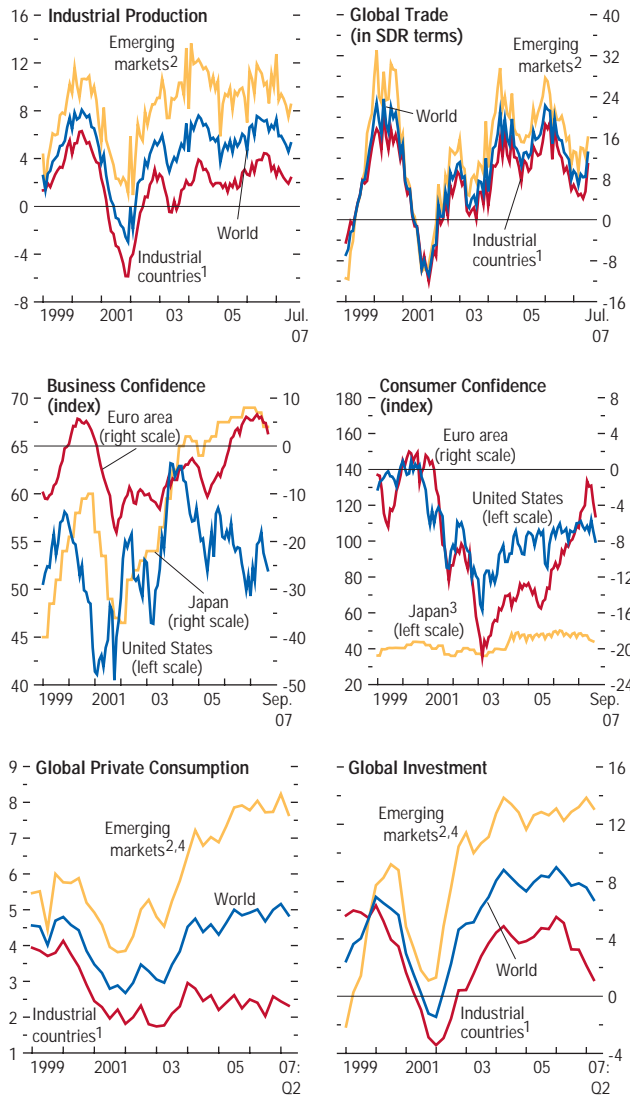
While projections have been marked down moderately to reflect the impact of recent financial market turbulence, output growth is still expected to be well sustained over 2007–08. Emerging market countries in Asia continue to lead the way, but all regions are expected to share in the strong performance.



Sources: Haver Analytics; and IMF staff estimates.
¹Australia, Canada, Denmark, euro area, Japan, New Zealand, Norway, Sweden, Switzerland, the United Kingdom, and the United States.
²Newly industrialized Asian economies (NIEs) include Hong Kong SAR, Korea, Singapore, and Taiwan Province of China.
³Indonesia, Malaysia, the Philippines, and Thailand.
⁴Czech Republic, Estonia, Hungary, Latvia, Lithuania, and Poland.
⁵Argentina, Brazil, Chile, Colombia, Mexico, Peru, and Venezuela.
⁶Commonwealth of Independent States.

Figure 1.9. Current and Forward-Looking Indicators
(Percent change from a year ago unless otherwise noted)

Industrial production and trade growth have moderated since 2006 as growth in the advanced economies has eased. Business and consumer confidence indicators have dipped recently but remain generally positive. Domestic demand continues to grow robustly in the emerging market economies.



Sources: Business confidence for the United States, the Institute for Supply Management; for the euro area, the European Commission; and, for Japan, Bank of Japan. Consumer confidence for the United States, the Conference Board; for the euro area, the European Commission; for Japan, Cabinet Office; and, for all others, Haver Analytics.

¹Australia, Canada, Denmark, euro area, Japan, New Zealand, Norway, Sweden, Switzerland, the United Kingdom, and the United States.
²Argentina, Brazil, Bulgaria, Chile, China, Colombia, Czech Republic, Estonia, Hong Kong SAR, Hungary, India, Indonesia, Israel, Korea, Latvia, Lithuania, Malaysia, Mexico, Pakistan, Peru, the Philippines, Poland, Romania, Russia, Singapore, Slovak Republic, South Africa, Taiwan Province of China, Thailand, Turkey, Ukraine, and Venezuela.
³Japan's consumer confidence data are based on a diffusion index, where values greater than 50 indicate improving confidence.
⁴Data for China, India, Pakistan, and Russia are interpolated.

extensive—the effects could be felt more widely, given growing cross-border linkages across the global financial system.

Moreover, other sources of financial risk could be exposed by sustained volatile conditions. So far, emerging markets have generally been less affected by recent turbulence in the advanced economies than in past episodes beyond a few countries that were affected by a reversal of short-term flows. However, a number of countries have become dependent on large external financing inflows, including some emerging European and Commonwealth of Independent States (CIS) countries. In these countries, promising growth prospects have generated large foreign direct investment (FDI) inflows, but also bank flows and international bond issuance often denominated in foreign currencies, which have been used to finance credit booms and rapid growth in consumption. These flows could be jeopardized by a fuller repricing of risk and tightening of lending standards, and a general increase in risk aversion in the context of continued turbulent conditions.

Risk to Domestic Demand in the United States

In the baseline projections, the U.S. economy is now expected to maintain only moderate growth through the end of 2008. However, the balance of risks to domestic demand has shifted further to the downside, as recent financial developments have raised the risk of more protracted problems in the housing sector that could start having a deeper impact on the rest of the economy.

The correction in the U.S. housing sector, which has now been under way for two years, has been a major drag on activity as the drop in residential investment alone has taken nearly 1 percentage point off GDP growth in the past year. The baseline forecast for the U.S. economy already envisages that the housing correction will continue well into 2008. Inventory-to-sales ratios remain exceptionally high; conditions for mortgage financing have now tightened beyond the subprime sector, including for Alt-A and

jumbo prime mortgages; and delinquency rates are expected to continue rising as interest rates on adjustable rate mortgages are reset upward. However, although consumption will be slowed, it is projected to remain resilient, provided that key supports—low unemployment and high household wealth—remain in place.

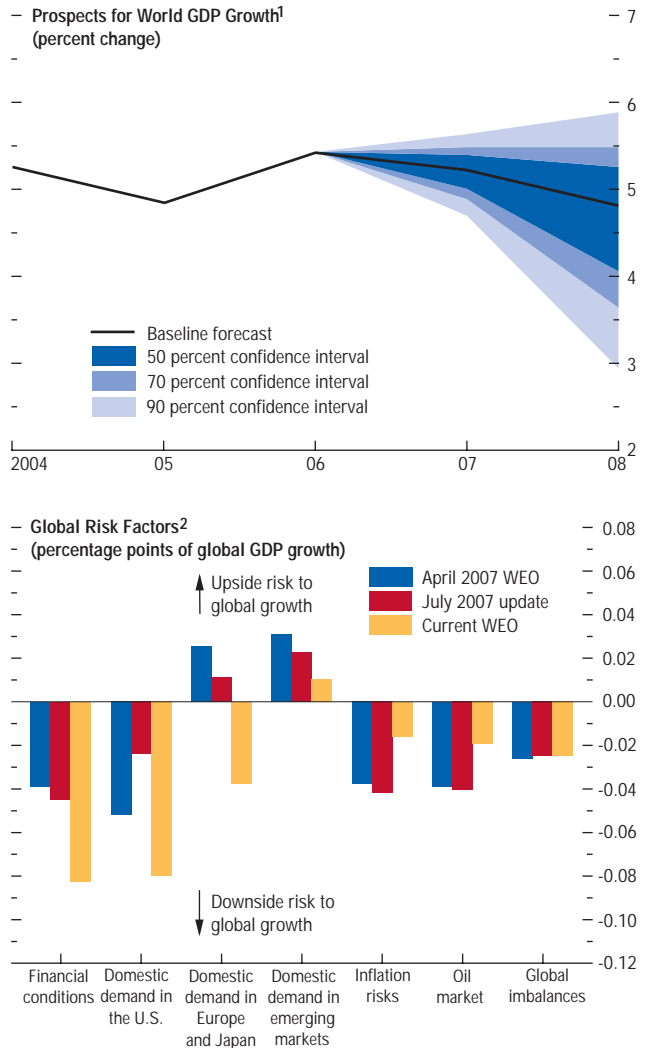
However, downside risks to U.S. domestic demand have clearly risen. The concern is that tightening credit availability would affect a broader range of households and further curtail effective demand for housing, while also adding to the supply as foreclosures rise and sales fall through. The baseline projections already build in a further 5 percent decline in house prices, but the decline could be sharper, adding to difficulties of refinancing and weakening household balance sheets, with a dampening impact on consumption as well as residential investment. A more general deterioration in labor market conditions or a sustained drop in the stock market would also make it more difficult for households to absorb the impact of housing-related difficulties. Against this background, risks of a recession have risen, although the Federal Reserve would be expected to respond quickly by easing monetary policy further in the face of signs of rising weakness, and the more likely outcome would seem to be a more prolonged period of subpotential growth.

Risk to Domestic Demand in Western Europe and Japan

Notwithstanding the downward revision to the baseline forecast, risks to domestic demand in western Europe and Japan have now shifted to the downside, particularly in the event of continuing financial turbulence. Western Europe has been impacted directly by contagion from the turmoil in the U.S. subprime mortgage sector, as a number of banks have been affected by their involvement in the housing sector, including through off-balance-sheet vehicles supported by backup lines of credit and difficulties in funding markets. Although actions by the ECB and the Bank of England have helped to address

Figure 1.10. Risks to the Global Outlook

Risks to the global outlook have moved squarely to the downside. The largest adverse risks relate to global financial conditions and domestic demand in the United States and western Europe.



Source: IMF staff estimates.

¹The fan chart shows the uncertainty around the *World Economic Outlook* (WEO) central forecast with 50, 70, and 90 percent probability intervals. As shown, the 70 percent confidence interval includes the 50 percent interval, and the 90 percent confidence interval includes the 50 and 70 percent intervals. See Box 1.3 in the April 2006 *World Economic Outlook* for details.

²The chart shows the contributions of each risk factor to the overall balance of risks to global growth, as reflected by the extent of asymmetry in the probability density for global GDP growth shown in the fan chart. The balance of risks is tilted to the downside if the expected probability of outcomes below the central or modal forecast (the total "downside probability") exceeds 50 percent (Box 1.3 in the April 2006 *World Economic Outlook*). The bars for each forecast vintage sum up to the difference between the expected value of world growth implied by the distribution of outcomes (the probability density) shown in the fan chart and the central forecast for global GDP growth. This difference and the extent of asymmetry in the probability density in the fan chart also depend on the standard deviation of past forecast errors—which, among other factors, varies with the length of the forecasting horizon. To make the risk factors comparable across forecast vintages, their contributions are rescaled to correct for differences in the standard deviations.

Box 1.1. Who Is Harmed by the Surge in Food Prices?

Over the past year, prices of some food products—notably corn, soybeans, and wheat—have risen substantially. The boom in nonfuel commodity prices, including food, was discussed in the September 2006 issue of the *World Economic Outlook*. This box reexamines the impact of the food price surge in light of the increased use of some food items as a source of fuel (see Box 1.6)—a development that could substantially alter the structure of demand for food products. These developments are of particular significance for low-income countries, given the large exposure of their populations to fluctuations in food prices.¹ Specifically, this box aims at

- identifying the factors behind the recent rise in food prices,
- gauging the impact on net trade and inflation across different regions, and
- providing some policy assessment.

Impact on Trade Balances

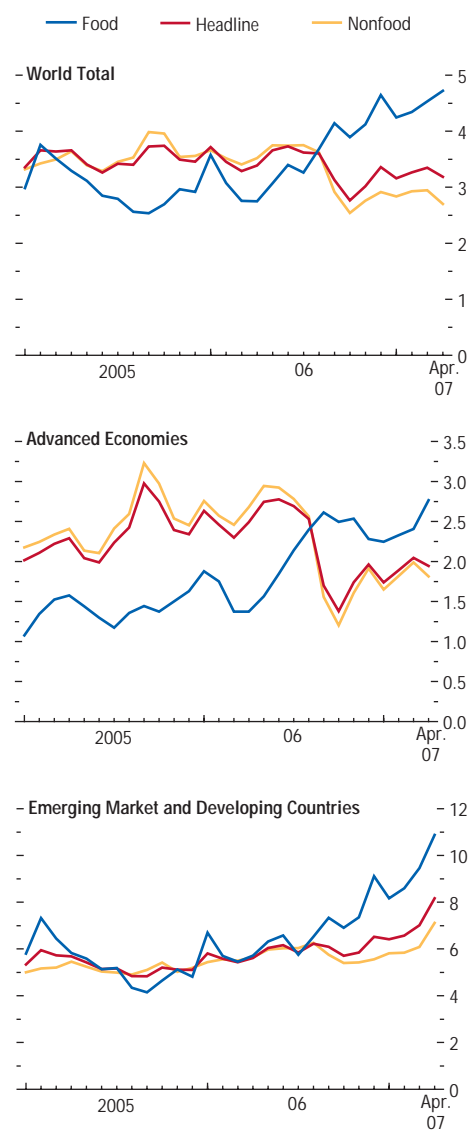
For many economies, food represents a significant share of export receipts or import payments. Thus, higher food prices can have a significant impact on a country's net trade balances.² A number of food-exporting countries in the Western Hemisphere—such as Argentina, Bolivia, and Chile—and in southern Africa—such as South Africa, Namibia, and Swaziland—have benefited from higher food prices since 2002. However, many of the poorer regions of Africa—for example, Benin, Cape Verde, Ghana, and Niger—and a number of countries in Asia—including Bangladesh, China, Nepal, and Sri Lanka—as well as in the Middle East are net losers. Among advanced

Note: The authors of this box are Kevin Cheng and Hossein Samiei. Research assistance was provided by Murad Omoev.

¹Factors underpinning the recent food price boom are discussed in Appendix 1.1.

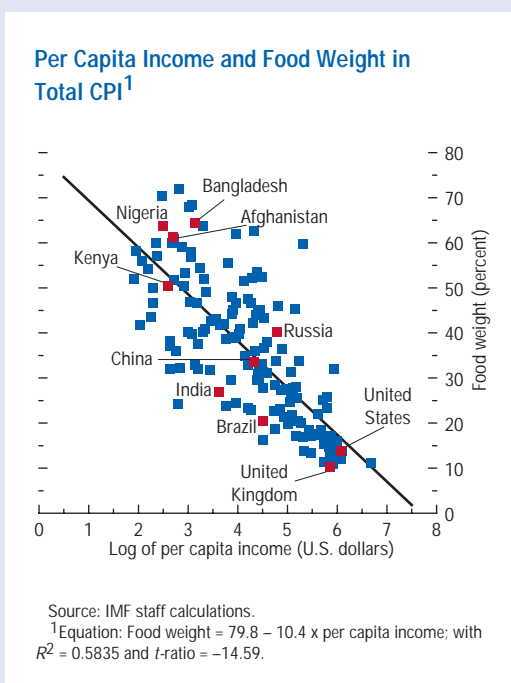
²Based on commodity weights obtained from COMTRADE, the exercise calculates the first-round cumulative impact of movements in food prices on trade balances relative to the base year (2002), assuming that trade patterns remain unchanged.

Headline, Food, and Nonfood Inflation
(Twelve-month percent change, January 2005–April 2007)



Source: IMF staff calculations.

economies, Canada, the United States, Australia, and New Zealand are among the gainers from higher prices.



Impact on Inflation

Higher international food prices put upward pressure on the cost of living, both directly and through their potential impact on nonfood prices. Average domestic food price inflation (defined as the purchasing-power-parity-weighted aggregate of an individual country's domestic food price inflation) rose to about 4½ percent in the first four months of 2007 from about 3 percent over the same period in 2006 (first figure). The figure is more than 9 percent for developing countries (excluding Zimbabwe and other countries with insufficient data).

To analyze the impact of food prices on headline inflation across regions, two methodologies are followed: inflation accounting to calculate the direct impact and econometric analysis to estimate the indirect impact through spillovers to nonfood prices.

Direct effect. For many developing countries, food accounts for a significant share of total consumer expenditure and the headline CPI. Indeed, the share across countries tends to be negatively correlated with income levels (second

Direct Impact of Food Prices on Headline Inflation

	2000–06 Contribution (percent)	2007 ¹ Contribution (percent)
World	26.6	36.4
Advanced economies	14.2	18.4
Africa	46.5	37.9
CIS	41.3	26.9
Developing Asia	34.1	55.9
Central and Eastern Europe	29.9	33.0
Middle East	37.4	52.2
Western Hemisphere	25.6	37.2

Sources: Country authorities; and IMF staff calculations.
¹January–April.

figure). For example, the weight of food in the consumption basket averages more than 60 percent in sub-Saharan Africa, whereas it is about 30 percent in China, and only 10 percent in the United States.³

The direct first-round contribution of food to inflation⁴ for the world as a whole has risen from about ¼ in 2000–06 to more than ½ in the first four months of 2007 (table and map). It has risen quite drastically in developing Asia, with the contribution in China, at more than ¾, being among the largest. The contribution has also risen in most other developing regions. In Africa it has fallen, but remains high, in part reflecting earlier price hikes associated with adverse weather conditions—for example, in East Africa in 2006.

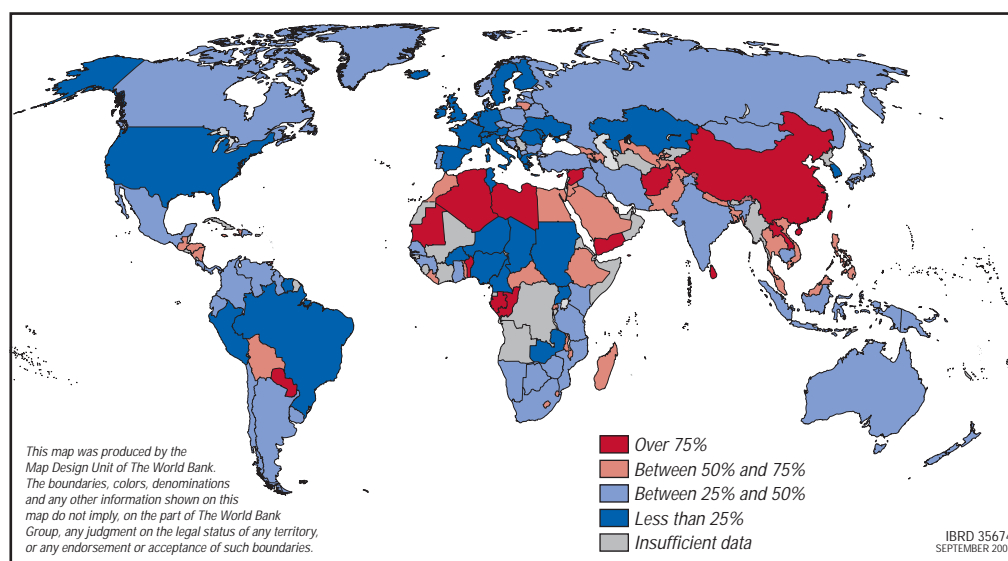
Indirect effect. Food prices could also increase headline CPI indirectly by raising nonfood prices—for example, through a wage response to higher food prices—especially in poorer countries in which food accounts for a sizable share of total household expenditure. A VAR

³These weights may overestimate the true consumption of food in some countries, owing to the time it takes to revise them.

⁴The contribution is calculated as the share of food in the CPI multiplied by food price inflation divided by headline inflation. In calculating the contribution, food price and headline inflation were first aggregated across regions. The direct contribution assumes no change in consumption patterns in response to changes in prices.

Box 1.1 (concluded)

Contribution of Food Inflation to Headline Inflation (January–April 2007, Year on Year)



model is estimated using monthly data to illustrate the indirect effect for 10 selected countries from different income groups: Switzerland, the United Kingdom, and the United States for advanced economies; Brazil, China, India, and Russia for emerging markets; and Kenya, Tanzania, and Uganda for low-income countries. The models consist of three endogenous variables: domestic food and nonfood annual price inflation, and annual rate of change in broad money; and two exogenous variables: international food and energy annual price inflation. The idea is to capture the impact of food prices on nonfood prices after controlling for other possible factors (for which monthly data are available):⁵

⁵The models use monthly observations for January 1995–April 2007. Optimal lags are chosen based on the Schwarz Information Criteria. We use Pesaran's generalized impulse responses, which do not require an ordering of the endogenous variables. The estimation results and impulse responses for the 10 countries will be available on the *World Economic Outlook* website.

- for the three advanced economies, based on the generalized impulse response functions, food price inflation does not appear to have a discernible impact on nonfood inflation;
- for the four emerging market economies, except for India, the results suggest a significant impact: a 1 percentage point temporary increase in food price inflation may raise nonfood price inflation in the range of 0.1–0.6 percentage point, with the effect disappearing only after six months to a year; and
- similarly, for the three low-income economies, food prices appear to be a significant determinant of nonfood inflation. A 1 percentage point temporary increase in food price inflation may raise nonfood price inflation in the range of 0.1–0.9 percentage point, with the effect sustained up to a year.

These results illustrate the likely impact of higher food prices on nonfood prices across different regions, but—given the small number of countries in the sample and the simple model used—further research is needed to provide more solid global evidence.

Other Effects

Higher food prices could have other macroeconomic and distributional effects.

- An inflation-targeting central bank may have to curb inflationary pressure from higher food prices when the effect on nonfood prices is significant. As noted above, this is likely to be a more serious problem for developing countries, where feed-through to nonfood prices is more pronounced. For example, interest rates have been raised recently in China (in August), Mexico (in May), and Chile (in July) in part to preempt the potential impact of higher food prices. In China, soaring domestic meat prices have further boosted food price inflation, pushing up headline inflation to 6.5 percent in August.
- Higher food prices are also likely to adversely affect income distribution within a net-food-importing economy, because food tends to absorb a greater share of expenditure for poorer people. Indeed, the World Food Program recently warned that, as a result of the increases in food prices, its purchasing costs have risen by almost 50 percent in the past five years, thereby making it difficult to afford to feed the same number of people that it has helped in the past.

Concluding Remarks and Policy Implications

The use of food as a source of fuel may have serious implications for the demand for food if the expansion of biofuels continues: income elasticity of demand will likely increase; and although supply will respond to the surge in

demand, the catch-up period may be prolonged.⁶ Technological advances in both food and biofuel production will mitigate the long-term effects on food supply-demand balances, but the developments already warrant a reexamination of policy frameworks and may call for coordination at the international level:

- One country's policy to promote biofuels while protecting its farmers could increase another (likely poorer) country's import bills for food and pose additional risks to inflation or growth. This impact would be mitigated if the United States and the EU biofuel-producing countries reduced barriers to biofuel imports from developing countries (such as Brazil) where production is cheaper, more efficient, and environmentally less damaging (see Box 1.6). Such a shift in policies could also provide opportunities for other developing countries with potential comparative advantage in producing biofuels to enter the industry.
- In many countries, monetary policy decisions focus on core inflation, because food price movements are often erratic, supply driven, and have transient effects on overall inflation. However, central banks—particularly in developing countries where food prices do significantly affect nonfood prices—will need to monitor food prices carefully and respond quickly if food price movements are threatening achievement of inflation goals.

⁶In the case of sugar production in Brazil, supply responded strongly to higher demand for ethanol production in 2005–06, which led to a subsequent fall in prices.

systemic concerns, credit spreads have widened, uncertainty has increased, and the impact on domestic demand could turn out to be substantially larger than already incorporated in the revised baseline forecasts.

One particular area of downside risk relates to the housing market in western Europe. Housing markets have boomed in a number of fast-growing economies, most notably Ireland,

Spain, and the United Kingdom, with rapid price rises and sharp increases in residential investment relative to GDP exceeding even those observed during the U.S. housing boom (see Box 2.1 in Chapter 2). The steady increase in policy interest rates has already contributed to some cooling of these housing booms, and recent developments are likely to have a further dampening impact, particularly if credit

Box 1.2. Macroeconomic Implications of Recent Financial Market Turmoil: Patterns from Previous Episodes

How could the recent period of financial turmoil affect global growth? This box aims to shed some light on this issue by comparing current events with four previous episodes of financial market stress: the U.S. stock market crash of 1987; the Russian debt default and collapse of Long-Term Capital Management (LTCM) in 1998; the “dotcom” crash of 2000; and the aftermath of the September 11, 2001, terrorist attacks. The obvious similarity across all of these episodes is a sudden and widespread increase in uncertainty and difficulty of judging risks. Also, often, but not always, these episodes were accompanied by a drying up of liquidity. But the fundamental causes of these episodes, the policy reactions to them, and their impact on growth and employment show significant differences.

Episodes of financial market turbulence can be analyzed by tracing the evolution of key variables around these events (first figure).¹ At first glance, the current episode appears similar to previous episodes, with an increase in investor risk aversion, characterized by heightened market volatility and a flight to safer assets. In some ways, market movements have been more limited in this episode. Despite an increase in volatility in equity markets, the declines in equity prices in the United States and the rest of the world have, so far, been smaller than in previous episodes. Spreads on high-yield corporate paper and mortgage-backed securities have risen, but have remained at or below historical averages. Spreads on emerging market sovereign bonds have been less affected than in other episodes, reflecting the origin of the current distress and reduced external vulnerabilities of emerging market countries.

Note: The main author of this box is Alasdair Scott.

¹In the figures in this box, the 1987 crash is centered on October 19, 1987, when the Dow Jones Industrial average fell dramatically; the Russian default/LTCM episode is centered on August 17, 1998, the day of the Russian default and devaluation; the dotcom crash is centered on March 13, 2000, the day after the peak of the NASDAQ index value; the 9/11 episode is centered on September 11, 2001; and the current episode is centered on July 26, 2007, the first major fall in stock markets worldwide.

It is more worrying, however, that the disruption to money markets and interbank operations seems more severe than in recent episodes. This is displayed in the sharp rise in the TED spread—the difference between the eurodollar rate, the rate at which banks lend to each other in the eurodollar market, and the risk-free treasury bill rate, particularly at three-month maturity. There has also been a large rise in the spread between monetary policy rates and interbank lending rates. This disruption, which has persisted despite heavy liquidity injections by major central banks, seems to reflect a combination of banks’ desire to hoard their own liquidity in the face of possible calls on their lending capacity and heightened perceptions of counterparty risk in the context of continuing uncertainty about the distribution of losses from the financial turbulence.

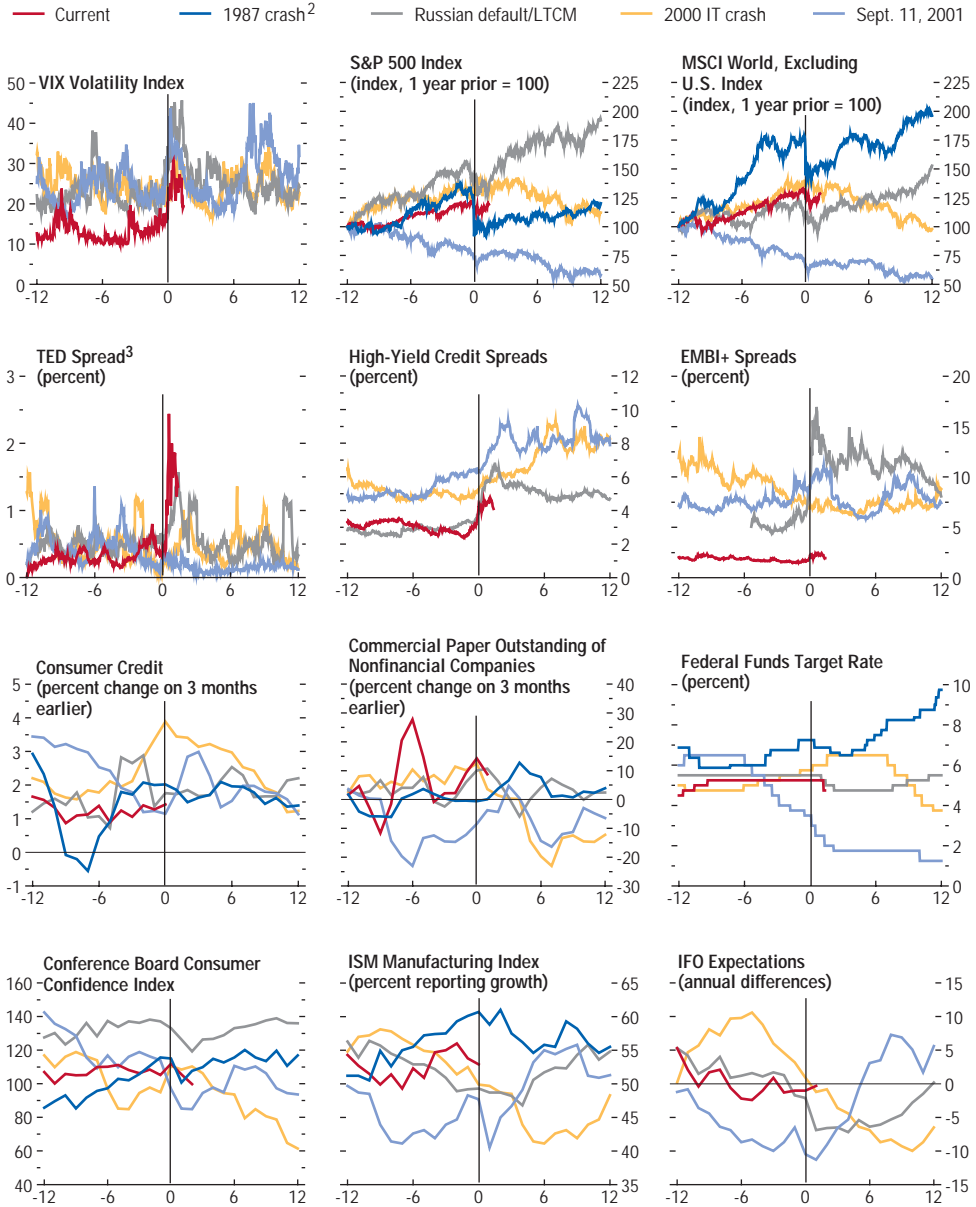
A key question is how the turbulence in financial markets is likely to spill over into the wider economy. Two channels appear to be at work during crisis episodes: a first whereby households and firms face a higher cost of and/or restrictions on financing activity, and a second “confidence” channel, which may suppress aggregate demand because of greater caution about the future.

Evidence from previous episodes suggests that increases in spreads and restrictions on credit are likely to be persistent, and could have a moderating influence on consumption and investment. There are two particular factors in this episode that could increase the macroeconomic impact. The first is the potential for a rolling back of the rapid rise in securitization seen in recent years as investors took on more risk in a “search for yield.”² Second, the banking system’s capacity to re-intermediate credit

²For example, between 2000 and 2006, assets under management by hedge funds increased by over 250 percent. Issuances of credit derivatives, collateralized debt obligations, and mortgage- and asset-backed securities have experienced even greater growth in this period, all consistent with a rise in leverage in a quest for yield. See the April 2007 *Global Financial Stability Report*, pp. 50–57.

Recent Market Volatility in Perspective¹

(Months before and after event on x-axis)



Sources: Bloomberg LP; Haver Analytics; and IMF staff calculations.

¹All series for the United States, except the MSCI World stock index, the EMBI+ emerging markets index, and the German IFO business expectations series. IT = information technology.

²Not all data series are available for this episode.

³Defined as the difference between rates on three-month eurodollar deposits and on three-month treasury bills.

Box 1.2 (concluded)

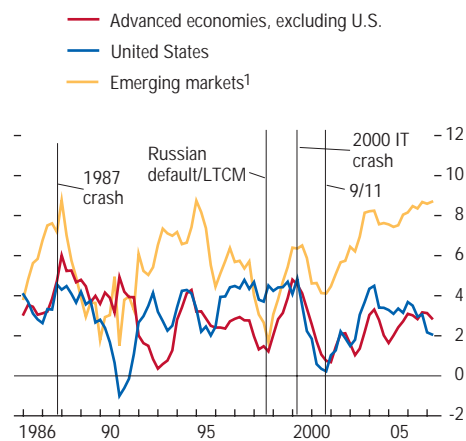
flows onto its balance sheets may be limited by constraints on bank capital and by losses already incurred in the present turbulence. For both of these reasons, the impact on economy-wide credit availability may go considerably beyond the repricing of risk.

Consumer and business confidence in the United States has typically fallen following previous episodes of financial turbulence, and measures of foreign confidence often follow U.S. measures. But previous episodes also show that such indicators can recover quickly, such as during the stock market crash of 1987 and the Russian default/LTCM case. In most cases, an important factor helping to bolster confidence was swift action by the central bank to ease the monetary stance. The exception was in 2000 when the Fed continued to raise interest rates for another six months after the NASDAQ peaked, and only started to ease the rates nine months later; confidence measures did not pick up until approximately one year later. This time, the Fed has cut interest rates by 50 basis points, and financial markets expect interest rates to be cut by a further 50 basis points by early next year.

What then were the effects of previous episodes of financial market turbulence on activity? Output growth in the United States actually picked up after the 1987 and 1998 episodes, and was largely unaffected in 2001 (second figure). In 1987, 1998, and 2001, the Fed cut interest rates quickly. Moreover, the events of 1998 and 2001 were initiated by events outside the U.S. financial system. By contrast, the bursting of the information technology bubble in 2000 preceded a short recession and a long bear market, perhaps because the financial turbulence was related to a fundamental reevaluation of prospects for profitability; notwithstanding the eventual application of strong monetary and fiscal stimulus, it took some time for demand to regain momentum and asset values to return to more typical ratios to earnings.³

³Activity in the rest of the world has generally followed that in the United States. The IMF staff analysis in the April 2007 *World Economic Outlook* found

Real Output Growth During Previous Episodes (Percent)



Sources: IMF staff calculations.

¹Aggregate comprises 27 emerging market and developing countries.

In summary, with the exception of disruption to money markets, recent financial market turbulence has not been unusually large compared with previous episodes. Moreover, past periods of financial retrenchment have not always presaged slower economic activity—in three out of the four previous episodes considered here, growth accelerated, helped by easier monetary policy. However, there are at least three reasons why the macroeconomic implications of recent events may yet be larger than what these earlier experiences suggest.

significant spillovers from growth rates of U.S. output to those in the rest of the world. Moreover, previous work has noted that U.S. house price movements lead world house prices—see the September 2004 *World Economic Outlook*, p. 87. Recent work by IMF staff has identified financial conditions as the major conduit for the transmission of shocks from the United States to the rest of the world. (See Bayoumi and Swiston, 2007, who argue that short-term interest rates are the most important factor in the spillover mechanism, but real equity prices and nominal government bond yields are also important.)

First, recent financial developments have been associated with, and may exacerbate, an ongoing correction in the U.S. housing market, which could continue to exert substantial drag on the economy. Second, continuing uncertainty and loss of confidence in structured

credits could lead to a sustained retrenchment in securitization. Third, the current turbulence has placed strains on banking systems in the United States and elsewhere, which could further exacerbate constraints on the availability of credit.

availability were to be tightened. Given that rapid increases in some countries have raised concerns about possible excesses, some cooling seems desirable, if it does not go too far too fast. But could a housing correction in western Europe be as deep as in the United States? The analysis in Box 2.1 suggests that the extent of house price overvaluation may be considerably larger in some national markets in Europe than in the United States, and there would clearly be a sizable impact on the housing markets in the event of a widespread credit crunch. Nevertheless, there are moderating factors. First, housing markets in western Europe have generally avoided subprime mortgage origination and the deterioration of lending standards observed in the United States. Second, a number of country-specific structural factors, including strong immigration and supply constraints, are likely to continue to support housing sectors in particular national markets.

In the case of Japan, the direct financial exposure to the U.S. subprime mortgage sector is much more limited. However, recent indicators of activity suggest a weakening of momentum, and consumption and investment could be affected if the recent global financial turmoil intensifies and undermines confidence.

Risks to Emerging Market Countries

Risks to domestic demand growth in emerging market countries are now viewed as being modestly to the upside overall. China and India maintained a strong growth momentum in the first half of 2007, but further upside surprises remain possible. In particular, it remains

unclear to what extent policy tightening in both countries will prove effective in cooling robust demand growth that has raised concerns about overinvestment (particularly in China) and overheating (particularly in India).

Nevertheless, there are considerable downside risks in some countries. The main one is that continued turbulence in global financial markets could disrupt financial flows to emerging markets and trigger problems in domestic markets. As already mentioned, countries in emerging Europe and the CIS with substantial current account deficits and reliance on bank-related inflows for financing would seem to be at particular risk, especially given concerns that credit booms have fueled a deterioration in credit quality and run-ups in house prices. Elsewhere, emerging market countries in Asia and Latin America would generally seem much less vulnerable than in the past to tighter conditions in international credit markets, given their high levels of international reserves, stronger public sector balance sheets, and improved macroeconomic management. However, growth in these countries would be vulnerable to spillover effects from slower aggregate demand growth in the advanced economies, including through the dampening effect on prices of commodity exports. Other downside risks relate to supply constraints in specific countries—such as emerging energy shortages in Argentina and production problems in a number of oil exporters, such as Nigeria.

Inflation Pressures

Recent buoyant global activity and rising commodity prices raise the concern that tightening

resource constraints could put upward pressure on inflation and prompt central banks to tighten monetary conditions more aggressively than has been built into the projections. Such concerns have taken a backseat in the advanced economies since the recent bout of financial market turbulence, but even under a somewhat slower growth track than previously envisaged, the assessment of the extent of inflationary risks remains a key factor affecting central banks' judgments in setting the policy stance. In the emerging market and developing countries, inflation risks are more immediate.

Commodity markets have been the most obvious source of recent upward pressure on prices. Strong growth of demand has kept oil and metals prices at high levels since 2006, while food prices have also spiked upward. Despite recent financial turbulence, supplies remain tight, and this area remains an important source of risk. The concern is particularly acute in emerging market and developing countries where food often represents 35–40 percent of consumption baskets and the credibility of monetary policy regimes is less well established, increasing the likelihood that rising food and energy costs could affect inflation expectations and feed into other prices and wages.

A second source of inflationary pressures comes from closing output gaps more broadly. Product markets for manufactured goods were a disinflationary force until recently, as rapid productivity growth, especially in East Asian exporters, and spare capacity that opened up after the global downturn in 2000–01 led to declining nonfuel import prices in the advanced economies. However, over the past three years, this tide has reversed, as sustained growth has closed output gaps, not only in the advanced economies but also in emerging market countries (Figure 1.11).² As

²Output gaps are notoriously difficult to measure, except with the benefit of considerable hindsight. Figure 1.11 shows a simple aggregate measure of the output gap, based on a Hodrick-Prescott times series technique for estimating potential output. It also shows alternative measures of the gap based on estimates of the nonaccel-

a result, a number of emerging market countries are facing overheating risks, which could also affect inflation pressures in the advanced economies coming from rising nonfuel import prices. However, such risks would clearly be alleviated in the event of a significant global slowdown.

Another concern is that labor market pressures could intensify in the advanced economies if a combination of sluggish productivity and rising compensation led to an acceleration of unit labor costs. So far in the present cycle, such concerns have been focused on the United States—which is further along the cycle and where productivity growth has come down to its slowest pace since the early 1990s (Figure 1.12). While much of this slowdown is likely to be cyclical, part of the recent performance may reflect some moderation in the burst of productivity growth from the application of new information technologies from the 1990s onward. At the same time, employee compensation has risen. Thus, overall unit labor costs have accelerated, although not yet to the point of posing a serious threat, given that U.S. growth is likely to remain moderate and that high corporate profit margins provide firms some leeway to limit feed-through of rising costs to price increases. In the euro area and Japan, meanwhile, unit labor costs have been contained, because productivity performance has been favorable, particularly in the euro area, and compensation has shown few signs of acceleration, despite declines in unemployment rates to cyclical lows. Thus, concerns about labor cost pressures at this point are still largely forward looking, related to the possibility of accelerating wage growth if labor markets continue to tighten.

Tight Oil Markets

Global oil markets remain very tight, and with spare capacity still limited, supply shocks or heightened geopolitical concerns could

erating inflation rate of unemployment (NAIRU) and of capacity utilization in the manufacturing sector.

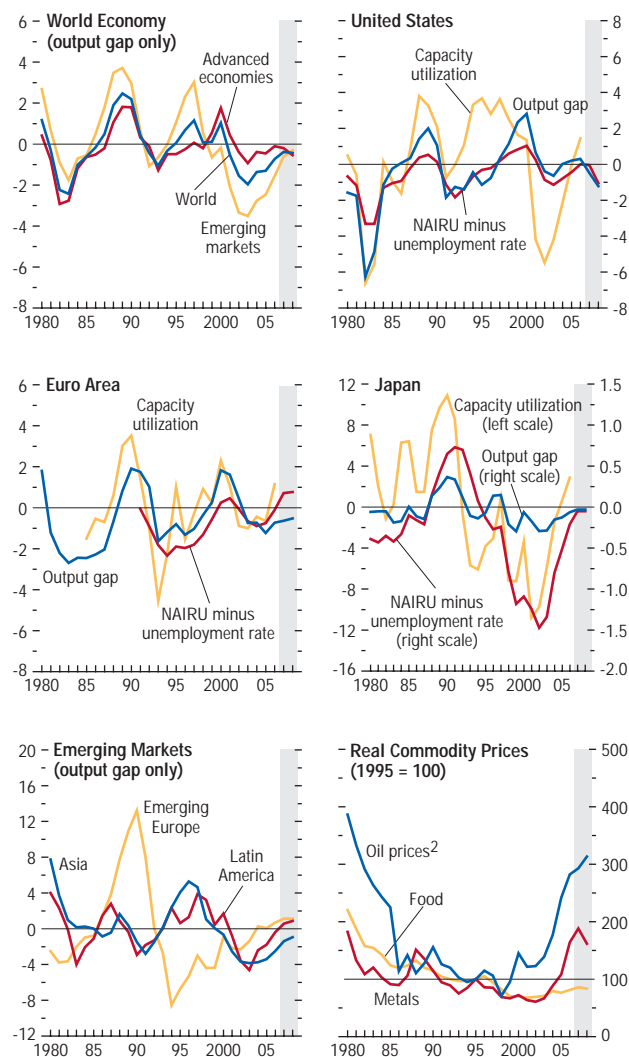
lead to further price spikes that could quickly translate into higher headline inflation (see Appendix 1.1). The subsequent impact on output may be more subdued than in the 1970s, because economies are less energy intensive and greater monetary policy credibility has anchored inflation expectations more securely (see discussion in Box 1.1 of the April 2007 *World Economic Outlook*). Thus far, the global economy has been able to absorb the sustained run-up in oil prices over the past five years without major impact. Nevertheless, while OPEC's capacity has expanded (in particular in Saudi Arabia) and the Gulf states are embarking on massive investments, the overall supply response to the recent higher level of prices has been sluggish so far, in part because rising demand has pushed up the price of investment in new capacity in the oil sector and because of uncertainties about the investment climate in certain oil producers. Moreover, demand for oil products has continued to rise, especially in fast-growing emerging market countries, and shortages of refining capacity are an increasing constraint. Thus, the dip in oil prices in the second half of 2006 proved temporary, and prices rose to new highs by the summer of 2007. At this point, markets are expecting that prices will remain around their current level through the end of 2008, but uncertainty remains high, and options prices suggest a 1 in 6 chance of prices rising above \$95 a barrel over this period.

Global Imbalances

Persistent large global imbalances remain a worrisome downside risk for the global economy. The U.S. current account deficit is projected to decline slightly to 5½ percent of GDP this year and next, as it benefits from recent real effective depreciation of the U.S. dollar and a more balanced pattern for global demand growth. Nevertheless, assuming no further changes in real effective exchange rates and with current policies, the U.S. deficit would still remain close to this level in 2012—equivalent

Figure 1.11. Measures of the Output Gap and Capacity Pressures¹

Various measures of the output gap suggest that the gap has been closing in both advanced and emerging market economies. Another indicator of supply pressures is that commodity prices have been sustained at high levels.



Sources: OECD, *Economic Outlook*; and IMF staff estimates.

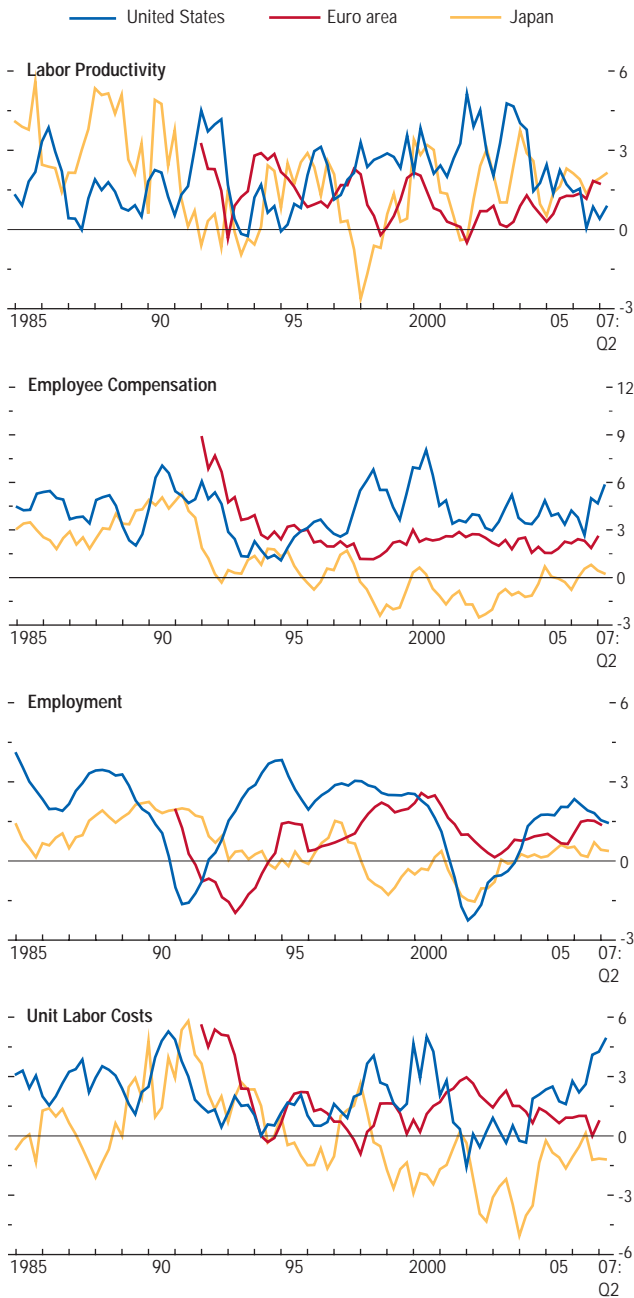
¹Estimates of the nonaccelerating inflation rate of unemployment (NAIRU) come from the OECD. Estimates of the output gap, expressed as a percent of potential GDP, are based on IMF staff calculations. Capacity utilization measured as deviations from 1980–2006 averages for the United States (percent of total capacity) and Japan (operation rate index for manufacturing sector), and deviations from 1985–2006 for euro area (percent of industry capacity).

²Simple average of spot prices of U.K. Brent, Dubai Fateh, and West Texas Intermediate crude oil.

Figure 1.12. Productivity and Labor Cost Developments in Selected Advanced Economies¹

(Percent change from four quarters earlier)

Labor productivity has slowed in the United States, but performance has improved in the euro area and Japan. Unit labor costs have accelerated in the United States, but in the euro area and Japan, with little upward trend in compensation growth, unit labor costs have remained largely contained.



Sources: Haver Analytics; OECD, *Economic Outlook*; and IMF staff calculations.
¹Estimates are for the nonfarm business sector for the United States, and the whole economy for the euro area and Japan.

to 1.5 percent of global GDP (Figure 1.13). The current account surpluses of the oil exporters are projected to come down as these countries ramp up spending. However, China's current account surplus has widened sharply in recent quarters, and it is now projected at 12 percent of GDP in 2008 and to remain at a high level through the medium term. Accordingly, emerging Asia's projected current account surplus in 2012 has been marked up to 1¼ percent of global GDP.

Persistent large imbalances raise two principal concerns. First, the necessary financing flows for the U.S. current account deficits may become less easily obtained, triggering a disorderly adjustment—a low-probability but high-cost event. Second, sustained large trade imbalances could prompt rising protectionist pressures.

One open question at this point is how recent financial market developments have affected risks of a disorderly adjustment. In recent years, the U.S. economy has benefited from large capital inflows, attracted by the apparent sophistication and security offered by the U.S. financial system, as well as the underlying strength of the U.S. economy itself. Under an "orderly adjustment," the U.S. current account deficit would be lowered gradually through a combination of demand rebalancing and further exchange rate movements, and would be smoothly financed. However, investors in the United States have been earning lower returns on their assets than elsewhere in recent years—as a result of both dollar depreciation and slower rates of asset price appreciation than in other markets. As a consequence, the composition of inward flows to the United States had shifted over time toward higher-return, higher-risk vehicles.³ During recent market turmoil, foreign investors presumably shifted away from collateralized debt obligations, and back toward more secure and more liquid U.S. government bonds. What remains

³It is noteworthy that in recent quarters, a high share of net capital flows to the United States have come from official sources. Some official investors are also adopting more aggressive investment strategies, such as shifting reserves into sovereign wealth funds.

to be seen are the longer-term consequences of recent events. One possibility is that disillusion with asset-backed credit structures could prompt a more sustained shift in investor preferences away from U.S. assets, which would raise risks of a disorderly unwinding of imbalances.

A separate concern is that persistently large trade imbalances could be a source of protectionist pressures, particularly where domestic industry does not adjust successfully in the face of import competition, contributing to a sense that the growth benefits of an open economy are not being adequately shared among different social groups. Protectionist sentiment could be exacerbated by perceptions of unfair use of exchange rate policy for competitive advantage. The recent lack of progress with negotiations on the Doha Round and increasing recourse to a proliferation of bilateral trade treaties are an indication of an increased focus on national interest on the trade front. Pressures for increased trade restrictions or retaliatory measures have so far been largely resisted, but protectionist risks associated with large trade imbalances would be substantially increased in the context of a global slowdown with rising levels of unemployment.

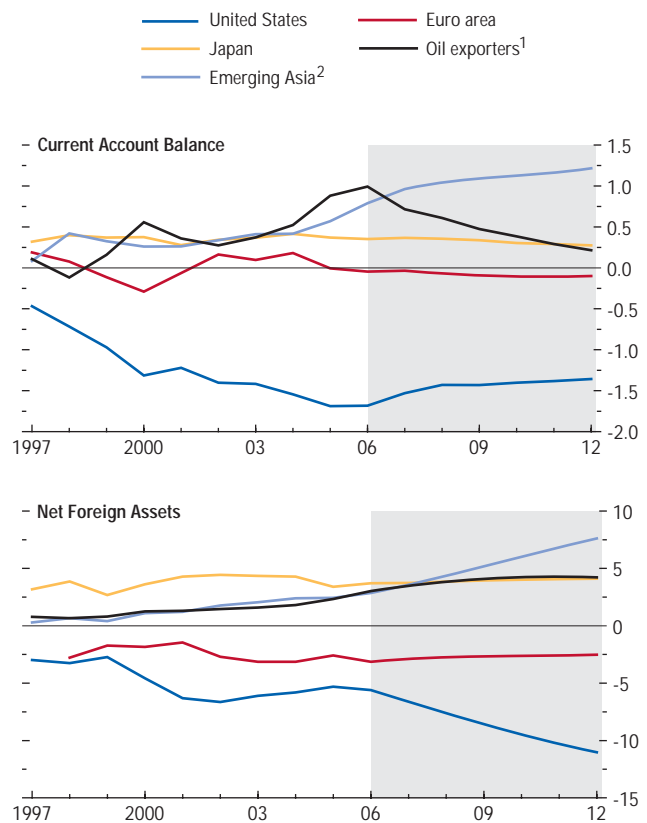
Against this background, some welcome progress has been made toward developing a joint approach toward global imbalances. The Multilateral Consultation held by the IMF represents the first use of an innovative approach to addressing systemic challenges. It has provided a forum for discussion with key countries to strengthen mutual understanding of the issues and to reaffirm support for the International Monetary and Finance Committee (IMFC) Strategy, and for each country to indicate specific policies consistent with the Strategy that together should allow for a substantial reduction in imbalances in the years ahead (see Box 1.3).

Two Downside Scenarios

In discussing the various risks to the global economy, it is clear that many of these risks are interrelated, with the evolution of financial

Figure 1.13. Current Account Balances and Net Foreign Assets
(Percent of world GDP)

The U.S. current account deficit is projected to come down only slowly relative to world output and still be close to 1.5 percent of global GDP in 2012. This trajectory implies a continuing buildup in U.S. net foreign liabilities, with the main counterpart being a steady rise in net assets of emerging Asia.



Sources: Lane and Milesi-Ferretti (2006); and IMF staff estimates.

¹Algeria, Angola, Azerbaijan, Bahrain, Republic of Congo, Ecuador, Equatorial Guinea, Gabon, I.R. of Iran, Kuwait, Libya, Nigeria, Norway, Oman, Qatar, Russia, Saudi Arabia, Syrian Arab Republic, Turkmenistan, United Arab Emirates, Venezuela, and the Republic of Yemen.

²China, Hong Kong SAR, Indonesia, Korea, Malaysia, the Philippines, Singapore, Taiwan Province of China, and Thailand.

Box 1.3. Multilateral Consultation on Global Imbalances

What Was the Multilateral Consultation and Why Was It Needed?

On June 5, 2006, the IMF initiated its first-ever Multilateral Consultation (MC)—a new tool of multilateral surveillance—with a focus on addressing global current account imbalances in a manner supportive of global growth. Five countries or regions agreed to participate—China, the euro area, Japan, Saudi Arabia, and the United States. This group of participants was chosen either because they were a direct party to the existing imbalances (through their current account deficits or surpluses) or because they represented a very large share of global output and could contribute to sustaining world growth as demand and saving patterns adjusted.

The central issue at hand was that, despite widespread agreement on which policies were needed to help support a global rebalancing process—as communicated in the IMF’s International Monetary and Financial Committee (IMFC) Strategy,¹ progress in implementing policies was relatively slow, and imbalances remained wide. This suggested the need to develop new avenues for achieving the goal. Thus, a central objective of the first MC was to facilitate a dialogue and, ultimately, foster policy actions by participants that could make a significant contribution toward global rebalancing—

that is, sustaining global growth while reducing imbalances—and reducing the associated risks of a disorderly adjustment.

To this end, the Consultation began with bilateral discussions with senior policymakers from each of the participant countries or regions, followed by joint meetings of senior officials from all participating countries or regions with IMF staff. The open and constructive consultations contributed to an improved understanding of the issues and of each other’s positions. Participants reaffirmed that reducing global imbalances was a multilateral challenge, and that resolving them in a manner compatible with sustained growth was a shared responsibility. They also stressed that an orderly unwinding of imbalances was in the interest of the world economy more generally, because, among other reasons, sustained imbalances could add to protectionist pressures.

What Did the MC Deliver?

During the Consultation, the participants reiterated their support for the IMFC Strategy to reduce imbalances through policies that were in each individual country’s interest as well as desirable from a multilateral perspective. The Consultation culminated with the publication of policy plans by each participant, which included substantive steps in all key areas of the IMFC Strategy.² When implemented, these policy plans could significantly reduce global risks. The agreement to publish these plans also provided a clear roadmap to assess progress toward policy implementation. In its April 2007 Communiqué,³ the IMFC welcomed the report from the group, noting that the policy plans set out by the participants represented further progress in the implementation of the IMFC Strategy.

Note: The main authors of this box are Hamid Faruquee and Gian Maria Milesi-Ferretti.

¹Since April 2004, the IMFC has set out in each Communiqué its views on the measures needed to foster an orderly resolution of global imbalances—the so-called IMFC Strategy. While the IMFC Strategy has evolved somewhat over time, reflecting the changing nature of the imbalances, in September 2006, the Committee called for steps to boost national saving in the United States, including fiscal consolidation; further progress on growth-enhancing reforms in Europe; further structural reforms, including fiscal consolidation, in Japan; reforms to boost domestic demand in emerging Asia, together with greater exchange rate flexibility in a number of surplus countries; and increased spending consistent with absorptive capacity and macroeconomic stability in oil-producing countries.

²See IMF, “IMF’s International Monetary and Financial Committee Reviews Multilateral Consultation,” Press Release No. 07/72, April 14, 2007.

³See IMF, “Communiqué of the International Monetary and Financial Committee of the Board of Governors of the International Monetary Fund,” Press Release No. 07/71, April 14, 2007.

The Executive Board's review of the experience with the process in July 2007 reached a similar assessment.⁴

Will It Make a Difference?

While a precise quantification of the effects of the proposed policy package on global imbalances is difficult, IMF staff estimates based on simulations from the Global Economic Model⁵ and other empirical evidence suggest that, when fully implemented, the package could reduce the U.S. current account deficit by 1–1¼ percent of GDP over the medium term, and hence limit the accumulation of U.S. external liabilities. Surpluses would decline correspondingly elsewhere, and particularly in China and Saudi Arabia. For the purpose of these calculations, IMF staff assumed an increase in exchange rate flexibility in China, with a real appreciation consistent with current market expectations as embedded in forward rates and Consensus Forecasts, as well as financial market reforms; the implementation of growth-enhancing structural reforms in the euro area and Japan; a substantial increase in investment in line with policy plans in Saudi Arabia; and a fiscal adjustment of about 2 percent of GDP (consistent with the target of a balanced federal budget) and measures to stimulate private saving in the United States.

It should be stressed, however, that an orderly adjustment in global imbalances accompanied by sustained growth does not depend solely on the participants' policies. In particular,

- *Other countries have an important part to play.* Higher expenditures by other oil exporters, together with greater exchange rate flexibility and higher investment in other parts of emerging Asia, could reduce the U.S. current account deficit by a further ¼–½ percent of

GDP, matched by reduced surpluses in these regions, assuming broadly comparable efforts to those by MC participants.

- *Changes in private sector balances can also be expected to play a key role in reducing current account imbalances,* including through an increase in household savings in the United States and strengthened private domestic demand in surplus countries. Although the size of this adjustment could be significant, its pace is uncertain, not least because it depends on variables that are difficult to forecast—such as house prices in the United States. These uncertainties, as well as other imponderables such as oil prices, reinforce the case for early public policy adjustment, especially since this is also consistent with the domestic interests of the countries concerned.

Where Do We Go from Here?

The key now is implementation. Since the consultation discussions and the report, each participant has made some progress toward implementing its policy intentions, but much remains to be done. Specifically,

- In the *United States*, the federal deficit has narrowed more rapidly than expected, and Congress has adopted the administration's balanced budget objective by FY2012. But consensus has not emerged on how to achieve this objective while providing adequately for war funding and the alternative minimum tax relief, and there are political obstacles to deeper entitlement reform.
- In *China*, the renminbi has appreciated in real effective terms by about 6 percent over the past year, and the currency band for daily exchange rate fluctuations against the dollar has been widened from 0.3 percent to 0.5 percent. However, China's current account surplus has widened further, reflecting continued strong export performance. More rapid appreciation of the renminbi would help provide the right price signals for investment and, together with additional steps toward rebalancing domestic demand, help to contain China's current account surpluses

⁴See IMF, "IMF Executive Board Discusses Multilateral Consultation on Global Imbalances," Public Information Notice No. 07/97, August 7, 2007.

⁵The Global Fiscal Model was used to calibrate the effects of fiscal policy on the current account. See Faruqee and others (2007); Appendix 1.2 in the September 2005 *World Economic Outlook*; and Box 1.3 in the September 2006 *World Economic Outlook*.

Box 1.3 (concluded)

over time. At the same time, it would provide greater scope for monetary policy to focus on slowing lending and investment growth.

- In the *euro area*, some progress is being made with respect to the structural reform agenda, including improving the efficiency of clearing and settlements in EU financial markets. Looking forward, raising competition, productivity, and growth will require further reforms in product, labor, and financial markets—such as, for example, an effective implementation of the Services Directive in all member states.
- In *Japan*, recent progress on the structural reform agenda includes advances on job placement and training and on liberalization of foreign direct investment inflows. Looking forward, further action is needed to strengthen competition and thereby raise productivity, particularly in the nontradables sectors.
- In *Saudi Arabia*, public spending in 2007 was increased in three key areas—oil sector invest-

ment, social projects, and infrastructure—as planned. Massive public-private partnership-based investment programs are also continuing, although there is still a long way to go to meet the medium-term targets.

Thus, the Multilateral Consultation on Global Imbalances represents the first use of an innovative approach to addressing systemic challenges. Working with the endorsement of the IMF's global membership, a relevant subset of IMF members—with the participation of IMF staff and management—conducted a series of focused, constructive, and confidential discussions. The result was a set of mutually consistent policy plans that have been welcomed by the IMF. With the agreement of the participants in the Consultation, the implementation of these policy plans will be the subject of regular IMF surveillance. According to IMF staff analysis, these plans will—as implemented—make a significant contribution toward the achievement of the goals of the IMFC Strategy of sustaining global growth while reducing imbalances.

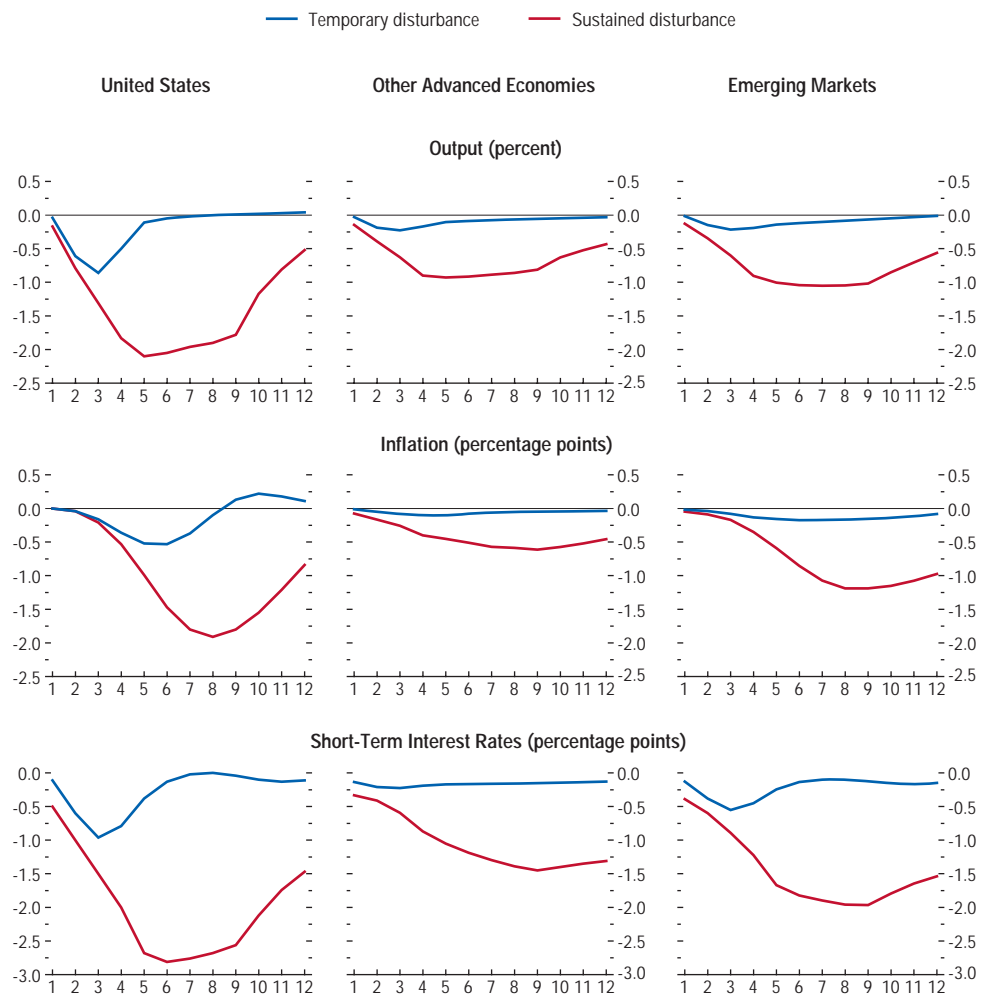
market conditions having important consequences for the range of other domestic and external risk factors. In principle, financial disturbances—even large ones such as the recent credit market turmoil—could be absorbed without major consequences for global activity, provided markets stabilize, prices adjust in an orderly way, and losses are recognized. Indeed, some previous episodes of financial market dislocation—prominently the stock market drop in 1987 and the events in 1998 surrounding the collapse of LTCM and the Russian default—have had only a limited and temporary effect on global activity. Nevertheless, the interaction between a deterioration in financial conditions with other vulnerabilities in advanced and emerging market economies could lead to a deeper and more prolonged slowdown in global activity than envisaged in the baseline projections. Such an episode would have more in common with the lengthy global

slowdown following the 2000 equity market crash, where a correction in equity market valuations interacted with a reassessment of the returns to high-tech investment not just in the United States but also in Europe and Asia. In present circumstances, the core vulnerability would seem to be the possibility that a tightening of credit constraints could interact with the housing market corrections in the United States and other countries where house prices have risen rapidly in recent years.

Figure 1.14 shows the results of a macroeconomic modeling exercise aimed at simulating the impact of a financial shock originating in the United States on three key counterparts of the global economy: the United States, other advanced economies, and emerging market countries. With a temporary shock—which starts to be reversed after two quarters—the impact on GDP would be relatively small, and largely confined to the United States itself. With a sustained

Figure 1.14. Simulated Effect of a Financial Disturbance on the Global Economy
(Deviation from baseline)

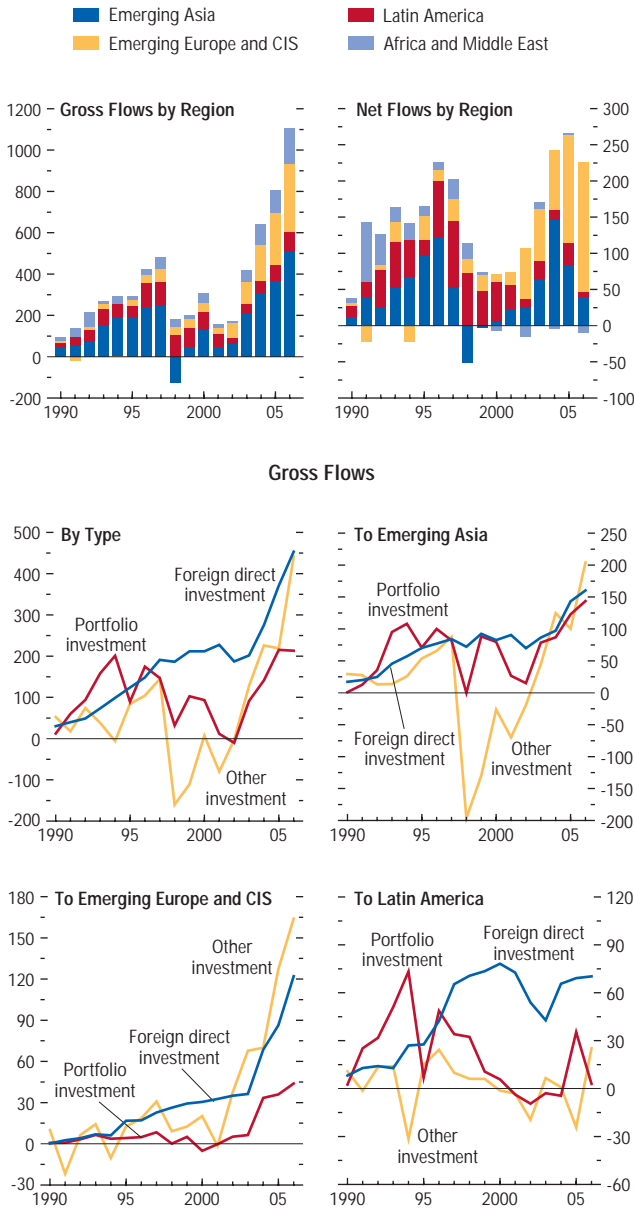
A persistent large financial disturbance centered on the United States (involving a 10 percent decline in house prices, a 10 percent drop in equity prices, and a 50 basis point widening in the term premium, all relative to baseline) would have a substantial adverse impact on global activity, with spillovers from the U.S. economy through trade and financial channels, including by inducing corrections in housing markets, around the world. Monetary policy easing would help to cushion the downward impact. By contrast, a disturbance of the same initial magnitude that was quickly reversed would have a much smaller macroeconomic impact.



Source: IMF staff estimates.

Figure 1.15. Private Capital Flows to Emerging Markets
(Billions of U.S. dollars)

Gross private flows to emerging markets have risen rapidly in recent years, while net flows have been sustained at historically high levels. Although foreign direct investment has risen, portfolio flows and other investment flows have risen more steeply, especially to emerging Asia, emerging Europe, and the Commonwealth of Independent States (CIS).



Sources: IMF, World Economic Outlook database; and IMF staff calculations.

shock—lasting eight quarters—the impact on output in the United States would be much greater, however, as wealth effects start to kick in and depress consumption, and the Federal Reserve would be prompted to cut interest rates aggressively to stabilize output and inflation. Moreover, the spillover effects on other countries are substantially larger—housing markets around the world would weaken on top of the impact of slower trade growth, weaker equity prices, and higher risk premiums. This scenario is consistent with the finding in the April 2007 *World Economic Outlook* that spillovers are more than proportionately greater in the context of a downturn than in a mild slowdown in activity. With this combination of events, the global economy could slow sharply.

Living with Heavy Foreign Exchange Inflows

Over the past year, many emerging market and developing countries have experienced historically high levels of net foreign exchange inflows, through both current and capital accounts. The recent rise in private capital flows to emerging markets has been particularly dramatic. As shown in Figure 1.15, in dollar terms, gross flows have risen sharply in the past few years—to levels twice as high as at the previous peak in 1996, just before the Asian crisis. In part, the gross flow number reflects the continuing process of cross-border financial diversification. The rise in net flows to emerging markets has been somewhat less steep, but nevertheless capital has flown at record levels over 2005–06, picked up further in the first half of 2007, and is projected to be maintained at high levels in the aggregate, notwithstanding recent financial market turbulence.

An abundance of foreign exchange resources provides an enormous opportunity for boosting long-term growth if used prudently. However, countries also face substantial short-term macroeconomic challenges in managing heavy foreign exchange inflows. If exchange rate flexibility is limited, a surge in net foreign

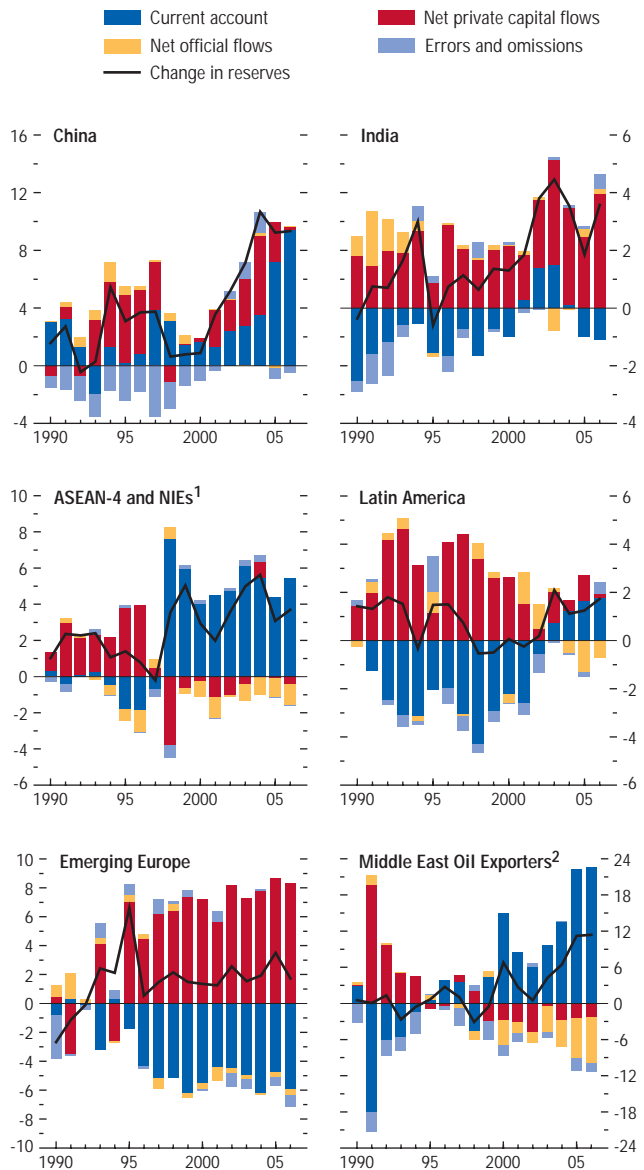
exchange inflows can quickly generate rapid credit growth, strong increases in domestic asset prices, an overheated economy, and eventual pressure on inflation. Allowing the exchange rate to appreciate provides a greater degree of monetary control, but also can lead to a loss of competitiveness and limit export opportunities. There is also the related challenge of avoiding a buildup in vulnerabilities to a sudden reversal of the inflows—a concern underlined by the recent turbulence in global financial markets.

While these challenges are general ones, different groups of countries are facing different external and domestic situations, affecting policy trade-offs (Figure 1.16). Across a variety of different situations, how have countries responded and what lessons can be learned from their experience? Chapter 3 of this report investigates countries' experiences with surges in capital flows since the late 1980s. One general finding in Chapter 3 is that in recent years, countries have shifted to more flexible exchange rate regimes and allowed more upward movement in exchange rates, although resistance to appreciation through intervention remains generally high. Thus, significant exchange rate appreciations have occurred both in inflation targeters in Latin America (Brazil, Chile, and Colombia) and in emerging Asian countries (India, Korea, and Thailand are good examples). Allowing more exchange rate flexibility has the advantages of increasing direct control over the monetary base, and thus credit growth, and helping reduce one-way bets and thus incentives for carry trade capital inflows to arbitrage interest rate differentials. However, in the face of very strong capital inflows, countries have also continued to intervene heavily, building up reserves in an attempt to limit the extent of real exchange rate appreciation, although the results obtained in Chapter 3 suggest that such intervention has not generally been successful over extended periods.

One strong conclusion from the experience reviewed in Chapter 3 is that fiscal restraint in the face of strong capital inflows helps reduce pressures on the real exchange rate and the

Figure 1.16. Current and Capital Account Flows to Selected Emerging Market and Developing Countries (Percent of GDP)

The buildup in reserves in most Asian emerging markets and Middle East oil-exporting countries has been driven mainly by large current account surpluses (India being an exception). In emerging Europe, large net capital inflows have financed substantial current account deficits.



Source: IMF staff calculations.

¹ASEAN-4 countries include Indonesia, Malaysia, the Philippines, and Thailand. Newly industrialized Asian economies (NIEs) include Hong Kong SAR, Korea, Singapore, and Taiwan Province of China.

²Bahrain, I.R. of Iran, Kuwait, Libya, Oman, Qatar, Saudi Arabia, Syrian Arab Republic, United Arab Emirates, and the Republic of Yemen.

risk of a hard landing when the inflows slow or reverse. There are well-known limits to the use of discretionary fiscal policy for fine-tuning purposes that apply particularly in this context, because capital flows are volatile, hard to predict, and have an uncertain macroeconomic impact, while frequent short-term modification to fiscal policy instruments would reduce transparency and predictability. That said, the evidence suggests that countries facing overheating pressures in the context of strong output growth and capital inflows would benefit from greater fiscal restraint, by saving a larger share of buoyant revenues, rather than allowing public spending to soar or prematurely cutting taxes. This is a lesson that is particularly relevant for countries in emerging Europe and the CIS with large current account deficits, where vulnerabilities are particularly salient, and where government spending has grown rapidly.

Moving beyond macroeconomic policy instruments, a number of countries have imposed measures to restrict or discourage capital inflows. Notably, Chile in the 1990s and, more recently, Argentina (since 2005), Thailand (since 2006), and Colombia (since May 2007) have set unremunerated reserve requirements on certain types of capital inflows, effectively applying a tax on short-term inflows. Other countries, such as Brazil, Kazakhstan, and Korea, have recently introduced other specific measures aimed at curbing short-term inflows through the banking system, and India has recently placed new restrictions on external commercial borrowing. Experience suggests that such measures tend to have a diminishing impact over time, as ways are found to elude the controls, and can, if sustained, also have negative consequences for financial system development.⁴ Consistent with this assessment,

⁴In Thailand, the controls were initially set very broadly, including to apply to FDI-related inflows; had a strong negative impact on equity and currency markets; and were quickly narrowed in scope. In Argentina and Colombia, the requirements were set more narrowly and seem to have had a limited impact.

Chapter 3 finds that capital controls have not had much impact on the macroeconomic outcomes from capital inflows.

Alternatively, liberalization of restrictions on capital outflows can help ease foreign exchange market pressures while also encouraging greater cross-border portfolio diversification for domestic investors and integration with international markets. East Asian countries have been most successful in following this approach, as evidenced by the high and rising capital outflows from these countries, and similar reforms have continued over the past year across a wide spectrum of countries, including Brazil, China, Colombia, India, Malaysia, Morocco, Peru, and Thailand. However, the timing and magnitude of the impact of such reforms is hard to quantify with any precision, qualifying their value for short-term macroeconomic management.

A final set of approaches seeks to offset the domestic side effects of capital inflows. First, countries have tightened regulatory and supervisory guidelines related to bank lending, to limit the risk of increasing balance sheet vulnerabilities. Second, countries have used tax and other measures to cool down domestic equity and property markets, such as China's recent increase in stamp duty on stock market transactions and Singapore's increased property redevelopment charge. Third, countries have used fiscal incentives to offset some of the implications of exchange rate appreciation, such as Brazil's introduction of import tariffs on certain sectors. Care must be taken in using such fiscal measures to make sure that they do not have adverse microeconomic or political economy consequences. A more productive approach would be to advance initiatives to increase an economy's ability to adapt to exchange rate movements, including, for example, labor market reforms and improvements in the business environment.

Overall, recent experience and the findings of Chapter 3 are consistent with the view that there is no single universal formula for dealing with the short-term macroeconomic

consequences of heavy foreign exchange inflows. Instead, countries need to take a pragmatic approach, finding an appropriate blend of measures suited to their particular circumstances and longer-term goals. So far, most countries have been largely successful in averting exchange rate appreciations that leave exchange rates substantially overvalued, but overheating concerns are a continuing issue. A number of countries would find monetary control and inflation objectives easier to achieve by allowing somewhat more flexible exchange rates. There would also seem to be scope for more restrained fiscal policy approaches, saving rather than spending a larger portion of strong revenue growth; for further steps toward liberalization of capital account outflows; and for tighter regulatory and prudential frameworks to limit possible balance sheet vulnerabilities from too rapid growth of domestic credit.

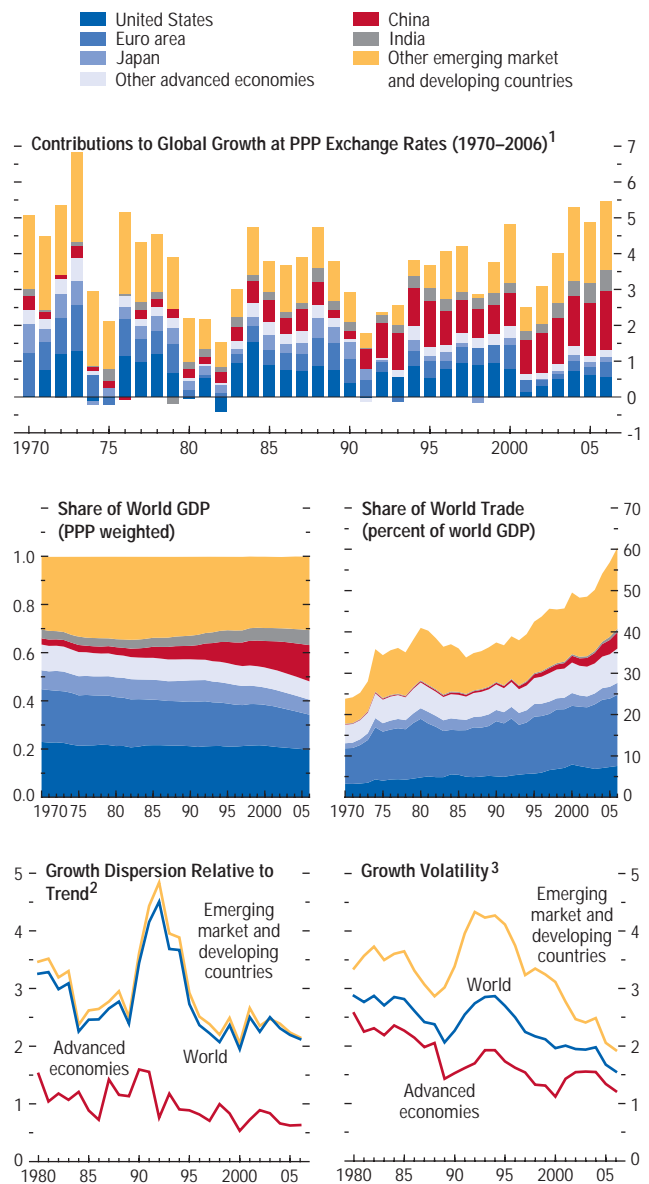
Sustaining Robust Growth

The current global expansion has been the period of strongest growth since the early 1970s (Figure 1.17). The recent experience is also remarkable in other ways. First, with the rapid growth of world trade, openness has risen by more than 10 percentage points since 2001, and financial openness has also risen rapidly. Second, emerging market and developing countries now account for a high share of growth: more than $\frac{2}{3}$ compared with about $\frac{1}{2}$ in the 1990s. Third, the success is not being enjoyed only by a few dynamic countries; in fact, most countries and regions are doing well by their own past standards, as reflected in the decline in the dispersion of growth rates relative to trend. And, fourth, the volatility of growth has declined substantially.

Chapter 5 of this report provides a longer-term perspective on the current expansion, asking how much of the changing dynamics of the global business cycle reflects good policies and how much is good luck. It presents evidence that a number of structural changes—including higher-quality monetary policy, reduced fiscal

Figure 1.17. Perspectives on Global Growth

More than two-thirds of global growth is being contributed by emerging market and developing countries. These countries also account for a rising share of world trade, and they show lower growth dispersion and growth volatility.



Source: IMF staff calculations.

¹Exchange rates based on purchasing power parity (PPP).

²Standard deviation of current year growth minus average growth in 1970–2006.

³Measured as weighted averages for countries' standard deviation of growth over rolling seven-year periods.

policy volatility, improved institutions, and greater financial development—imply that business cycles are likely to be of longer duration and lesser magnitude than in the past.

However, the chapter warns that the business cycle is by no means dead, and concludes on a cautionary note that the present period shares a number of characteristics with the 1960s and early 1970s—a period of strong sustained global growth but followed by a period of greater turbulence punctuated by the collapse of the prevailing monetary policy anchor (the Bretton Woods system of fixed exchange rates), large supply shocks, and inflationary surges. Recent increased financial market volatility has underlined concerns that benign conditions may not be sustained. But, going beyond such considerations, there are also a number of deeper-rooted concerns, which, if not adequately addressed, could pose serious challenges to the continued success of the current expansion.

First, while most countries are doing well at the aggregate level, there are rising concerns about the distribution of the gains. Rapid technological progress and continuing globalization of trade and finance have been enormously growth enhancing and have helped reduce poverty, but they have also contributed to increasing concentrations of income and wealth, both in the advanced economies and the emerging market and developing countries. Owners of capital and of scarce skills have been amply rewarded, but less-skilled workers and those with limited access to jobs or finance have seen more limited gains. Rising inequality has already led to resistance to globalization and contributed to recent setbacks in the process of multilateral trade liberalization, but the protectionist backlash could become yet more virulent. And beyond welfare and political economy concerns, inequality also has real economic costs, because it implies that human resources are not being productively used, as a high share of the world's population continues to have inadequate access to education, health care, and economic and financial opportunities.

Chapter 4 of this report looks in more detail at the relationship between globalization and income inequality. It finds that technological progress is by far the largest factor behind rising inequality, because of the associated income gains to highly skilled workers. Globalization has offsetting effects on income distribution: trade, and particularly exports by developing countries, has in fact tended to reduce inequality, whereas financial globalization, including foreign direct investment, has increased inequality, in part because it is closely related to the diffusion of new technologies. These results yield a number of policy lessons, including the importance for developing countries to achieve their export potential, particularly in agriculture; the value of extending access to education and financial resources to ensure that lower-income groups have the skills and resources needed to benefit from opportunities created by new technologies and globalization; and the need to ensure adequate safety nets for groups adversely affected by the new environment.

A second possible trend that would affect growth dynamics is that over time global savings may well become more scarce, putting upward pressure on real interest rates. In recent years, the global expansion has been supported by the ready availability of external financing at relatively low interest rates. In part, this reflected very easy monetary policy in the advanced economies after the 2000–01 downturn to head off deflationary concerns, but this source of liquidity has been progressively tightened (Box 1.4). Abundant credit has also been related to financial market innovations that have improved liquidity and the distribution of risk, which, notwithstanding recent market volatility, should provide permanent gains. A third factor is the pattern of global saving and investment, which created what Federal Reserve Chairman Ben Bernanke has called a “savings glut” but is perhaps more accurately characterized as low rates of investment (outside China) and a very high rate of saving in China.

However, the global pattern of saving and investment is likely to shift over time. Surpluses

of the oil-exporting countries are projected to decline quite rapidly as they increase their absorption to match the earnings potential implied by higher export price trajectories. In the advanced economies and in some middle-income countries too, population aging will tend to increase consumption rates as rising shares of the population retire from the labor force. In China, in particular, consumption rates are likely to rise substantially from current low levels (only 35 percent of GDP), as precautionary savings are reduced and the financial system becomes better adapted to providing credit to households, supported by government policies to rebalance domestic demand and in a context in which the population is aging fast.

Third, more resources may be required for investment and for addressing climate change. Current rapid growth has been achieved with relatively low rates of global investment, driven by productivity gains from trade and financial globalization and application of new information technologies. However, the impetus from globalization and new technology may dwindle, especially if distributional issues are not adequately addressed. Moreover, the need to reduce the rate of global warming is increasingly accepted, which will require new investments to control carbon emissions, for example, in power generation. Recent estimates suggest that mitigation efforts could cost about 1 percent of GDP. Appendix 1.2 looks in more detail at the macroeconomic consequences of climate change and the policy challenges it generates.

Overall, then, a number of medium-term trends may contribute to slowing productivity, rising interest rates, and conditions less conducive to rapid global growth. Financing may become less readily available, and the global economy may become more susceptible to financial reversals and crises. One large question mark in such a context would be the continuing ability of the United States to fund a large current account deficit at a reasonable cost, particularly as surpluses come down in

other countries and as financial systems elsewhere develop and are better able to compete in terms of scarcity, liquidity, and range of products. Emerging market and developing countries that have become reliant on external savings—such as those in emerging Europe—could also find themselves facing tighter external financial constraints.

Policy Challenges

Policymakers around the world face the immediate challenge of safeguarding the continued expansion of activity in the face of risks posed by recent turbulent global financial conditions, while remaining alert to inflation pressures. At the same time, greater progress is needed to tackle the deeper obstacles to continued global prosperity.

After a period of tightening that has brought monetary stances to close to or above neutral in most advanced economies, central banks have had to address the recent dramatic drying up of market liquidity and associated financial strains. They have acted as needed to ensure the orderly functioning of financial markets while continuing to base decisions on the monetary policy stance on judgments about economic fundamentals. The concern is to avoid perceptions that central banks would automatically respond to financial distress by taking actions to curtail losses, which could raise moral hazard, reduce credit discipline, and impart an inflationary bias to policy setting.

Looking forward, policy choices will be contingent on the consequences of recent volatility becoming clearer. In the United States, signs that growth was likely to continue below trend would justify further interest rate reductions, provided that inflation remains contained. In the euro area, monetary policy can stay on hold over the near term, reflecting the downside risks to growth and inflation from financial market turmoil. However, as these risks dissipate, further tightening eventually may be required. In the event of a more protracted slowdown, an easing of monetary policy would

Box 1.4. What Is Global Liquidity?

In recent years, a great deal of attention has been paid to the concept of liquidity. Declines in risk premiums across various asset classes; buoyant prices in equity, bond, and real estate markets; low long-term real interest rates; and rising cross-border flows of capital have been interpreted as signs of “excess liquidity” in the global economy. At the same time, however, major central banks around the world have been in a tightening mode for some time. And in mid-August, liquidity dried up suddenly in several money markets and spreads on a number of risky asset classes widened markedly, prompting a significant injection of funds by central banks to stabilize short-term interest rates. What definition of liquidity can reconcile these facts?

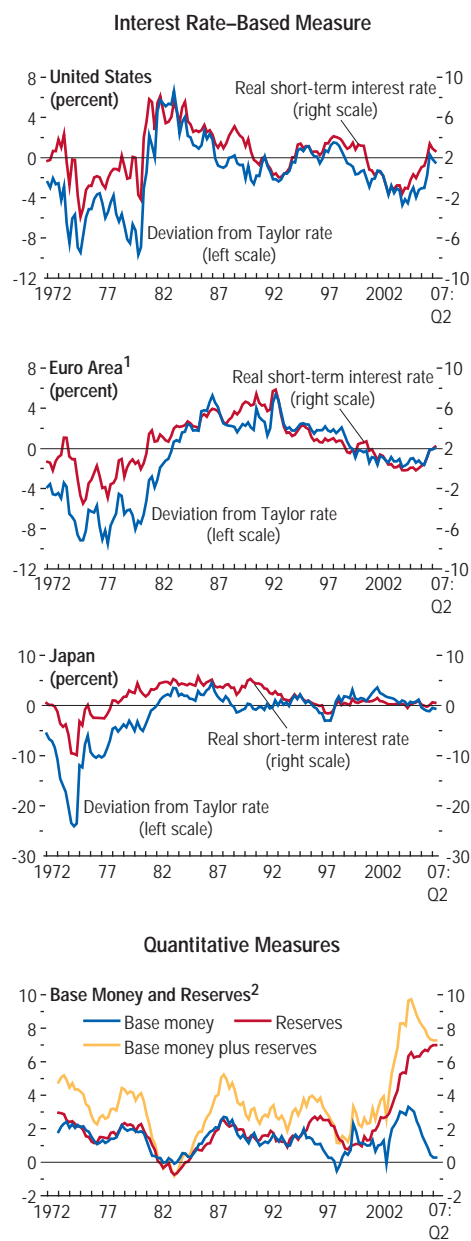
The term excess liquidity is rarely well defined. In fact multiple definitions of liquidity, seldom carefully distinguished, are often used. One definition associates excess liquidity with low interest rates or easy borrowing conditions created by an unusually accommodative monetary policy stance across major central banks. Another focuses on market liquidity, associated with structural trends toward financial innovation, deepening, and integration. This box assesses recent trends in simple indicators of global liquidity related to these alternative notions of liquidity and considers how far these are drivers of the global decline in risk premium.

Measures of the Global Monetary Policy Stance

A simple proxy of the monetary policy stance is given by the evolution of *real policy rates*. A monetary policy stance can be termed *strongly accommodative* if real policy rates are negative. The first figure depicts the evolution of real policy rates for the euro area, Japan, and the United States. The U.S. monetary policy stance was indeed strongly accommodative between 2003:Q1 and 2005:Q3, but rates are now close to neutral. Moreover, even during the expansionary phase, the degree of accommodation was less than that observed in the late 1970s and

Note: The authors of this box are Gianni De Nicolò and Johannes Wiegand.

Measures of the Global Monetary Policy Stance



Source: IMF staff calculations.
¹Before 1998, purchasing-power-parity-weighted average across euro area member countries.
²Change over three years for the United States, euro area, and Japan, denominated in U.S. dollars, scaled with GDP.

early 1980s. A similar, albeit less pronounced, pattern characterizes the monetary policy stance of the European Central Bank (ECB) since 1999. In Japan, a strongly accommodative monetary policy stance shows up only in 1997–98.

Another proxy measure of monetary policy stance, also shown in the first figure, is the deviation of a nominal short-term interest rate from a “Taylor rate,” obtained by estimating a Taylor rule, or monetary reaction function that relates the policy interest rate to the inflation rate and the economy’s cyclical position. A short-term nominal interest rate that is lower than the Taylor rate can be seen as reflecting aggressive monetary accommodation.¹ Overall, this measure provides very similar results to the real policy rate, showing aggressive monetary accommodation between 2002 and end-2006 in the United States and—to a lesser extent—Europe. More recently, however, rates have moved back in line with those implied by the Taylor rule as a result of policy tightening.

An alternative to interest rate measures of the global monetary policy stance is a quantitative measure. A global monetary aggregate based on the growth of base money in the major advanced economies, shown in the bottom panel of the first figure, generally confirms monetary accommodation in the early 2000s, which exceeded in scope even that of the 1970s. The expansion peaked in 2002–04, but it has since reversed. This index is sometimes broadened by adding on the global accumulation of international reserves, the latter being a proxy for monetary expansion by central banks of countries with external surpluses, many of them emerging markets. Using this measure, “global liquidity” shows elevated growth rates until very recently. However, this measure mixes different sorts of indicators, and it is difficult to draw firm conclusions based on it.

¹The Taylor rate depends positively on (1) the neutral real rate of interest, which, in turn, is a function of (time-varying) potential output growth, (2) the deviation of consumer price inflation from the inflation target, and (3) the output gap. For the exact parameterization of the index, see Chapter 2 of the September 2004 *World Economic Outlook*.

Notwithstanding the reversion to a neutral monetary policy stance in the United States and the euro area, real long-term interest rates on government securities in advanced economies have remained low compared with their historical average. One factor that is likely to have affected long-term interest rates is the global pattern of saving and investment. In particular, the abundance of global savings relative to investment may have contributed to, among other things, an increase in demand for longer-term securities. In this context, large current account surpluses in oil-exporting and Asian countries and the associated capital outflows may have also contributed to the decline of long-term interest rates.²

Financial Market Liquidity

The monetary policy measures discussed so far do not capture the implications for market liquidity of the rapid financial deepening and innovation that has characterized global financial markets in the past decade.³

Standard monetary and finance theory views liquidity as an attribute of an asset. The degree of liquidity of an asset is higher the lower the expected costs incurred in converting it into cash—by definition the most liquid asset—at any point in time. Liquidation costs can be reduced by borrowing to spread asset sales over time, but the ability to borrow and its cost will depend on the extent to which other market participants are able and willing to provide financing.⁴ This suggests that the

²See Warnock and Warnock (2006).

³A simple illustration of this is provided by a decomposition of changes in M2/GDP between changes in the ratio of liquid assets to total assets in the economy—the ratio of M2 to an economy’s total financial assets—and the ratio of total financial assets to GDP, as an indicator of financial deepening. Data over the past decade show that the aggregate liquidity ratio has *decreased* whereas financial deepening has increased.

⁴This ability can be temporarily enhanced by central banks’ *money injections*. However, money injections do not as such increase the liquidity of the market as defined, but just increase the ability of market participants to obtain funding to carry out and settle certain transactions.

Box 1.4 (concluded)

degree of liquidity of an asset *cannot* be defined independently from the liquidity of its market. Moreover, market liquidity can dry up rapidly as a result of market participants' reassessment of counterparty risk. This point is underscored by recent events when major central banks have temporarily injected large amounts of funds to support liquidity in the interbank market.

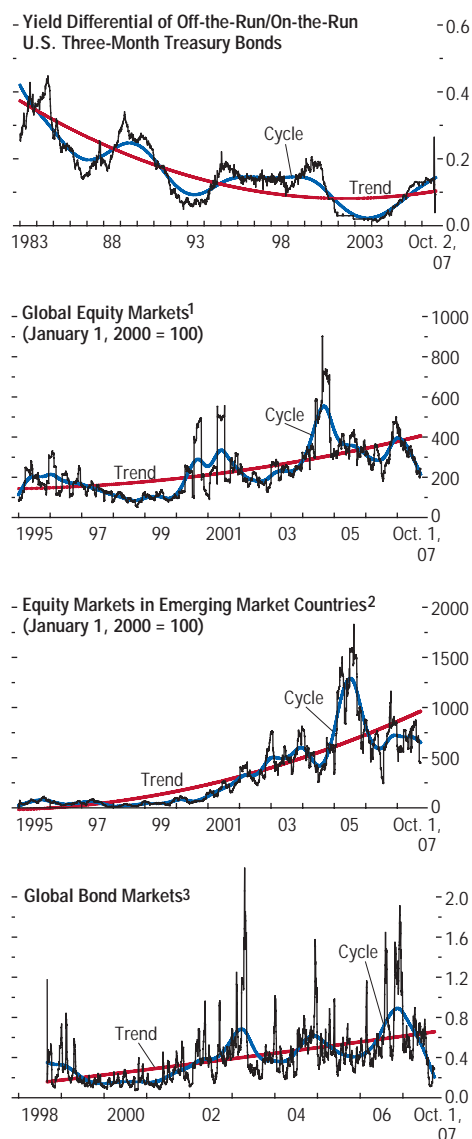
One important point to stress is that the *risk premium of an asset incorporates a liquidity premium*. The degree of liquidity of a tradable asset has value and therefore carries a price. Thus, higher market liquidity can reduce the risk associated with a given asset portfolio (Longstaff, 2001). An important implication of this is that a larger portion of investors' wealth may be invested in "risky" assets, even though risk tolerance has not changed.

Three indicators of a financial-markets-based concept of liquidity are illustrated in the second figure.⁵ The first such indicator is the yield differential between less frequently traded (off-the-run) and more frequently traded (on-the-run) three-month U.S. treasury bonds, which is a proxy measure of the liquidity premium in the short-term U.S. government bond market. The second indicator is based on a return-to-volume ratio⁶ introduced by Amihud (2002), which captures two dimensions of market liquidity—*depth* or the volume of trades (order flows) that can be executed without significantly affecting prices and *resiliency* or the speed at which price fluctuations resulting from trading dissipate. Specifically, it tracks the liquidity of global equity markets—measured by a market-capitalization-weighted average of the inverse of the daily return-to-volume ratios of equity markets in advanced economies and emerging market countries. As constructed, an increase in this indicator denotes improved liquidity. The third

⁵In its April 2007 *Financial Stability Report*, the Bank of England constructs a similar indicator relevant to the market in which U.K. banks are active.

⁶The return-to-volume ratio is given by the daily absolute return on the equity market divided by the ratio of traded volume over market capitalization.

Global Market Liquidity Indicators



Sources: Datastream; Federal Reserve Board; and IMF staff calculations.

¹Market-capitalization-weighted average of daily return-to-volume ratios of equity markets in advanced and emerging market countries.

²Market-capitalization-weighted average of daily return-to-volume ratios of equity markets in emerging market countries.

³Market efficiency ratio of the JPMorgan Global (All Maturities) Bond Index.

indicator tracks the liquidity of global bond markets—measured by a version of the so-called market efficiency ratio (MEC) introduced by Hasbrouck and Schwartz (1988), which equals the ratio of volatility of bond market returns for a five-day horizon divided by the volatility of daily returns multiplied by the length of the horizon (five days).⁷ This indicator should be closer to 1 in more *resilient* markets, because in such markets the short-term volatility due to price discovery, measured in the denominator, dissipates quickly, making the volatility of returns in a buy-and-hold strategy for a given investment horizon comparable with the daily-return volatility multiplied by the length of the horizon.

As shown in the second figure, liquidity in the U.S. Treasury market has risen sharply since the early 1980s. The liquidity of global equity markets has also increased substantially since the mid-1990s, with the rise in emerging market economies being particularly impressive. Likewise, liquidity in global bond markets has also risen substantially, as seen by the increasing closeness of the MEC indicator to unity both from below and from above.

All three of these market liquidity indicators exhibit cycles, but the cycle is only weakly related to movements in real policy rates and is unrelated to quantitative measures of the global monetary policy stance, suggesting that secular factors underlie improvements in global market liquidity.⁸ Overall, this evidence is strongly

suggestive of an implied historical decrease in liquidity premiums, likely contributing to the overall decline in risk premium.

Against the backdrop of worsening subprime woes in the United States, in mid-August, liquidity in money markets in several advanced countries became scarce. In this context, the global equity and bond liquidity indicators recorded a sharp decline, although market liquidity has remained higher than the low levels recorded in the late 1990s. Liquidity in bond markets, however, declined more sharply than in equity markets, reflecting the greater impact on the former of the drying up of liquidity in money markets.

Conclusion

Notwithstanding recent market events, long-term interest rates and spreads across a broad range of assets are still at low levels relative to their long-term averages. This seems, however, no longer associated with aggressive monetary accommodation. In particular, measures of the global monetary policy stance confirm a period of generally accommodative policies in industrial countries in the early 2000s, but this has ended. At least part of the increase in global liquidity and the associated decrease in risk premium is likely the result of a structural, and possibly enduring, component related to improvements in the liquidity of financial markets. These improvements are a result of financial globalization; financial innovation, such as securitization and the growth of derivatives markets; and increased market participation. Even in the context of the recent market turmoil, these improvements do not appear to have been completely reversed. However, money markets are yet to return to normal and this could still have a further bearing on global liquidity. At the same time, low long-term interest rates may also reflect the impact of global savings-investment imbalances, which are likely to correct over the medium term.

⁷The MEC has been computed for a global bond market return index, the JPMorgan Global (All Maturities) Bond Index.

⁸An estimate of the cycle of the liquidity premium in the short-term U.S. government bond market and of global equity and bond market liquidity indicators is obtained by filtering daily data at standard business cycle frequencies using a Hodrick-Prescott filter. Estimates of a vector autoregression (VAR) with global equity and bond market liquidity indicators and U.S. real policy rates yield a negative but statistically insignificant relationship between current U.S. real policy rates and future market liquidity, while there is no such relationship when quantitative measures of the monetary policy stance replace U.S. real policy

rates in the VAR. However, a thorough analysis of the relationship between market liquidity and monetary policy stance is left for future research.

need to be considered. In Japan, given the muted outlook for prices, monetary policy should remain supportive. The return to a more neutral stance should proceed in tandem with a firming of inflation prospects and a reduction of concerns about the consequences of recent financial volatility.

Despite the weaker growth prospects for advanced economies, a number of emerging market economies still face overheating pressures and rising food prices, and further monetary tightening may be required to contain inflation. Moreover, notwithstanding recent financial developments, strong foreign exchange inflows from current account surpluses as well as continuing net capital inflows are likely to continue to complicate the policymakers' task. In some cases, greater exchange rate flexibility would help provide more room for monetary control. Specifically for China, further upward flexibility of the renminbi, along with measures to reform the exchange rate regime and boost consumption, would also contribute to a necessary rebalancing of demand and to an orderly unwinding of global imbalances. More generally, policymakers in emerging market countries should be pragmatic in managing the trade-offs between excessive credit growth driven by rapid reserve accumulation and concerns about competitiveness from exchange rate appreciation, but should be careful to avoid measures that could bring microeconomic inefficiencies and other longer-term costs. Greater restraint over growth of government spending, a tightening of prudential standards in financial systems, and steps to liberalize controls on capital outflows could all play useful roles.

In due course, lessons will need to be drawn from the recent experience of turbulent market conditions to reduce vulnerabilities to future strains, lessons that would be relevant in both advanced and developing economies. One set of issues concerns the various approaches central banks have used to provide liquidity to relieve financial strains and linkage with broader financial safety nets. For some countries, stronger deposit insurance systems and bank resolution

mechanisms may provide more scope to take a disciplined approach to providing liquidity to individual institutions that minimizes moral hazard without generating systemic risk. There are also a series of regulatory issues that will need to be addressed, as discussed in more detail in the October GFSR. First, greater attention will need to be given to ensuring adequate transparency over risks, including off-balance-sheet exposures, to ensure that the market is able to price risk properly in a world where financial instruments have become more complex, particularly with increasing reliance on securitization. Second, there is a need to strengthen checks and balances throughout the supply chain of structured products to ensure that loan originators have appropriate incentives to assess repayment capacity. Third, the approach taken to rating of complex financial products should be reviewed to ensure that investors are alerted to liquidity and market risks, in addition to credit risks. Fourth, financial institutions should be encouraged to improve liquidity risk management. And fifth, the relevant perimeter for risk consolidation for banks may need to be widened to recognize that banks may be forced under adverse circumstances to step in to support their affiliates.

The advanced economies have made significant progress toward fiscal consolidation during the present expansion, but need to do more to advance plans to ensure fiscal sustainability in the face of population aging, although automatic stabilizers should be allowed to work in most countries in the event of a downturn. General government structural deficits have been lowered substantially across the major economies since 2003, and further progress is expected in 2007. However, prospects through 2012 show limited further consolidation, implying little reduction in net debt to GDP from current levels. Moreover, much of the consolidation that has occurred in recent years has reflected rapid revenue growth driven by the rising share of profits and high-end incomes, and it is not clear to what extent these revenue gains will be sustained. Governments should

adopt more ambitious medium-term consolidation plans, together with reforms to tackle the rising pressures from government health and social security spending (see Box 1.3 of the April 2007 *World Economic Outlook*).

- In the *United States*, the newly adopted goal of balancing the federal budget by 2012 is a step forward, but the policies to achieve this objective are not yet in place, and a more ambitious medium-term target—such as balancing the budget without relying on Social Security revenues—would better prepare for the coming buildup in spending pressures and contribute to current account adjustment.
 - In the *euro area*, the Eurogroup ministers have committed to achieving country-specific medium-term objectives (MTOs) by 2010. Although this commitment is welcome, it will be important that countries that fall short of their MTOs adjust by at least ½ percentage point of GDP a year—a goal that according to current plans does not look likely to be met in some countries in 2007.
 - In *Japan*, net debt is projected to continue to rise despite continuing consolidation efforts, and faster progress than currently envisaged would buy policy insurance against shocks and help meet the challenges of population aging.
- The emerging market and developing countries have also generally taken advantage of recent buoyant conditions to advance fiscal consolidation goals, which has contributed importantly to reduce balance sheet vulnerabilities. But, as with the advanced economies, there are concerns that much of the recent improvement reflects strong revenue growth—for example, generated by high commodity prices and strong profits—which may not be sustained. Moreover, in many countries, government spending has been allowed to accelerate, which has added to overheating concerns. Most countries face a long list of fiscal reform challenges—to improve the structure of taxation, to strengthen the allocation of spending, and to consolidate the overall framework for fiscal management—and should do more to tackle these challenges.

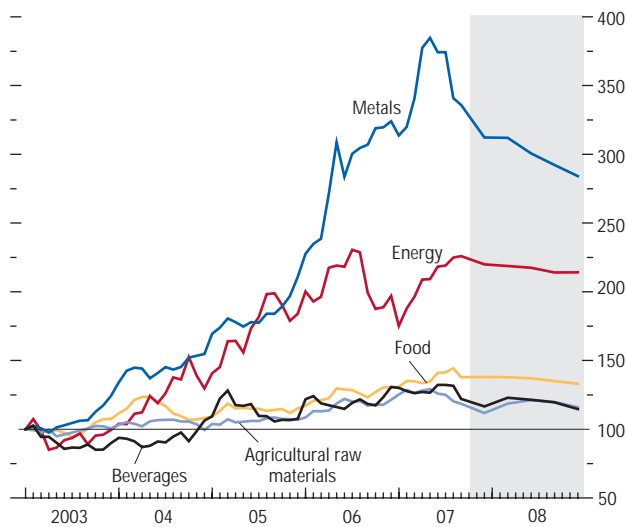
More broadly, countries must continue their efforts to advance reforms that allow their economies to take full advantage of the opportunities created by globalization and technological advances. A key part of this agenda are initiatives to make sure that markets work well, with priorities being liberalization of financial and service sectors in western Europe and Japan and a broad range of reforms in emerging market and developing countries to improve infrastructure, develop financial systems, and strengthen the business environment.

It is increasingly recognized that more is needed to ensure that the benefits of globalization and technological advances are well distributed, with rewards accruing not only to the well-off and well positioned but also to the broader population. As emphasized in the analytical chapters of the April 2007 *World Economic Outlook* and in this report, a range of policies are relevant here across advanced and developing economies. Reforms to strengthen education and training would help to ensure that workers have the appropriate skills to compete and contribute in the emerging knowledge-based global economy. Labor market reforms are needed to ensure that jobs are created flexibly in the most dynamic sectors. And social safety nets should be enhanced to provide greater protection for those who may be adversely affected by the process of change, without impeding the changes themselves.

In some key areas, joint actions across countries will be crucial. The recent slow progress with the Doha Trade Round is deeply disappointing, and major trading countries should show leadership to find a way to reenergize the process of multilateral trade liberalization. The continuing proliferation of bilateral trade treaties is a concern. Although such treaties can bring benefits to the countries involved, they also have negative externalities, and a code of conduct is sorely needed that would help reduce trade diversion and contain the complexities from multiple sets of rules of origin and other regulations.

Concerns about climate change and energy security also clearly require a multilateral

Figure 1.18. Commodity Price Indices¹
(January 2002 = 100)



Source: IMF staff estimates.
¹Shaded area denotes projections.

approach. Global warming may be the world's largest collective action problem with the negative consequences of individual activities felt largely by others. It is to be hoped that countries can come together to develop a market-based framework that balances the long-term costs of carbon emissions against the immediate economic costs of mitigation, which can attract broad country participation while providing a fair distribution of the costs involved. Approaches to energy security must be consistent with greater attention to environmental consequences, involving reduced focus on the autarkic strategy of developing national sources of energy, often with considerable associated environmental damage, and more attention to price-based incentives to containing growth of energy consumption and steps to encourage international diversification of energy sources (for example, by reducing barriers to trade in biofuels).

Finally, joint actions toward ensuring a smooth unwinding of global imbalances remains an important task. Following up on the IMF's Multilateral Consultation, the key now is consistent implementation by participating countries of the policy plans that have been announced, which, according to IMF staff analysis, will make a significant contribution toward the reduction of imbalances while sustaining growth. With the agreement of participants in the Consultation, implementation will be monitored by the IMF, including through future issues of the *World Economic Outlook*.

Appendix 1.1. Developments in Commodity Markets

The authors of this appendix are Kevin Cheng, Valerie Mercer-Blackman, and Hossein Samiei, with contributions from Nese Erbil and To-Nhu Dao.

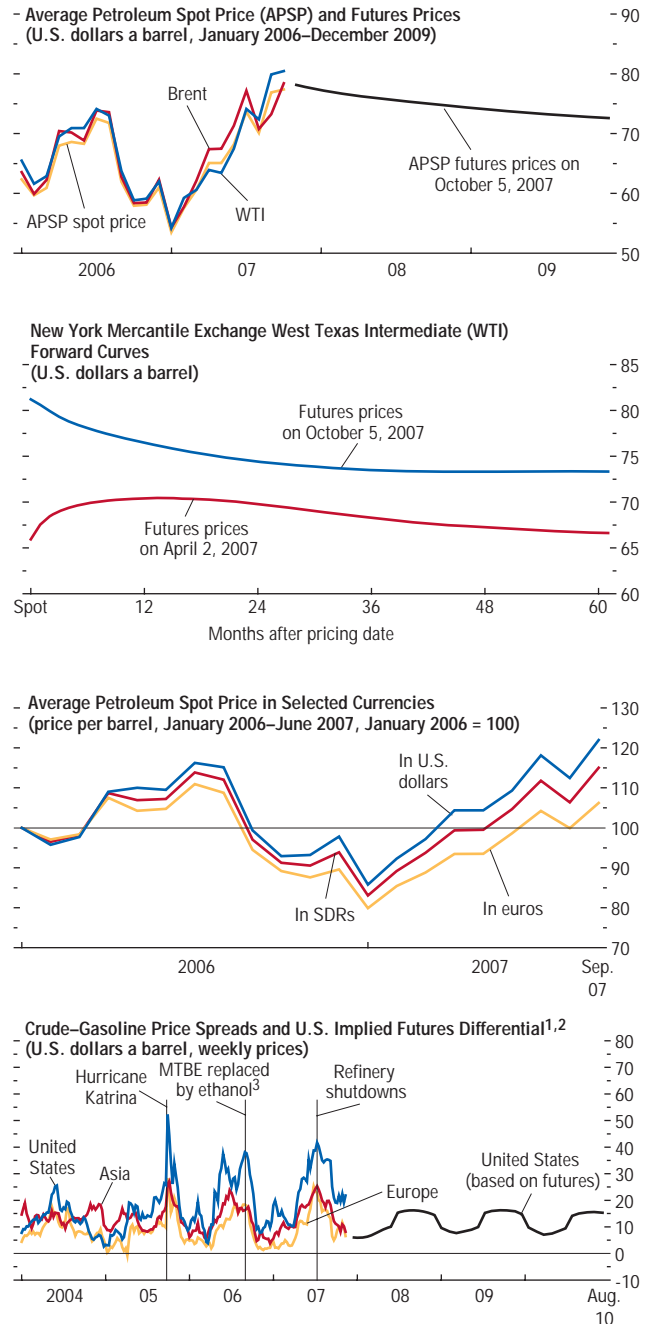
Commodity markets have generally been tight since the beginning of 2007, notwithstanding the recent financial turmoil. The IMF commodities and energy price index rose by 21 percent in the first eight months of the year, dominated

by a resurgence in oil prices and supported by rising metals and food prices (Figure 1.18). Oil prices rose to all-time highs in September, largely resulting from solid demand growth in the face of tight supply. Metals prices have remained strong, despite some losses amid sell-offs during the recent financial turmoil, and food prices have been boosted by strong demand—particularly for biofuel production—and supply shortfalls. Looking forward, with continued geopolitical and supply risks coupled with stronger demand—especially from China, the Middle East, and the United States—oil prices are likely to remain high in the absence of a further change in OPEC’s quota policies or a major global slowdown. Metals prices are expected to soften further from recent highs, although rising production costs will limit the decline. Food prices should also moderate over the medium term, although demand for biofuels and from emerging markets could provide continued support.

Surging Oil Prices Reflect Robust Demand amid Tight Supply

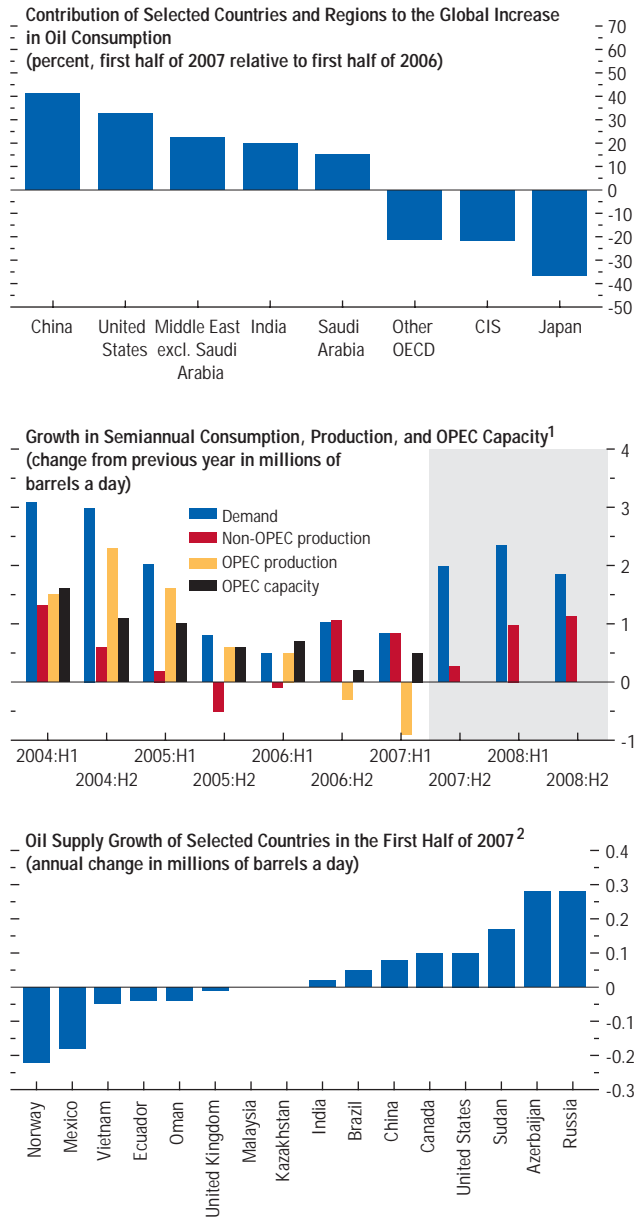
Record-high crude oil prices. Following a dip in January, the average petroleum spot price (APSP) has remained strong since late March. Despite OPEC’s announced quota increase of 0.5 million barrels a day (mbd) starting in November and some softening in August amid the subprime turmoil, the APSP set an all-time record high in mid-September, with the West Texas Intermediate (WTI) reaching beyond \$83 and Dubai beyond \$75; the Brent price has also reached a record high of almost \$80 in late September (Figure 1.19, top panel). Long-term futures prices have risen much less than spot prices: since early July, the crude oil forward curve has moved from partial contango at the front end (where futures prices are higher than the spot price) to full backwardation (the opposite situation) for the first time in three years (Figure 1.19, upper-middle panel). This development suggests that market concerns are focused on the current availability of oil in the context

Figure 1.19. Crude Oil and Gasoline Prices



Sources: Bloomberg Financial Markets, LP; and IMF staff estimates.
¹Differentials are West Texas Intermediate prices and 93 octane gasoline for the United States; Brent and 95 octane gasoline for Europe; and Dubai and 95 octane gasoline for Asia.
²Futures crack margins are as of September 19, 2007.
³MTBE is methyl tertiary-butyl ether.

Figure 1.20. Developments in Oil Consumption and Production



Sources: International Energy Agency; and IMF staff estimates.
¹Non-OPEC supply and demand projections are from the International Energy Agency. Projections are not available for OPEC production and capacity.
²Includes crude oil and synthetic crude oil from tar sands, oil shale, and others.

of increased supply uncertainty and declining crude inventories.⁵ The weakening of the U.S. dollar—by lowering real prices for consumers and producers—may have also contributed to higher dollar prices: in terms of the euro and the SDR, oil prices have not risen as sharply (Figure 1.19, lower-middle panel).

Gasoline price spike. Refinery bottlenecks pushed U.S. retail gasoline prices to a record high in late May, but prices have since eased somewhat (Box 1.5). While the long-term gasoline price trend is determined by crude oil prices, over shorter periods changes in refinery availability can cause crude and gasoline price movements to diverge.⁶ Indeed, the gasoline crack spread spike in May 2007 followed two major spikes within a span of less than two years,⁷ likely reflecting an increased susceptibility of gasoline prices to supply shocks in the face of increasing refinery bottlenecks. Refinery problems in the United States have spilled over to other regions, in part through higher demand for imports of refined products—particularly in the United States and the Middle East—resulting in a rise in crude-gasoline price differentials in all major markets in the second quarter (Figure 1.19, lower panel). Refinery bottlenecks also depressed the price of WTI—the U.S. reference crude—relative to other crudes, particularly Brent, as crude inventories built up, waiting to be refined in the central United States. As refinery problems in the U.S. Midwest eased, WTI recovered and rose above Brent in late July.

⁵In general, the futures price equals the spot price plus costs of carry (such as cost of interest, cost of storage, and insurance) minus benefits of carry (or the “convenience yield”). When the spot market is tight, the benefits (or convenience) of having the commodity available on hand may offset costs of carry, pushing futures prices below the spot price.

⁶In addition, gasoline demand has a strong seasonal component that could cause large crude-gasoline differentials.

⁷The first spikes took place when Hurricane Katrina damaged Gulf of Mexico refineries and the second when ethanol was introduced as a gasoline additive.

Buoyant consumption. Global oil demand accelerated in the first half of 2007, growing at about 1 percent year on year, compared with about ½ percent during the same period in 2006. Demand has been subdued in many OECD countries, with consumption falling in Europe and Japan in the first half of 2007, as warm winter temperatures reduced demand for heating oil. Demand also weakened in the United States in the early part of 2007 but ended up increasing as a whole by about 1¼ percent year on year in the first half of 2007 as a result of strong consumption of transportation fuels, particularly diesel. Weak overall OECD demand, however, has been more than offset by robust demand growth in non-OECD countries—led by buoyant demand from China, India, and the Middle East (Figure 1.20, top panel; and Table 1.2). The strong non-OECD consumption growth, despite high prices, reflects rapid income growth in emerging market countries and below-market prices (especially in the Middle East), coupled with a weakening U.S. dollar that makes oil more affordable in local currencies.

Supply and inventories. Notwithstanding robust demand growth, overall output was unchanged in the first half of 2007 relative to the same period last year, and inventories were flat. The rise in non-OPEC production (1.0 mbd) was offset by a decline in OPEC production (0.9 mbd) (Figure 1.20, middle panel), reflecting quota cuts as well as shutdowns in Nigeria. Non-OPEC production growth was also lower than expected, reflecting a fall in production in Alaska, Mexico, and Norway, despite strong growth in Russia and Azerbaijan (Figure 1.20, lower panel). Preliminary estimates suggest global supply fell by 0.4 mbd in August owing to hurricane outages in Mexico and maintenance work in the North Sea. OECD commercial oil and product inventories have remained flat in the first half of 2007. U.S. gasoline inventories fell precipitously starting in February 2007 and are now decisively below their five-year average. Crude inventories began to decline in the third quarter of 2007—losing 10 percent of the stock—but still remain comfortable (Figure 1.21,

Table 1.2. Global Oil Demand by Region

	Demand			Annual Change		
	2005	2006	2007*	2005	2006	2007*
	Millions of Barrels a Day			Percent		
OECD	49.67	49.23	49.41	0.6	-0.9	0.4
North America	25.50	25.26	25.66	0.5	-0.9	1.6
of which						
United States	20.80	20.67	20.92	0.3	-0.6	1.2
Europe	15.61	15.56	15.38	0.8	-0.3	-1.2
Pacific	8.57	8.40	8.38	0.8	-1.9	-0.3
Non-OECD	34.05	35.27	36.56	3.2	3.6	3.6
of which						
China	6.69	7.16	7.58	4.2	6.9	5.9
Other Asia	8.79	8.87	9.11	1.9	0.9	2.8
Former Soviet Union	3.80	3.98	3.92	1.2	4.7	-1.5
Middle East	5.99	6.28	6.58	4.6	4.8	4.7
Africa	2.94	2.93	3.06	6.1	-0.3	4.4
Latin America	5.13	5.31	5.49	2.9	3.6	3.5
World	83.75	84.50	85.92	1.7	0.9	1.7

Source: International Energy Agency, *Oil Market Report*, September 2007.

Note: OECD = Organization for Economic Cooperation and Development.

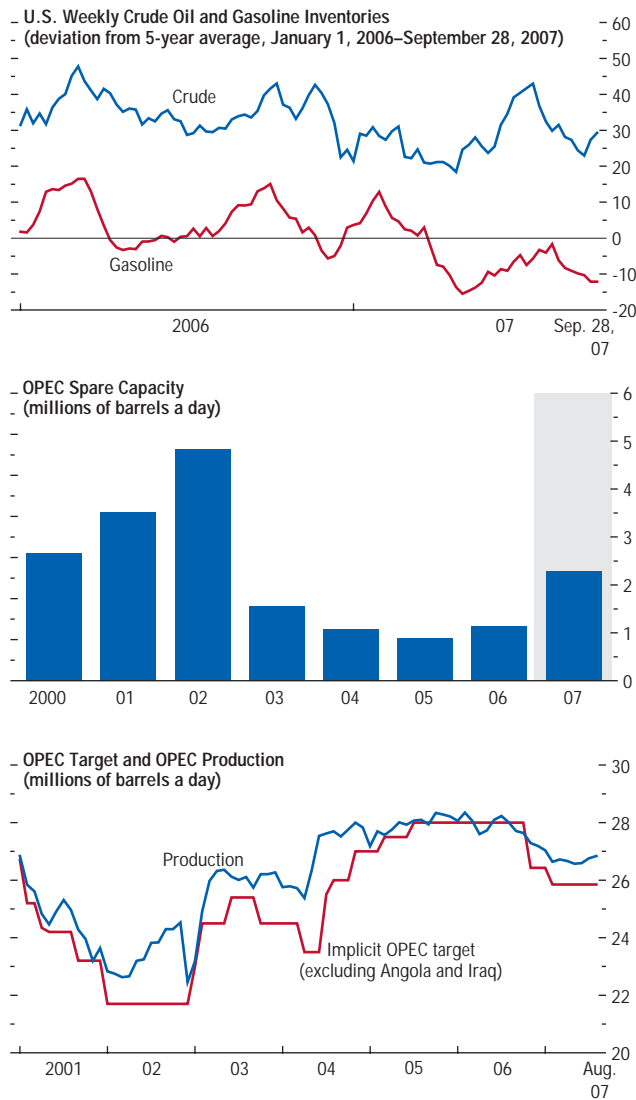
*Projections.

top panel). No comprehensive data are available on non-OECD inventories.

Increased OPEC spare capacity. OPEC crude oil production capacity increased by 0.5 mbd in the first half of 2007 relative to the same period in 2006. This, together with previous production cuts, has increased spare capacity to more comfortable levels. While this could in principle mitigate upward pressures on prices by reducing concerns about potential future supply disruptions, its impact on current prices has been more than offset by lower OPEC production (Figure 1.21).

Outlook. Looking forward, demand growth is expected to outstrip non-OPEC supply growth in 2007 and 2008. The International Energy Agency's (IEA's) revised forecasts point to a tighter market than envisaged earlier. On the supply side, growth is expected to be limited, with non-OPEC supply growth remaining lackluster at 0.6 mbd in 2007 (slightly higher than the increase in 2006), reflecting a proliferation of project delays and higher output declines than earlier expected in maturing fields (particularly in Norway, the United Kingdom, and Mexico). OPEC envisages a more optimistic supply scenario, projecting a rise in non-OPEC

Figure 1.21. Inventories and OPEC Production



Sources: Bloomberg Financial Markets, LP; Energy Information Agency, U.S. Department of Energy; International Energy Agency; and IMF staff estimates.

production of about 0.8 mbd in 2007. Rapid growth of the biofuels supply will raise the supply of transportation fuel, but biofuels still account for just over 1 percent of total fuel use (Box 1.6). The impact of biofuels on oil prices should be small—although they are having a tangible impact on food prices.

In contrast, on the demand side, the IEA expects consumption to grow by 1.4 mbd, driven by emerging market economies, in particular China, India, and the Middle East, as well as the United States—despite a slight downward revision to U.S. demand growth in the wake of the credit turmoil in August 2007. Furthermore, OECD demand for nontransportation fuels—which is more sensitive to the weather—is expected to pick up in the second half of 2007, assuming that temperatures revert to more normal levels from a relatively mild 2006. OPEC’s forecasts point to a somewhat smaller increase in global consumption (1.3 mbd in 2007).

As a result, although oil prices currently lie at the upper end of their historical range and modest declines are possible, upward pressures remain. An important characteristic of the recent price surge is that—unlike last year’s price peak in August—there has been no apparent intensification of geopolitical risks in the wake of the surge. Therefore, further upward price pressure could materialize in the event of renewed geopolitical concerns. The extent of upward pressures will in part depend on OPEC’s quota policies, dollar exchange rate movements, and global activity, but the direction and magnitude of these pressures remain uncertain. OPEC has indicated that it would consider increasing supply further in 2007:Q4, if necessary, as its assessment (as outlined above) is consistent with an implicit price target in the \$60–\$70 range. While OECD economic activity is expected to weaken somewhat, oil demand will be significantly affected only if the slowdown spills over to emerging markets where oil consumption growth is the most prominent.

As of October 5, futures and options markets indicate that oil prices will average over \$77 a barrel in the remainder of 2007 and \$76 a bar-

rel in 2008, with a 50 percent probability that Brent crude prices will be between \$69 and \$87 by January 2008 (Figure 1.22, top panel).

Over the medium term, the IEA expects tight market conditions to persist and possibly intensify by 2012, assuming strong GDP growth continues. Average global demand in the 2007–12 period would remain strong, increasing by 1.9 mbd a year—slightly above the average annual increase during 2002–07: a period of rising prices, spurred by accelerating non-OECD demand. OPEC’s capacity is expected to increase by an average of 0.8 mbd a year and non-OPEC capacity by only 0.5 mbd a year over the same period (compared with 0.7 mbd in the previous five years), as rising investment costs and prolonged project delays, together with high decline rates of major fields, create a drag on capacity expansion plans. With the increase in capacity likely falling short of the increase in demand, medium-term upward pressure on prices may continue in the absence of a global slowdown.

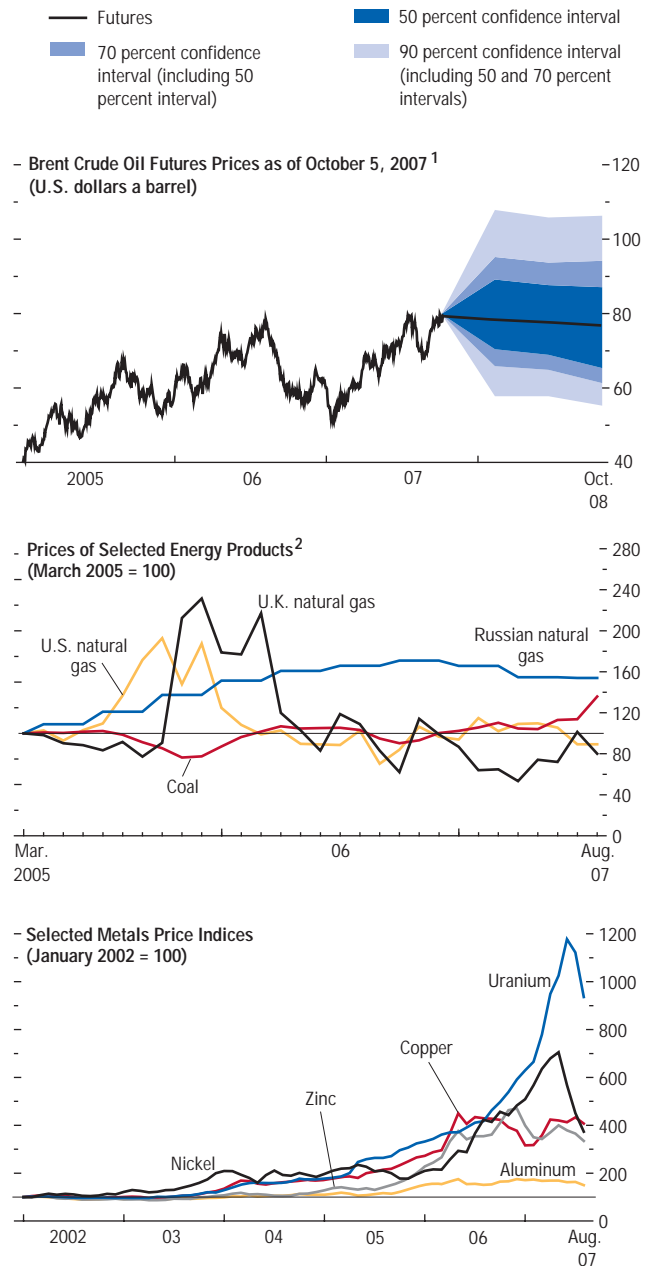
Natural Gas and Coal Markets

Natural gas prices have followed different trends across the Atlantic (Figure 1.22, middle panel). In the United States, after rising in the first quarter of 2007, prices have weakened—amid record-high inventory accumulation and the financial turmoil, although it strengthened somewhat in September. By contrast, after a dip in late April, U.K. prices largely followed an upward trend, reflecting some storage maintenance problems amid strong weather-related demand. Russian gas export prices have weakened somewhat over the past year. Average international coal prices rose by more than 32 percent during the first eight months of 2007, and demand is expected to strengthen further, with China emerging as a net importer for the first time in April.

Nonenergy Commodities

The IMF nonenergy index rose by 7 percent during the first eight months of 2007. Metals

Figure 1.22. Oil Futures Prices, and Selected Energy and Metals Prices



Sources: Bloomberg Financial Markets, LP; and IMF staff calculations.

¹From futures options.

²U.K. natural gas price data begin on March 11, 2005.

Box 1.5. Refinery Bottlenecks

Gasoline and diesel prices in the United States and elsewhere rose sharply in May 2007, with “crack spreads” (premium over crude oil prices) reaching levels close to those seen following Hurricane Katrina. The rise in spreads stemmed from refinery outages in the United States, owing to delayed maintenance and unexpected factors, which, combined with tight global refinery capacity, resulted in a drawdown in product stocks just before the peak summer demand period for transport fuels. Spreads have since come down (see Figure 1.19, bottom panel).

Refinery problems are not new in the United States. Refining capacity has lagged behind consumption growth, implying greater dependence on gasoline imports over the years (top panel of figure).¹ New investment has been hampered by strict environmental regulations, which can vary considerably by locality and thus add to uncertainty, as well as by a depressed oil market throughout the 1990s (which kept refining profit margins low). No new refineries have been built in the United States since the late 1970s. While notional capacity has increased somewhat through expanding capacity at existing refineries and enhancing efficiency, this process is limited by aging distillation units and increasingly strict fuel specifications, which have led to more required downtime and longer processing periods.

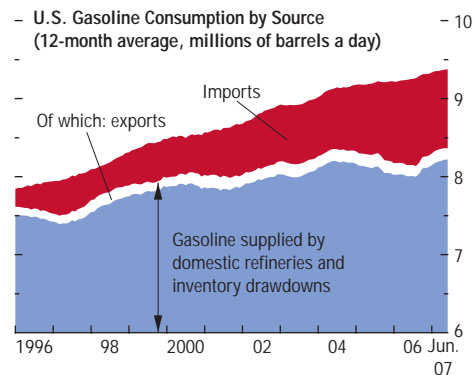
There is also a mismatch between the type of crude available and the refining capabilities at a more global scale. The majority of refineries cannot process heavy or sour oil² (which is in relatively greater supply globally) into high-

Note: The author of this box is Valerie Mercer-Blackman.

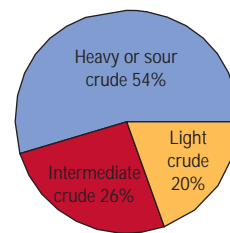
¹Refinery capacity problems also exist in Europe and in Japan, but unlike in the United States, consumption has stabilized in these regions.

²Heavy oil refers to a crude type that is relatively dense or has a high gravity per volumetric unit. Sour crude refers to a crude type that has relatively high sulfur content per volumetric unit. Both properties mean that the crude requires additional and more complex distillation to turn it into a unit of light, low-sulfur product.

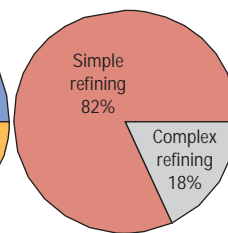
Gasoline Consumption and Refining Capacity



Global Crude Supply by Gravity and Sulfur Content¹



Refining Capacity by Distillation Complexity²



Sources: HPI Consultants; International Energy Agency; Platt's Haverly Crude Assay Library; and IMF staff calculations.

¹Crude quality is defined by its density and sulfur content. It is classified as heavy if its API gravity is below 30 degrees, intermediate if it is between 30 and 40 degrees, and light otherwise. It is sour if its sulfur content is greater than 0.05 parts per million.

²Simple refining is defined as a process of simple distillation or reforming. Complex refining is defined as catalytic cracking or thermal cracking, including upgrading capacity.

quality distillates such as gasoline and low-sulfur diesel (which are in relatively greater demand, and increasingly so) (bottom panel of figure).

In part reflecting these global mismatches, OPEC (2007) projects that growth of trade in refined products will exceed growth of trade in crude by 2020, with much of the growth coming from trade in products refined from sour oil (abundant in the Middle East) and directed mostly toward Asian markets. Planned refinery investment in the coming years should

expand capacity, albeit slowly. The International Energy Agency predicts that most of the new distillation capacity additions will be in emerging markets: out of the almost 11 million barrels a day (mbd) capacity expansions planned globally over the next five years, Asia and the Middle East are expected to contribute about 7 mbd.

The risks to these projections, however, are on the downside. Rising costs of materials and a chronic lack of skilled labor may delay or constrain projects. In addition, uncertainties arising from environmental concerns and efforts to switch to cleaner alternatives, in part through stricter regulations to control emissions, will likely raise costs for potential refinery investors.

prices extended their strong price run-up of recent years, while some food prices rose sharply. Agricultural raw materials and beverage prices increased more slowly. Looking forward, the index is expected to decline somewhat as supply responds to increased demand, although short-term downside price risks to food prices should be limited by the strong biofuel demand.

Robust metals prices reflecting supply problems. While prices suffered losses amid sell-offs during the recent credit crunch, they have remained strong, largely reflecting supply problems. Overall, prices rose by about 8¾ percent during the first eight months of 2007, led by lead—which set new record highs during the period—as well as copper and tin (Figure 1.22, lower panel). Nickel and uranium, however, suffered major losses more recently after both reached record highs in the early summer. While demand has been buoyant—for example, for copper, reflecting increased Chinese demand for restocking, and for uranium (during the first half of 2007), owing to increased demand for nuclear energy—supply factors appear to have been the main driver of higher prices. Labor disputes in copper mines in Chile, Mexico, and Peru continued to disrupt production, while the ensuing wage increases have increased the long-term cost of production. In addition, certain restrictive government policies—such as Indonesia’s tightened tin export regulation—have reduced supply. Finally, industry consolidation has reduced the number of plants against the background

of delays in new projects. Consequently, inventories have been low for most metals, thereby reducing the safety cushion in the event of supply disruptions. Looking forward, prices are expected to soften from recent highs, but they are expected to be supported by increasing costs over the longer term, reflecting intense competition for skilled labor and equipment and energy costs.

Buoyant food prices amid robust biofuel demand. Food prices rose by 10½ percent during January–August, led by soybean, edible oils, and wheat prices, and have remained relatively immune to the recent financial turmoil. Expansion of biofuel production has increased demand for corn, soybeans, and edible oils. Although corn prices fell by 8½ percent during the first eight months of 2007—as a result of production growth of 15 percent relative to 2006 in response to high prices—they are still about 50 percent higher than in the same period in 2006. Wheat prices reached their highest level since the mid-1990s in mid-July, reflecting adverse weather amid historically low inventories. Meat prices rose by more than 8 percent, reflecting the increased cost of feed. Higher prices have been accompanied by generally tighter demand-supply balances, as manifested in declining stock-to-consumption ratios for corn, wheat, and meat, as well as the projected decline for soybeans. In contrast, sugar prices have weakened significantly over the past year, owing to the strength of supply in Brazil and limited export opportunities for Brazilian sugar-based ethanol.

Box 1.6. Making the Most of Biofuels

High oil prices in recent years, together with generous policy support, have led to a surge in biofuel use as a supplement to transportation fuels in advanced economies.¹ In 2005, the United States overtook Brazil to become the world's largest producer of ethanol, while the European Union is the largest biodiesel producer. This box examines this development, assessing whether the strong push toward biofuels production makes sense in a global context, from both an economic and an environmental perspective.

What Are the Costs and Benefits of Biofuels?

There are important disagreements among policymakers and analysts on the viability of biofuels as a supplement to transportation fuels. Part of the disagreement stems from the difficulty of measuring their net benefit. Average production costs and net greenhouse gas emissions can vary substantially according to location, labor intensity, feedstock prices, production scale, and available infrastructure. Moreover, rapid advances in some biofuels production technology are rendering early estimates obsolete.

Subject to these limitations, the table shows indicators of costs and benefits of producing a unit of biofuel. Only Brazilian ethanol derived from sugarcane is less costly to produce than gasoline and corn-based ethanol (about 15 percent and, in energy-equivalent terms, 25 percent less, respectively). Furthermore, sugarcane ethanol produces 91 percent fewer greenhouse gas emissions per kilometer traveled than gasoline. Soaring palm oil prices since 2006 have recently eliminated the relative cost advantage Malaysian biodiesel had compared with diesel, but it is still cheaper to produce than other types of biodiesel. According to

some estimates, *Jatropha*-based biodiesel that is developed in India may be cheaper to produce than diesel, but some inefficiencies remain. All biofuels do less environmental damage than gasoline or diesel, but the relative benefits of corn- and wheat-based ethanol are small. Second-generation biofuels have substantially greater environmental benefits but are costlier to produce.²

In addition to these quantifiable aspects of biofuels' production, there are other, indirect, costs that would quickly escalate if first-generation biofuels were used more intensively than they are now. First, the growing use of grains and oils as feedstock in biofuel production could further boost food prices beyond current levels. Second, feedstock planting on a greater scale—particularly for biodiesel—would exert additional stress on already highly exploited land and water resources worldwide. A study by LMC International (2006) finds that raising biofuels production sufficiently to provide 5 percent of global fuel needs by 2015 would require expanding planted land acreage of all cultivated land by 15 percent. Finally, substantial fixed costs would be required to build the infrastructure and vehicles necessary for the distribution of ethanol on a larger scale.³

On the other hand, there are also potentially significant indirect benefits, particularly for commodity-producing developing countries. First, biofuels allow for the diversification of energy sources and thus lower a country's exposure to oil price volatility. They also hold the promise of contributing to rural development by creating jobs in the production of the feedstock and the relatively simple manufacture of biofuels. Given their negligible tailpipe

Note: The author of this box is Valerie Mercer-Blackman.

¹Ethanol accounts for over 80 percent of global biofuel use; it can be blended with gasoline and is produced from corn, wheat, and sugar. Biodiesel can substitute for diesel fuel and is produced from edible oils (soy, palm, rapeseed) and other fats.

²Global biofuels research aimed at developing biofuels that use waste vegetable products as inputs instead of foods (known as second-generation biofuels) is ongoing, but is expected to take at least five years to become commercially viable.

³Conventional gasoline-powered vehicles can only use fuel with up to about 15 percent ethanol without costly alterations.

Costs and Benefits of Biofuels Production (2007 or latest available figures)

Fuel	Cost Indicators		Indicators of Environmental Benefits	
	Cost of production per liter in dollars ¹	Share of feedstock cost in total production cost (in percent)	Life cycle analysis of GHG emissions ² (in percent)	Net renewable energy creation relative to petroleum-based fuels ³
Ethanol				
First generation				
Sugarcane-based Brazilian	0.23–0.29	37	–91	1.7
Corn-based U.S.	0.40	39–50	–18	1.22
Wheat-based European	0.59	68	–47	1.1
Sugar beet-based European	0.76	34	–35	1.7
Second generation				
Ethanol from cellulosic waste	0.71	90	–88	8.2
Gasoline in energy-value terms (U.S. market) ⁴	0.34	73	0	1.0
Biodiesel				
First generation				
Palm oil Malaysian	0.54	80–85	–70 to –110 ⁶	5.1
Soybean oil-based, U.S.	0.66	80–85	–70	3.8
Rapeseed oil-based, Europe	0.87	80–85	–21 to –38	3.8
Second generation				
Jatropha-based, India ⁵	0.40–0.65	80–85	–100 to –120	7.3 (e)
Diesel in energy-value terms (U.S. market) ⁴	0.41	75	0	1.0

Sources: Kojima, Mitchell, and Ward (2007); Energy Charter Secretariat (2007); Larson (2006); Farrell and others (2006); USDA Foreign Agricultural Service (2007); U.S. Department of Agriculture (2006); Sheehan and others (1998); World Wildlife Fund (2007); Renewable Energy (2007); European Biomass Association; and IMF staff estimates.

¹Costs are highly sensitive to feedstock prices. Average prices between 2006:Q1 and 2007:Q2 were used for estimates, where crude oil prices averaged about \$65. Subsidies and transport costs are not considered in the cost estimates.

²Defined as the change in life cycle greenhouse gas (GHG) emissions per kilometer traveled by replacing fossil fuels with biofuels in conventional vehicles. Life cycle means that the emissions are measured over the production cycle of the respective fuel.

³Defined as the new energy created relative to the energy input in the production, distribution, and retailing of biofuels. Measured relative to the new energy created in the production of the respective fossil fuel (measured in megajoules/megajoules).

⁴Ethanol gives about a third less energy per liter than gasoline in conventional autos, while biodiesel gives about 8 percent less than diesel. Gasoline and diesel costs have been correspondingly adjusted downward to make them comparable with biofuels' costs.

⁵Jatropha is a drought-resistant oil-producing tree that does not compete with food for arable land and water. It is being developed in India and, to a lesser extent, in Africa and Central America as a biodiesel feedstock. (e) = estimate.

⁶This estimate assumes best practices in land management and does not account for potential emissions caused by rain forest deforestation suggested by some environmental groups.

emissions, they can help reduce local pollution from agents such as sulfur particles—particularly when vehicle fleets are old. Finally, a producer from a Kyoto-Protocol-signatory developing country can earn carbon credits through the clean development mechanism for every unit of renewable energy created (Appendix 1.2).

On balance, therefore, some biofuels are economically and environmentally beneficial at modest blends. Whether the net benefits are realized, and how they are distributed, depends crucially on the policy context under which they are instituted.

What Are the Likely Effects of the Current U.S. and EU Biofuels Policies?

A number of countries have adopted policies to promote domestic biofuels production in an effort to reduce their dependence on petroleum imports.⁴ The most generous incentives

⁴In addition to the EU countries and the United States, tax benefits for consumers exist in Australia, Canada, Brazil, and India. Moreover, many countries have adopted targets—some mandatory—as well as research tax incentives for increasing biofuels production. Among them are Argentina, Canada, Brazil, India, Thailand, Malaysia, the Philippines, Colombia, China, and Japan.

Box 1.6 (concluded)

are offered by the United States and the EU countries.

- *In the United States*, blenders receive tax credits of \$0.51 and \$1, respectively, per gallon of ethanol and biodiesel sold against their income tax. There is also a \$0.54 a gallon (\$0.14 a liter) tariff on ethanol imports (none on biodiesel).⁵ In several states, a 10 percent ethanol blend must be added to gasoline as an oxygenate (to make it burn more efficiently) as of May 2006; other states have additional tax incentives. At the federal level, the 2005 Energy Policy Act set a goal that renewable fuels reach 7.5 billion gallons by 2012 (about 10 percent of the total expected gasoline use). Most of the target is expected to be met by domestically produced corn-based ethanol. A bill that would almost quintuple the biofuels target, to 35 billion gallons by 2022, is under consideration.
- *In the European Union*, most countries offer fuel tax exemptions for biofuels (a large benefit, given high fuel taxes) and research subsidies. The average tariff on ethanol imports is \$0.19 a liter, whereas biodiesel feedstocks have tariffs of up to 6.5 percent. Countries' official targets vary, but most converge to the EU current voluntary and somewhat ambitious target of biofuels comprising 5.75 percent of total fuels by 2010. The European Union also has a legally binding target of 10 percent by 2020.

To illustrate the effect of U.S. and EU policies, a hypothetical yet politically unlikely alternative scenario was simulated to 2012. The scenario illustrates the impact of removing biofuels tax credits and tariffs in the United States and European Union on global biofuels production and on net commodity exports.

⁵However, the United States and European Union both have tariffs on the oils used as feedstock for biodiesel, which at the outset ironically puts domestic producers at a disadvantage relative to importers. This is offset by the \$1.00 a gallon blender credit (in the United States) and tax exemptions for biodiesel (in Europe); these distortions have given rise to "subsidy arbitrage" across countries.

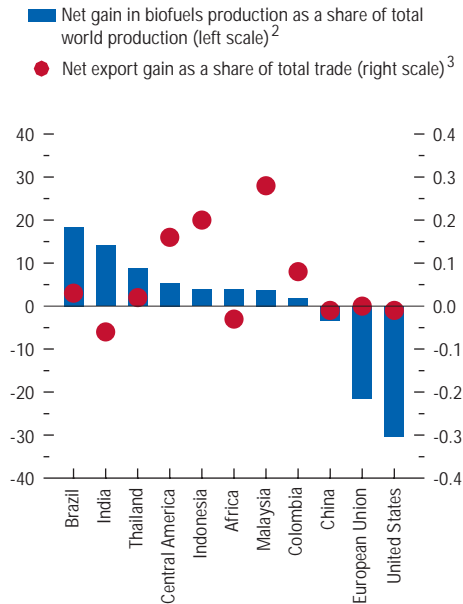
Many important interactions are ignored, and so the analysis should be considered as illustrative of the likely effects rather than as predictive. The baseline forecast for production and consumption volume of biofuels by country is based on the International Energy Agency's medium-term projections, whereas baseline commodity price projections are those of the IMF. Total demand for biofuels in 2012 and its distribution across countries is assumed to remain exactly the same under both scenarios, and still largely dictated by targets and mandates. Retail prices for mostly first-generation biofuels continue to be determined by domestic fuel prices as a result of their negligible share in total transportation fuels. Therefore, the only changes relative to baseline in the analysis are the geographical distribution of production, and feedstock prices.

Under this scenario, production using other, more expensive, feedstocks in the United States and European Union would become unprofitable and shut down as supply increasingly came from lower-cost importers (see figure). By 2012 ethanol would be produced largely by Brazil and other Latin American countries, and biodiesel by Asian countries (using *Jatropha* for the case of India).⁶ There is also an indirect effect through commodity prices. The ensuing higher demand for sugarcane and palm oil raises their price by 15 percent and 20 percent, respectively, while lower demand for corn, wheat, soybean oil, and rapeseed oil (the main biofuels feedstocks in the United States and the European Union) reduces their prices by 10 percent

⁶In the alternative scenario, countries are assumed to produce ethanol and biodiesel in proportion to their expected 2007 sugarcane and palm oil exports, respectively, using U.S. Department of Agriculture (USDA) data. This is because the production technology is fairly simple. At projected consumption levels, there would not yet be significant constraints on land use. Moreover, the market for Indian *Jatropha*-based biodiesel is expected to open up in the alternative scenario, as it is already being developed but does not have a large enough impetus in the baseline scenario.

Net Gain in 2012 Biofuels Production and Net Exports over Trade—Selected Countries and Regions¹

(Percent change relative to baseline forecast)



Sources: International Energy Agency; and IMF staff estimates.

¹In the alternative scenario, ethanol is produced exclusively from sugarcane, and biodiesel from palm oil (jatropha in India).

²Refers to the percent change in ethanol and biodiesel produced in 2012 relative to the baseline forecast.

³Refers to the change in net exports in the alternative scenario relative to baseline divided by projected 2012 trade, where trade is defined as exports plus imports of goods (IMF estimates). In the alternative scenario, corn, wheat, and soybean oil prices fall by 10 percent, and sugar and palm oil prices rise by 15 percent and 20 percent, respectively.

relative to baseline.⁷ Net exports as a share of total projected trade in goods in 2012 would

⁷Price changes are based on USDA forecasts and IMF staff calculations based on historical elasticities. Sugar is highly protected in the United States and European Union, so there is considerable room for expansion of its cultivation worldwide (including in the highly productive southcentral Brazil). Consequently, unlike corn in the United States, prices do not have to rise too dramatically to incite a supply response.

generally improve for biofuels producers (less so for net grain exporters). They would worsen slightly for net palm oil importers such as India and Africa, and by a negligible amount in the United States and the European Union (less than 0.01 percent of total trade). All in all, overall average global production costs and greenhouse gas emissions would decline as more efficient producers came in. Fiscal costs in the United States and the European Union would also fall, although by a very small percentage of their respective budgets.⁸

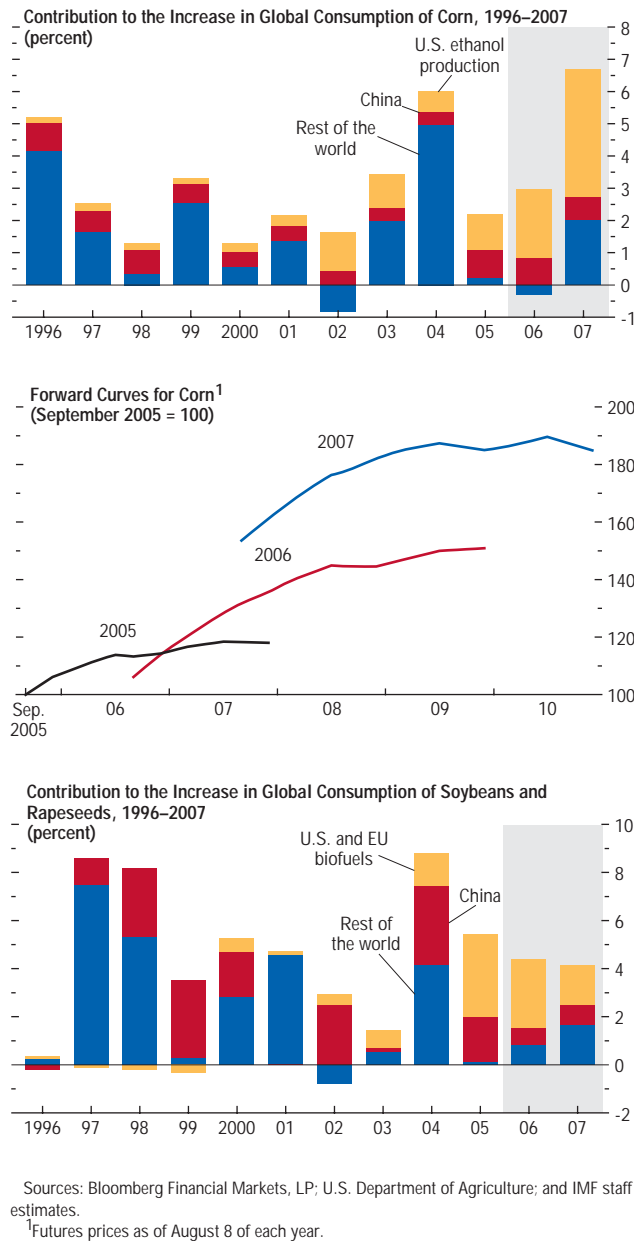
How Could Biofuels Policies Improve?

The analysis in this box illustrates how current policies in the United States and the European Union are sustaining inefficient production patterns. This does not mean that biofuel use should not be promoted as a supplement to regular fuel in small amounts; biofuels have some useful environmental benefits relative to petroleum-based fuels. Certain policies could be implemented to enhance these net benefits.

- The first-best policy would be to allow free trade in biofuels while levying a carbon tax on all fuels to reflect emissions costs. This way, the environmental benefits of biofuels would be fully maximized (see Appendix 1.2).
- A blending mandate with a clear time limit could be justified for biofuels as a means to overcome the transitional fixed costs of moving to a new technology.
- Research and development of renewables should be promoted. There is a legitimate role for governments to fund promising research on such activities, given their public good character, especially if the environmental impact is not being adequately priced.

⁸The main direct and indirect fiscal costs in the United States and European Union stem from agricultural policies, which are assumed to remain unchanged in the baseline and alternative scenarios. See the discussion on costs in Box 5.2 of the September 2006 *World Economic Outlook*.

Figure 1.23. Sources of Demand and Prices of Selected Fuel-Related Food Items



Overall, the recent boom in food prices reflects a combination of factors:

- Strong demand for biofuel: higher ethanol production in the United States is projected to account for 60 percent of the global increase in corn consumption in 2007 (Figure 1.23, top panel). The impact on corn prices has been amplified by policy commitments to promote the use of ethanol further, which have pushed up futures prices (Figure 1.23, middle panel). According to the U.S. Department of Agriculture, the amount of corn used to produce ethanol in the United States is likely to increase from 14 percent of total U.S. production in 2005/06 to 30 percent by 2010/11. Similarly, increasing use of soybean and rapeseed oil in producing biofuels in the United States and the European Union has accounted for the bulk of demand growth for these crops in recent years (Figure 1.23, bottom panel). Strong expansion in biofuel production has also indirectly buoyed prices of other nonfuel-related food items by providing incentives for farmers to switch away from other crop plantings and by increasing the cost of livestock feed.
- Increased demand from emerging markets: China has been an important source of global food demand growth, accounting, for example, for 35–40 percent of the increase in global consumption of soybeans and meat. India’s contribution to global demand for food, particularly meat, has also picked up recently. Although increased food consumption by emerging market economies has supported food prices, it is unlikely to have played a leading role in the recent surge, given that these economies’ food demand began to increase strongly in the 1990s, long before the current run-up in prices.
- Adverse supply shocks: unfavorable weather conditions have reduced the global harvest for some food items. For example, the severe drought in Australia, a major wheat exporter, reduced the Australian wheat production by 60 percent in 2006. In addition, an outbreak of the “blue-ear disease” has significantly

reduced pork stocks in China and pushed up domestic meat prices by over 50 percent in August 2007 (year on year), raising annual food price inflation to over 16 percent.

Semiconductors. Global semiconductor sales revenue declined by more than 2 percent the first half of 2007 year on year, compared with growth of more than 9 percent during the same period in 2006. This reflected declining average selling prices, because of fierce competition in the microprocessor segment amid excess capacity in DRAM markets, fragile demand, and high inventories. Looking forward, this trend is expected to continue in the second half of 2007 and beyond, with the forecast for 2007 sales growth revised significantly downward to 1.8 percent from the 10 percent envisaged earlier.

Appendix 1.2. Climate Change: Economic Impact and Policy Responses

The authors of this appendix, including the boxes, are Ben Jones, Michael Keen, John Norregaard, and Jon Strand.

There is now a wide consensus that man-made climate change is occurring, will continue into the foreseeable future, and is likely to intensify (IPCC, 2007b).⁸ The challenges for economic policy that this poses are substantial. Perhaps most fundamentally, climate change is a global externality: the social consequences of emitting the greenhouse gases (GHGs) that drive the process are not borne fully by those emitting the gases, but are shared across the world—with low-income countries likely to be most seriously affected. This raises significant problems of international coordination. These are com-

⁸The Intergovernmental Panel on Climate Change (IPCC) was established by the United Nations Environment Programme (UNEP) and the World Meteorological Organisation to provide syntheses of research on climate change. There are, it should be noted, dissenting opinions on the relationships between human activities and increased atmospheric concentrations of greenhouse gases and between increased concentrations and observed and projected temperature changes: see, for example, Lindzen, Chou, and Hou (2001); and Carter and others (2007).

pounded by the stock nature of the externality (harm arising not from the current flow but from the cumulated stock), which implies that much future damage reflects past emissions. Further conceptual and practical issues arise from the long lags in the process and from the considerable uncertainties that remain, including the risk (even if with relatively low probability) of extremely damaging events.

This appendix explores these challenges. It briefly lays out what is known about the science of climate change, to set the scene for a review of its economic impact. The appendix also discusses the economics of policy interventions to promote adaptation aimed at reducing the damage from climate change and of mitigation strategies to limit the atmospheric changes that cause it. These issues will be explored in greater depth in the April 2008 *World Economic Outlook*.

Outlining the Challenge

The main GHGs emitted by human activity are carbon dioxide (CO₂), contributing about 77 percent of total GHG emissions, and methane and nitrous oxide, each contributing about 14 and 8 percent, respectively.⁹ The atmospheric concentration of GHGs (measured in CO₂ equivalents, CO₂e) has increased from about 300 parts per million (ppm) in 1750 to 430 ppm now, and is increasing by about 2 ppm a year.¹⁰ The global average temperature increased by about 0.7°C between 1906 and 2005,¹¹ and existing GHG concentrations are expected to cause a further substantive temperature increase in the coming decades.¹²

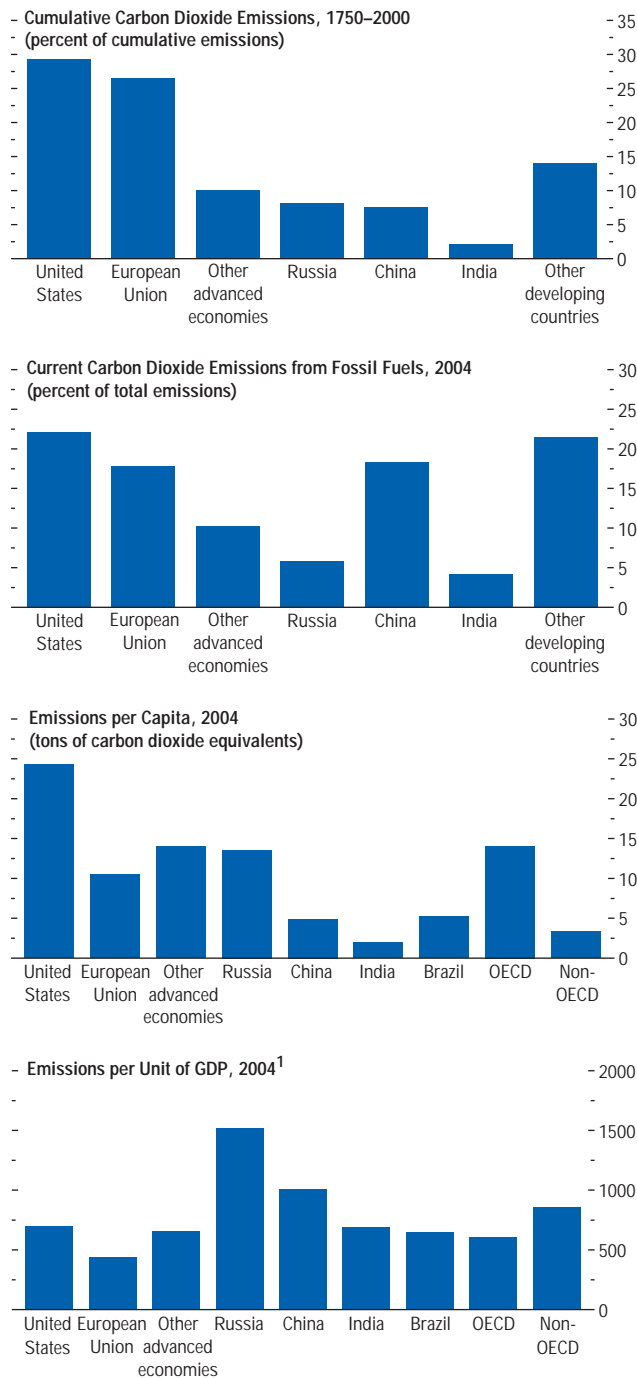
⁹Water vapor is the most abundant GHG, but human activities have only a small direct effect on its amount, and, unlike other GHGs, it has only a relatively short-lived climatic impact. References to GHGs henceforth exclude water vapor.

¹⁰Stern and others (2007).

¹¹IPCC (2007b). The increase has not been monotonic, however.

¹²Model-based estimates are that even if atmospheric concentrations were held constant at 2000 levels, further warming of about 0.2°C would occur over the next 20 years (with a best estimate of cumulative warming of 0.6°C by the end of the century): IPCC (2007b).

Figure 1.24. Greenhouse Gas Emissions by Region



Sources: Baumert, Herzog, and Pershing (2005); and International Energy Agency (2006, 2007).
¹Tons of carbon dioxide equivalents per million U.S. dollars, adjusted for purchasing power parity.

With no policy response, “business-as-usual” (BAU) emissions are projected by IPCC (2007b) to lead to average global temperature increases of between 1.1°C and 6.4°C (above preindustrial levels) by 2100.¹³ As an indication of the potential significance of this projection, warming of 5°C would be roughly comparable to the difference between temperatures during the most recent ice age and today.

Although timing and geographical incidence are uncertain, a number of climatic effects are expected. The greatest increases in temperature are projected for the northern parts of North America, Europe, and Asia, with smaller (but still sizable) increases in tropical areas. The global pattern of rainfall is likely to change, with many already dry areas (including in Africa, Australia, South Asia, the Middle East, and the Mediterranean) expected to become even drier. There are further possible (but highly uncertain) effects on rainfall in many tropical zones (such as the Amazon region) as well as on seasonal patterns (of the Asian monsoon, for example), potentially affecting the sustainability of large human populations and critical natural resources. Flood risk is projected to increase by more intense rainfall and sea-level rise (from 0.2 to 0.6 meters in this century¹⁴—more with accelerated glacial melting). In addition, the frequency and/or severity of extreme weather events, including hurricanes, floods, heat waves, and droughts, are expected to increase, most seriously in Africa, Asia, and the Caribbean.

Beyond these effects, there may be “tipping points,” which, if passed, would result in more dramatic and irreversible climate effects. These include the potential for rapid glacial

¹³IPCC (2007b) reports temperature projections for a series of scenarios, providing for each an upper and lower bound, with an 82 percent probability of temperature rise being between them: the range reported here is between the lowest and highest of these bounds. Underlying all these scenarios—and providing a simple, ready reckoner—is a common assumption that doubling CO₂ concentrations above preindustrial levels implies a 66 percent or higher chance of global average surface warming of 2°–4.5°C (with a best estimate of about 3°C).

¹⁴IPCC (2007a).

melting, reversal of the Gulf Stream (leading to dramatic climate change in northern Europe), and large-scale tundra thawing in Canada, China, and Russia, resulting in massive methane release. Although there is considerable uncertainty as to the precise location of these thresholds, many—such as irreversible melting of the Greenland ice sheet, contributing to several meters of sea-level rise—may lie within the range of temperature increases that are possible (even under some mitigation scenarios) in this century.

Sources of Greenhouse Gas Emissions

Climate change is caused by the accumulated *stock* of GHGs, while most policies to limit the risk can address only the flow of *emissions*.¹⁵ The top two panels of Figure 1.24 show the sources of the stock of CO₂ (accumulated emissions since 1750) by region, together with annual emissions in 2004, both in percent of the total. Advanced economies account for about 75–80 percent of this stock, but a much greater proportion of current emissions stems from emerging market and developing countries (henceforth, “developing countries” includes emerging markets).

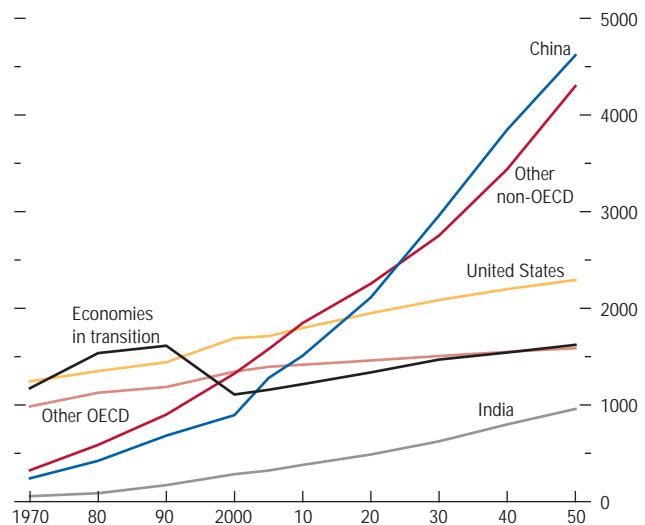
The bottom two panels in Figure 1.24 show that emissions per capita are about four times as high in OECD countries as elsewhere; relative to GDP, however, they are higher in developing countries. Reflecting this pattern of emission intensity, and prospective future growth, the share of developing countries in total emissions under BAU is expected to rise substantially from 2004 to 2050 (Figure 1.25).

Macroeconomic and Fiscal Impact of Climate Change

The macroeconomic and fiscal impact of climate change is potentially substantial, and could include the following effects:

¹⁵There are geoengineering approaches that instead seek to limit the warming from a given atmospheric concentration by limiting incoming radiation from the sun: see, for instance, Schelling (2007).

Figure 1.25. Actual and Projected Fuel-Related Carbon Emissions Under “Business-as-Usual”
(Millions of tons of carbon per year)



Sources: Baumert, Herzog, and Pershing (2005); and International Energy Agency (2007).

- direct negative impact on output and productivity from long-term temperature change and more intense and/or frequent extreme weather events,¹⁶ particularly in the agriculture, fisheries, and tourism sectors.¹⁷ Agricultural effects are likely to differ by region, with reduced output in hotter (and generally poorer) regions, whereas northern (often more prosperous) areas may benefit from temperature increases of 1°–3°C;¹⁸
- costs from sea-level rise and increased severity of flooding. One study estimates that a one-meter increase would reduce GDP by close to 10 percent for several countries, including Bangladesh, Egypt, Mauritania, and Vietnam (Dasgupta and others, 2007). This degree of sea-level rise is some way above the consensus estimate, and the costs are likely to fall more than proportionately at lower levels of the rise, but the effects could be sizable. Some small island states, including Kiribati, the Maldives, the Marshall Islands, and Micronesia, are seen as particularly at risk, as are populations in coastal areas across a wider set of countries, including many rapidly expanding urban centers;¹⁹
- increased risk of widespread migration and conflict, resulting from long-term climate deterioration and greater damage from extreme weather events;
- deteriorating fiscal positions arising from weakening of traditional tax bases and/or

- increased expenditure on some aspects of mitigation and adaptation (as discussed below);
- more positively, there is potential revenue to be gained from mitigation schemes—a double dividend, with benefits to the public finances as well as to the environment, from reduced reliance on more distortionary taxes;
- costs arising from efforts to mitigate carbon emissions, including higher energy prices and increased investment, are becoming important in many (so far, largely the industrial) countries;
- balance of payments problems in some countries owing to reduced exports of goods and services (agricultural products, fish, and tourism) or increased need for food and other essential imports. Damage to transport infrastructure (ports and roads) may disrupt trade flows; and
- “nonmarket” effects associated with the loss of biodiversity and ecological systems, and the effects of climate change on human health and the quality of life.

Determining an effective response to climate change requires calibrating the nature, extent, and distribution of these effects. Climate scientists have naturally focused on the uncertainties associated with the complex nonlinear dynamics of the warming process. But there are also substantial uncertainties associated with estimating the associated economic and wider welfare effects. Key variables include rates of future population and productivity growth, especially the rate of convergence of economic growth across regions, the intensity of emissions through time and for different regions, and the rate of adoption of new technologies. Aggregating effects over time also requires a choice of discount rate, which, as discussed later, has been the focus of much recent discussion.

Several studies take on these challenges, using models that emphasize different linkages. The recent *Stern Review* (Stern and others, 2007) uses an “integrated” climate-macroeconomic model and a probabilistic welfare framework that included nonmarket effects as well as low-probability but very damaging extreme

¹⁶There is evidence of rapid increases in the economic costs of extreme events. For example, Munich Re (cited in “UN Finance Initiative CEO Briefing,” 2006) reports that the infrastructure and some other costs of extreme weather events increased by an annual average of 6 percent between 1950 to 2005. A continuation of this trend would see expected losses of \$800 billion by 2041, with peak-year losses of over \$1 trillion.

¹⁷During the drought of 1991–92, to give just one example of the costliness of such events, agricultural output in Malawi fell by about 25 percent and GDP by 7 percent.

¹⁸However, this would depend largely on there being a strongly positive carbon fertilization effect, which remains uncertain.

¹⁹Twelve of the world’s 16 megacities (more than 10 million inhabitants), all growing rapidly, are coastal (“UN Finance Initiative CEO Briefing,” November 2006).

outcomes. Figure 1.26 shows the time path of expected damage (in percent of global GDP per capita) under Stern’s three main scenarios, which differ in climate sensitivity and the valuation of nonmarket effects (such as reduced biodiversity). The shaded areas show the corresponding 90 percent confidence intervals. The projected potential losses rise substantially over time: the range of the central estimates is from 1 to 2 percent of GDP in 2050, 2 to 8 percent by 2100, and 5 to 14 percent by 2200.²⁰

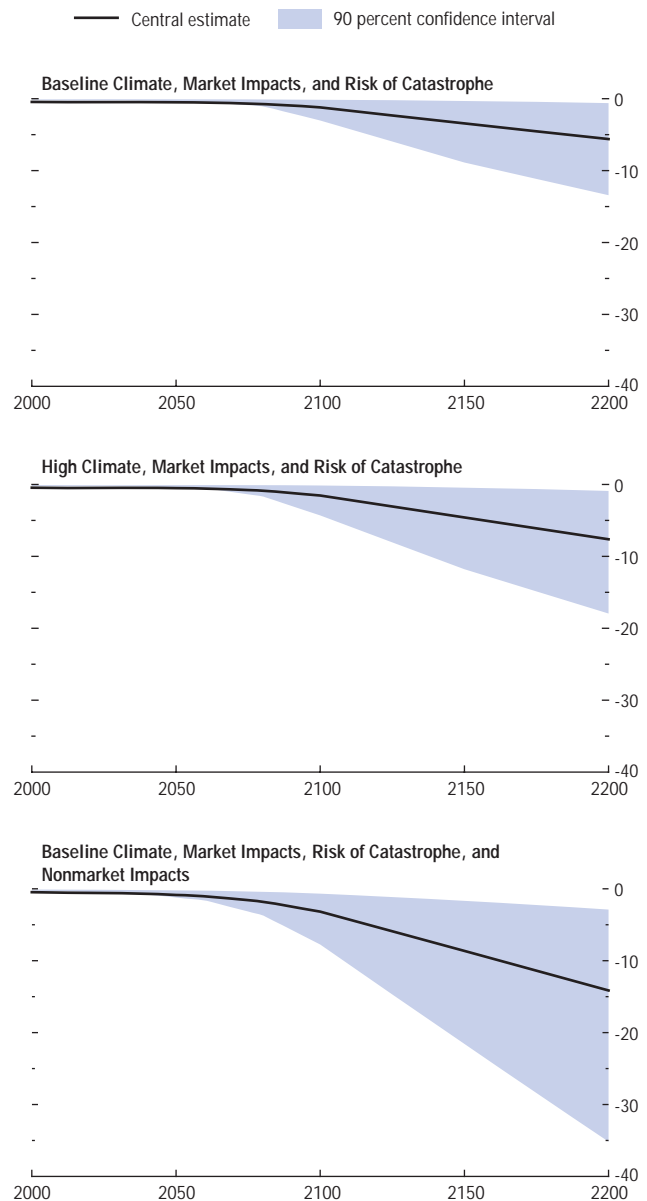
Other studies that assess the macroeconomic effects of climate change at different levels of warming include Mendelsohn and others (2000); Nordhaus and Boyer (2000); Hope (2006); and Tol (2005). Figure 1.27 presents some of these results alongside the central estimates of the three *Stern Review* scenarios referred to above. These results span a wide range of possible economic costs ranging from negligible (even positive at low levels of warming) to output losses of about 10 percent for average global warming of 6°C (possible, but unlikely by 2100, according to the IPCC).

Why are the estimates of the economic impact of climate change so different? The Mendelsohn analysis is based on relatively narrow sector coverage and assumes a relatively high capacity for adaptation. Nordhaus and Stern include estimates of wider nonmarket effects, and at higher levels of warming their results are driven largely by more extensive allowance for the risks and costs of catastrophic impacts and economic disruptions. Nordhaus, Stern, and Tol look beyond aggregate effects, recognizing that the poorest countries are likely to be affected hardest and earliest, generally owing to greater exposure to physical climate change and weaker socioeconomic resilience.²¹

²⁰Rising to 20 percent in 2200 if account is taken of the disproportionately high burden of climate change borne by poorer parts of the world. This is not included in the scenarios of Figure 1.27.

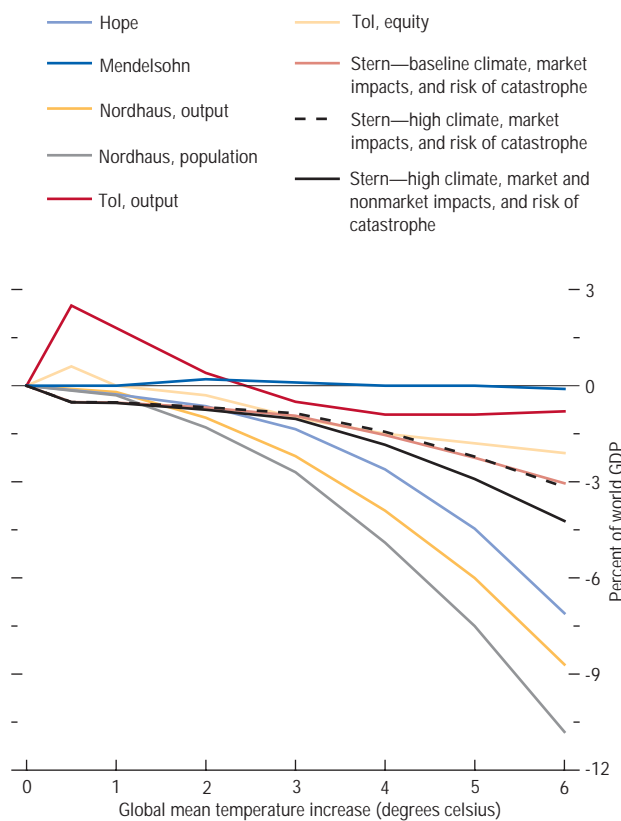
²¹This often reflects lower income levels, greater economic dependency on agriculture and vulnerable ecosystems, food insecurity, and less-developed infrastructure and public services.

Figure 1.26. Time Profile of Aggregate Damages from Climate Change
(Percent loss in GDP per capita)



Source: Stern and others (2007).

Figure 1.27. Mean per Capita GDP Losses at Different Levels of Warming



Sources: Hope (2006); and Stern and others (2007).

For example, at 2.5°C warming, Tol finds overall positive economic effects, reflecting output gains in rich countries, but he also finds (as does Nordhaus) GDP losses of about 4 percent in Africa. At higher levels of warming, similar distributional effects persist, although economic effects become universally negative (but with the range of uncertainty becoming wider). Allowing for these distributional aspects of climate change leads to larger effects than does focusing on total output. Differing choices of discount rate also powerfully affect the assessments that emerge from aggregating effects over time (see discussion below).

Policy Responses to Climate Change

Whereas views differ on the appropriate extent and urgency, there is broad consensus on the need for some action to reduce the high economic risks posed by expected levels of warming consistent with BAU projections. This can take the following two main forms, with action on both fronts now widely seen as needed:

- *adapting* behavior and investment to reduce the economic and social impact of climate change, for example, by constructing flood defenses in response to rising sea levels; and
- *mitigating* the extent of climate change by reducing GHG emissions through improved energy efficiency; carbon capture and storage; increased reliance on nuclear and renewable energy sources (wind, wave, tidal, geothermal and solar energy, hydroelectric power, and biomass for heat, electricity, and biofuels); and reduced deforestation.

While a number of policies bearing on climate change are in place (and some of them are discussed below), it is likely that their scale and coverage will need to be increased. The question of quite how much policy intervention would be desirable, however, has generated a lively debate, reflecting the differing assessments of the relative costs and benefits of action and inaction. The *Stern Review*, for example, argues for globally coordinated action to stabilize atmospheric concentration at about

450–550 ppm. This, the review proposes, would be achieved by substantial reduction in emissions (not merely relative to the large increase projected under BAU, but in absolute terms), beginning between 2020 and 2030 (Figure 1.28). This prescription reflects the *Stern Review's* conclusion that the potential costs of climate change under BAU are equivalent to a loss of between 5 and 14 percent of global per capita consumption, beginning now,²² whereas the estimated mitigation costs consistent with stabilization (at around 500–550 ppm) are about 1 percent of GDP (the latter within a range of +/-3 percent).²³

These results are heavily influenced by the use in the *Stern Review* of a low discount rate, reflecting a view that it is ethically inappropriate to attach less weight to the welfare of future generations than to our own. A low discount rate places a high weight on the benefits of mitigation, which largely come far in the future, relative to more immediate mitigation costs, thus warranting a high immediate mitigation effort. A fundamental problem in gaining broad support for mitigation policies is a lack of consensus on the appropriate discount rate to use in designing and evaluating alternative outcomes (Box 1.7).

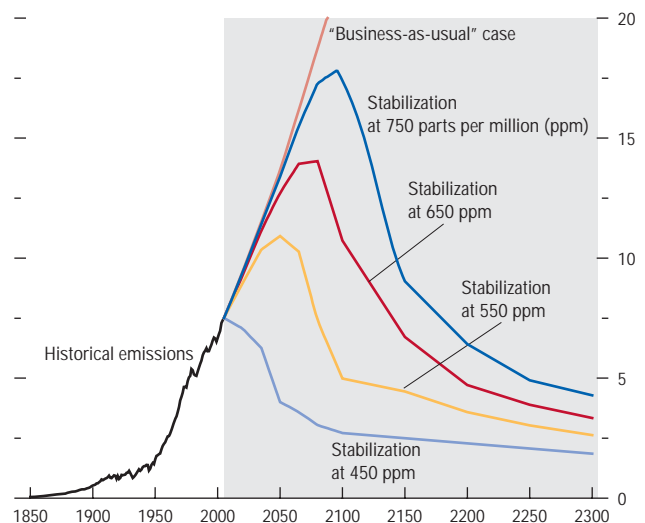
Adaptation to Climate Change

Adaptation is the process by which adverse economic effects of climate change and variability are limited by changes in private behavior and public policies, reducing exposure to both extreme weather events and long-term climate deterioration. It encompasses two broad areas: (1) specific steps to reduce costs from climate change (such as planting more resilient crops or strengthening flood defenses) and (2) strengthening the capacity to respond to it (for example,

²²This rises to 20 percent when account is taken of the disproportionately high costs of climate change for poorer parts of the world. This is not taken into account in the scenarios of Figure 1.27.

²³These cost assessments rise steeply (by a factor of three) with more aggressive abatement designed to stabilize emissions at 450 ppm.

Figure 1.28. Greenhouse Gas Emission Paths Consistent with Alternative Concentration Targets
(Gigatons of global carbon emissions per year)



Source: Edmonds and others (2007).

Box 1.7. The Discounting Debate

The choice of discount rate is central to assessments regarding the timing and extent of many responses to climate change. Discussion has focused on the result that the appropriate rate to discount future consumption in a standard (Ramsey) growth models is given by

$$\rho \equiv \sigma + \eta \cdot g,$$

where σ (the rate of pure time preference) is the rate at which future utility is discounted, g is the rate of growth of per capita consumption, and η is the elasticity of the marginal utility of consumption (which describes the rate at which society values the consumption of better-off generations relative to those less well off, and so captures aversion to inequality between the generations). The precise view taken of these parameters matters deeply because of the substantial mismatch in the timing of the costs incurred in limiting the damage from climate change (which would occur soon) and the benefits from doing so (occurring much later). The lower the discount rate, the greater the relative weight attached to future benefits, and so the stronger the case for action now.

Stern and others (2007) take $\sigma = 0.001$, $\eta = 1$, and $g = 1.013$, implying a discount rate ρ of 1.4 percent. The low value for σ reflects the view that equal weight should be given to the welfare of all current and future generations

(with σ positive only to reflect the possibility of global catastrophe). Critics such as Nordhaus (2006) point out that this is not the only possible ethical position and does not appear to be a realistic description of many decisions people currently make (such as public investments in infrastructure). Reflecting the importance of the issue, raising the rate of pure time preference even to (a still modest) 1.5 reduces the range of expected damage costs from 5–20 percent to 1.4–6 percent of global consumption.

Views on the appropriate discount rate differ in other respects too. Dasgupta (2007) argues that a value of $\eta = 1$ is too low: it implies that a 10 percent reduction in the consumption of any future generation causes the same loss of social welfare as does a 10 percent reduction in current consumption—arguably, it should cause less of a loss, because growth means that future generations will have a higher level of consumption. Increasing the presumed value of this elasticity value from the Stern value of 1 to a modest 1.5 reduces the range of expected damage costs outlined above from 5–20 percent to 3–15 percent. As Stern and others (2007) point out, however, a greater aversion to inequality would also result in attaching more weight to the more immediate welfare losses in poorer countries, tending to strengthen the case for prompt action.

through improved weather forecasting or fuller planning for associated fiscal risks).

Significant adaptation is likely to occur through private market decisions, with no need for public policy interventions—one example being recent credit market innovations to create specialized weather derivatives and catastrophe bonds. Policy support is likely to be needed, however, in response to extensive market failures that impede efficient adaptation. These may include the following:

- an undersupply of information on the need and options for adapting to climate change, and on shifting patterns of variability;
- limited attention to the interests of future generations, leading to insufficient investment in reducing exposure to climate risk;
- credit market imperfections and insufficient access to capital, hampering adaptation that requires substantial investments, particularly in the poorest countries; and
- moral hazard problems that can arise when vulnerable households, firms, or governments are (or feel they are) protected against climate risks. For example, individuals may expect to be compensated for losses through insurance indemnities or government disaster responses, and governments

may anticipate foreign support if a natural disaster strikes.

Efficient adaptation will also require international coordination in the face of cross-border vulnerabilities, for example, to manage major river systems, such as the Ganges or the Nile, in response to new patterns of water stress. Similarly, governments may need to cooperate at a global or regional level to overcome the barriers to adaptation, for example, to improve regional weather forecasting or deliver disaster relief to migrating populations. Policy formation in this area is hampered, however, by a shortage of strong quantitative evidence on the likely scale of adaptation costs and benefits. One estimate puts the costs of adaptation to protect developing countries from climate change risks at between \$3 billion and \$37 billion each year—a very wide range (the higher figure being roughly $\frac{1}{3}$ of total Official Development Assistance and concessional finance).

Mitigation of Greenhouse Gas Emissions

There are several feasible ways of achieving significant mitigation, and future technological advances are likely to further broaden the options. Putting them into effect, however, requires policies that are agreed on among major emitters and are in their own interests to actually implement. A crucial task for policymakers (including international institutions) is to design such policies, encourage and facilitate agreement on them, and ensure that they are implemented. A fundamental difficulty is overcoming the free-rider problem implied by the externalities involved: the harm caused by GHG emissions is felt by the entire global community, whereas the related costs of mitigation are borne fully by the emitter—so that each country may have a preference for mitigation by others rather than itself.²⁴

²⁴This does not mean there is no national incentive to mitigate: there may be local or national benefits from reducing local air pollution or energy insecurity. National and collective interests, however, remain potentially misaligned.

Core policy options for GHG mitigation are the following:

- taxes on GHG emissions, the first-best being a carbon tax applied uniformly across both emission sources and countries. Some existing tax instruments—notably, fuel excises—bear on emissions, but the approach is generally far from systematic;
- “cap-and-trade” schemes, which fix a total quantity of emissions while allowing trade in the associated rights to emit (such as the Emission Trading Scheme of the European Union, EU-ETS, discussed below);
- hybrid schemes, which combine elements of both tax and cap-and-trade schemes;
- energy efficiency standards for vehicles, buildings, and industrial processes, such as the U.S. Corporate Average Fuel Economy standards or the Japanese “top runner” program;
- subsidies to develop and deliver new and/or improved energy efficiency, energy storage, renewables, nuclear, and carbon sequestration technologies (such as expenditure in the European Union under the Framework Programme budget); and
- governance and incentive schemes to reduce deforestation and agricultural emissions (such as the payments to forest owners in Costa Rica and Mexico).

The first five of these are aimed at reducing fossil-fuel-related carbon emissions, which represent about 60 percent (and rising) of total GHG emissions. The last is relevant mainly in developing countries, where substantial scope for low-cost reductions in deforestation has been identified (see, for instance, Chomitz, 2007; and Grieg-Gran, 2006).

Policy should be designed to deliver mitigation efficiently, and with a distribution of the costs and benefits that is perceived as fair. In general, this requires policies that equalize marginal abatement costs across sectors and countries, with appropriate compensatory mechanisms to correct any undesirable distributional effects.

A key policy choice, likely to become central in discussions of climate policies beyond the

Kyoto Protocol period (2008–12), is between carbon taxes and cap-and-trade systems. Under ideal conditions—tradability and auctioning of emissions rights, perfect competition, and full certainty about abatement costs—a system of uniform GHG emission taxes is equivalent to a common cap-and-trade scheme: that is, they could lead to the same level of abatement, achieved at the same (minimized) total cost, and raise the same amount of revenue.

Under more realistic assumptions, however, the two instruments differ significantly. One key factor is uncertainty about the costs of reducing GHG emissions (see Box 1.8, based on Weitzman, 1974). In the case in which the marginal cost of reducing emissions increases only slowly with the level of reduction, while the marginal benefit from such abatement falls quickly, a cap-and-trade scheme is typically preferable to a tax scheme. Intuitively, a flat marginal cost curve means that surprises in the level of marginal costs will have a large impact on the realized level of mitigation under a tax scheme (compared with none, of course, under a cap-and-trade scheme) that, because of the steep marginal benefit curve, has a large impact on realized social benefit. By similar reasoning, a tax regime will tend to be preferable when the marginal cost curve is relatively steep and the damage function is relatively flat.

To see the implications of this in the climate change context, recall that the harm from global warming arises not from the flow but from the cumulative stock of emissions. This means that the expected damage function is relatively flat, because emissions over any relatively brief interval add relatively little to the accumulated GHG stock. This may lead to a preference for a tax instrument set over relatively short periods, but adjusted in its evolution over time by monitoring the associated emissions (and better informed, it is to be hoped, by increased understanding of the impact of alternative atmospheric concentrations).

Political economy considerations may also influence the choice between the two approaches. Proponents of cap-and-trade

schemes argue that coordinating tax strategies across countries and jurisdictions is difficult. Moreover, caps can be allocated in a way that reduces the distributional consequences of mitigation and fosters interest in maintaining the scheme, thus reducing the risk that the scheme will be abandoned in the future. It may also be easier to explain a policy based explicitly on scientific guidance about appropriate emissions levels than a simple tax scheme. Others argue that taxation offers clearer and more stable signals about the future value of emissions reductions, or may be a more useful tool for importing countries faced with monopolistic supply,²⁵ while some trading schemes may be subject to substantial price volatility (price being more sensitive to demand shocks when total supply is fixed).

Hybrid schemes, combining features of both tax and cap-and-trade schemes, have been proposed to address some of the drawbacks of pure tax and cap-and-trade schemes. These involve, for example, selling extra permits at a fixed price so as to eliminate price spikes. However, these schemes have potential limitations, for example, by increasing the difficulty of devising mechanisms to link trading schemes.²⁶

In practice, a controversial feature of cap-and-trade schemes has been a tendency for emissions rights to be partly or fully given away without charge to emitters, rather than auctioned to the highest bidders. This makes the introduction of the scheme more palatable to current emitters, but dissipates a potential source of government revenue. Under the EU-ETS (Box 1.9), at least 95 percent of emissions

²⁵For example, Strand (forthcoming) shows that a tax has advantages for importers in giving a strategic advantage when fossil-fuel supply is monopolistic, since the exporter then tends to select a less aggressive pricing and/or supply strategy in the tax case. Put differently, a tax is in these circumstances a more effective device for importers to extract rent from exporters.

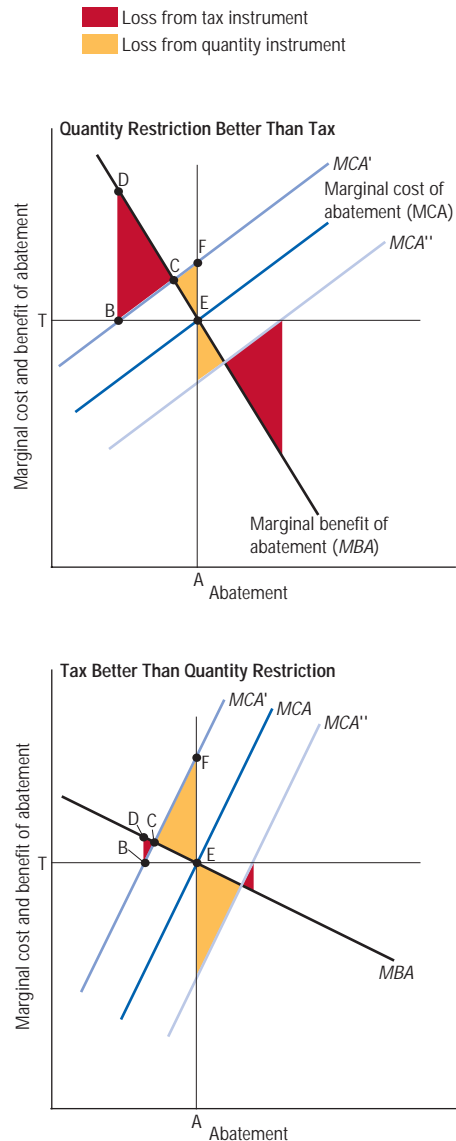
²⁶McKibbin and Wilcoxon (2002), for instance, propose a scheme under which the short-run carbon price is determined by a cap-and-trade scheme with a ceiling price, but with no trading across countries.

Box 1.8. Taxes Versus Quantities Under Uncertainty (Weitzman, 1974)

The optimal level of emissions reduction is found where the marginal social benefit from such abatement (*MBA*) equals its marginal cost (*MCA*), which is at abatement level *A* in each panel of the figure. If it were known that the *MCA* curve would be exactly the unbroken line shown, that optimum could be achieved either by simply mandating abatement of *A* or by setting a tax on emissions at the level *T* (this being such that when the private sector equates the cost it would incur if it chose to reduce emissions slightly to the tax it would pay if it did not, it will abate exactly to *A*). The two instruments would thus be exactly equivalent. But suppose now that—after the policy instrument has been set and before it can be changed—abatement costs turn out to be higher, at *MCA'*. In this case, the ideal outcome would be the level of abatement at point *C*. With the tax fixed at *T*, however, abatement will actually be at *B*, to the left of *C*—that is, there will be too little abatement. Comparing the marginal benefits and costs associated with this policy error, there is an ex post welfare loss—relative to the ideal at *C*—given by the triangle *BDC*. The quantity restriction will also differ from the ex post optimum if marginal costs turn out to be *MCA'*: in this case, with quantity fixed at *A*, there will be too much abatement, with a welfare loss given by the triangle *CEF*. Conversely, if marginal abatement costs turn out lower than expected, at *MCA''*, there is a welfare loss associated with too much abatement under the tax scheme, and a loss associated with too little abatement under the quantity scheme.

Comparing the upper and lower panels, whether the loss from the tax instrument is greater or less than that from quantity setting depends on the relative slopes of the *MBA* and *MCA* curves. Taxes are preferred in the lower panel, where *MBA* is relatively flat and *MCA* relatively steep.

Taxes Versus Quantities Under Uncertainty



rights are currently given away to firms, based on their past emissions. GHG emissions taxes and plans to auction emissions rights faced strong resistance by powerful industry groups in the European Union, while cap-and-trade

schemes with only limited auctioning met with far less resistance.

Efficiency standards are generally inferior to well-designed tax and cap-and-trade schemes, because they do not address the underpricing of

Box 1.9. Experience with Emissions Trading in the European Union

The EU-ETS, initiated in 2005, is a central policy instrument to meet the EU greenhouse gas emissions goals under the Kyoto Protocol. It aims at capping overall carbon dioxide emissions from electric power utilities and major industrial emitters representing about 40 percent of total EU carbon emissions. Emissions rights for Phases I and II (2005–07 and 2008–12) are allocated to individual installations, which are free to trade with other participants in the event of either surplus or insufficient permits to cover actual emissions levels.

The scheme is intended to promote economic efficiency in implementing a given overall emissions reduction, by enabling participating firms to reduce their emissions at the lowest marginal abatement costs. A number of design flaws, however, have reduced the scheme's effectiveness.

First, the total allocation has turned out to exceed actual emissions in the initial 2005–07 period, reflecting, among other things, informational difficulties and reduced demand for energy after the sharp run-up in oil prices. The current cap-setting process for Phase II (2008–12) is expected to generate some, rather

limited, market scarcity, with emissions reduction in the region of 2.4 percent compared with BAU expected in 2010 (see Capoor and Ambrosi, 2007).

Second, the provision of free allocations to participating installations has created market expectations that free allocations in the future will be based on current emissions, thus limiting the current incentive to abate. Rigid exit and entry rules (whereby exiting units lose their free allocations, and new entering units in most cases obtain fully free allocations) add to these problems.

The EU-ETS is a pioneering example of coordinated international action on climate change. Progress is being made to improve its design and operations, with increased harmonization of allocations, monitoring, and compliance methodologies. Further reform is needed, however, to improve its economic efficiency, for example, in regard to the rules for allocating emissions rights, in total and within and across participating countries. Community-based, rather than national, cap-setting is another issue for consideration for the promotion of a more harmonized scheme.

emissions, cannot cater for variance in abatement costs at the firm level, and forgo potential revenue. Standards can, however, be useful when individuals are shortsighted in evaluating returns on investments. In addition, their use may be appropriate in markets where assessment of alternatives is constrained by substantial complexity or high transaction costs relative to the potential benefits, for example, in consumer electronics markets.²⁷

The introduction of realistic carbon pricing, whether through tax or cap-and-trade schemes,

can do much to provide appropriate incentives to develop alternative energy sources. Public subsidies to develop new, immature, or strategically important energy efficiency, energy storage, renewables, nuclear, and carbon sequestration technologies may nevertheless be a useful supplement to emissions taxes and cap-and-trade schemes if there are significant positive externalities related to their development and production. Private developers of new technologies may not reap the full social returns from developing new technologies (perhaps because they can be easily copied), which leads to underinvestment in the absence of subsidies. However, large-scale subsidies of this kind also have substantial drawbacks: they reduce the cost of production and thus may increase polluting output; in addition, tax-based incentives not only forgo revenue

²⁷Spending on federal energy efficiency appliance standards in the United States of about \$2 per household since 1978 is estimated to have delivered present-value savings of \$1,270 per household (Meyers and others, 2002).

directly but can also create avoidance opportunities; finally, the correct levels of subsidy are difficult to determine. Given the revenue at stake, monitoring the cost and effectiveness of such subsidies is likely to become increasingly important.

Problems of Policy Coordination and Implementation

A core challenge is to reach agreement among major emitting countries on the implementation of policies to limit future GHG emissions. This is difficult for the following reasons:

- The negative externalities related to GHG emissions are global, so that countries' self-interest may not lead them to mitigate as much as their collective interest requires.
- Although abatement must start soon to have any significant future impact, the bulk of the prospective benefits arise relatively far in the future. Voters and policymakers may thus give too little emphasis to future benefits from current abatement.
- The considerable uncertainty that remains, including in relation to very damaging but low-probability events, calls for prudence—but may also imply some value, to a degree, in limiting costly actions now (recognizing that they might divert resources from alternative uses that have clear immediate benefit) while learning more about the problem and possible solutions.
- The potential future damage from climate change reflects past emissions, almost 80 percent of which originated in advanced economies (see Figure 1.24). This would suggest that they bear greater responsibility for the climate problem. On the other hand, however, more than half of current total emissions, and a much larger share of future emissions, are expected to be generated by less-advanced economies (see Figure 1.25).
- The effects of climate change are unevenly distributed across countries. Many tropical countries (most of which are poor) will sustain large losses from further global warming.

Some currently cool countries (including Canada, Russia, and northern Europe) can instead expect to lose little, or even gain, from moderate climate change.

- Countries naturally fear disadvantaging their producers in world markets by raising energy prices unless their competitors do likewise.

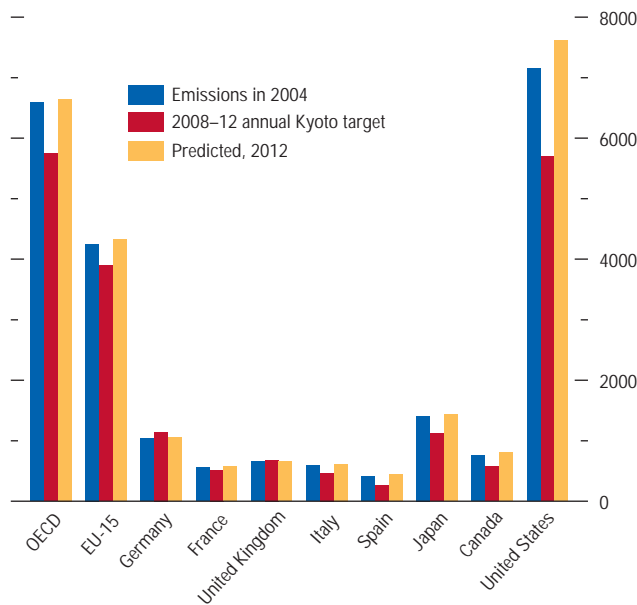
Initial steps toward international cooperation—most notably the Kyoto Protocol—have had only limited success. Figure 1.29 shows emissions for major industrial countries effectively subject to emissions limitations under the Kyoto Protocol, both in 2004 and as projected for 2012 (when the Kyoto Protocol expires), together with their Kyoto Protocol targets. The United States, also included here, was assigned an emissions reduction under the Kyoto Protocol but did not ratify the Protocol and is thus not committed to it. Several ratifying countries are currently some way from achieving their commitments. The punishment for any such failure—tighter targets under any future agreement—is small and perhaps not credible.²⁸

Early agreement on extension and development of mechanisms beyond the end of the Kyoto Protocol is critical, not least given the long lead time for many energy investments and the consequent need for reducing uncertainty about likely future carbon prices. It will also be a major policy challenge to broaden the coverage of a new mechanism to include major emitters in emerging market and low-income countries.

Some efforts to limit emissions currently undertaken by parties not bound by the Kyoto Protocol, notably Australia and the United States, have supported the development and diffusion of new technologies designed to promote energy efficiency. In addition, some non-Annex I countries have made efforts to reform energy pricing and reduce deforestation in order to increase energy security and reduce

²⁸The punishment for not fulfilling emissions reductions committed to under the Kyoto Protocol is that quotas will be reduced by 130 percent of current shortfall in future (as yet unspecified) implementation periods.

Figure 1.29. Greenhouse Gas Emissions, Kyoto Targets, and Predicted Emissions
 (Millions of tons of carbon dioxide)



Sources: Capoor and Ambrosi (2007); and International Energy Agency (2006).

local air pollution. In each case, there have been important cobenefits in constraining the growth of GHG emissions.

A range of wider international frameworks and processes is being developed, which should help to reduce GHG emissions. These include collaborative efforts to promote technology cooperation, such as the Asia-Pacific Partnership, together with a joint project between the European Union and China designed to establish a carbon storage demonstration project, potentially an important precursor to more widescale diffusion of such technology. Finally, international cooperation in relation to the design and implementation of energy efficiency standards is raising the potential cost-effectiveness of energy savings across countries and strengthening incentives to innovate throughout the supply chain.

Concluding Remarks

Climate change resulting from man-made increases in atmospheric GHG concentrations presents a serious challenge to human welfare. Understanding of both the issue and potential policy responses has developed rapidly in recent years, but much remains to be learned, including the nature, extent, and likelihood of the macroeconomic and fiscal effects from climate change and alternative responses to it.

Dealing effectively with climate change requires international cooperation to manage risks and associated economic costs related to necessary reductions in GHG emissions and development of adaptive capacity. Existing cooperative mechanisms will need to be extended significantly in breadth, depth, and efficiency, while paying due regard to the need for equitable sharing of the burden, in order to meet this challenge.

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