

# Shifting tides: Global economic scenarios for 2015–25

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Are we in for a bumpy ride? How bumpy? And for how long?

At the National People's Congress in Beijing in March 2015, China's Premier Li Keqiang announced a growth target of 7 percent, acknowledging that “deep-seated problems in the country's economy are becoming more obvious.”<sup>1</sup> Three months later and thousands of miles away in Washington, the World Bank lowered its growth forecasts across the board and asked the US Federal Reserve Bank to delay any contemplated rate hikes. The World Bank's chief economist said that it had “just switched on the seat belt sign. We are advising nations, especially emerging economies, to fasten their seat belts.”<sup>2</sup> So it's going to be a bumpy ride? How bumpy? And for how long?

Day-to-day developments in the world economy have become increasingly complex and global in their implications. Economic shocks, from Greece to China to Russia, are now of greater concern because around the world, traditional policy tools have already been used and financial resources depleted to help economies recover from the last downturn. Strategic decisions have become correspondingly more consequential. Shocks are inevitable, but strategists must find ways to extract the signals from the noise to understand what's over the horizon.

Three interlinked factors have the potential to shift the global economy from one long-term outcome to another: aggregate demand, structural challenges, and diverging growth patterns. First, in the near term, the major economies continue to struggle to achieve self-sustaining growth in aggregate demand. This continues despite years of monetary and fiscal stimulus, as well as the recent drop in oil prices. Second, the world's major economies face long-term structural challenges, including rising debt loads, aging populations, and inadequate or aging infrastructure. Success or failure in resolving these structural challenges will determine the speed of long-term growth in these economies. Third, the world's major economies have increasingly diverged in the last few years. In the past, global

integration has driven convergence. The prospects for further integration have become less certain. The global financial shock was followed by years of weak growth and concerns over rising inequality. The path to renewed and stronger growth remains elusive.

Given the consequences of these interlinked factors, it is small wonder that near-term developments have taken on oversized importance. Our approach has been to work backward from a series of long-term outcomes, determined by the degree to which the structural challenges have been met and global growth has become more or less divergent. We are then able to move forward, articulating the scenarios likely to emerge in the path ahead from near-term developments (see sidebar, “The McKinsey Global Growth Model: Methodology”).

## Near-term signals and long-term forces

The world's major economies, emerging and mature alike, have been experiencing clearly divergent growth paths in the first half of 2015, in some cases due to unexpected challenges (Exhibit 1). The US economy contracted in the first quarter; growth returned to the eurozone, even as a crisis loomed in Greece. Chinese policy makers continued to steer cautiously between the risks of a slowdown and those of rising debt levels. In India, growth accelerated in anticipation of reforms, while lower oil prices and economic sanctions contributed to a contraction in the Russian economy.

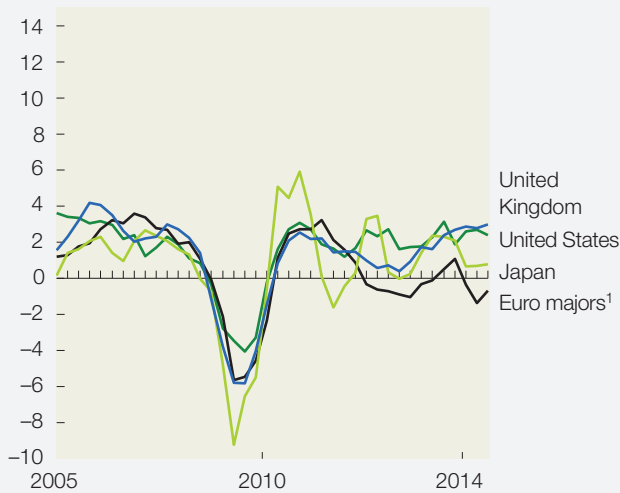
These developments may signal the return of country-level business cycles, suppressed in the depths of the global economic downturn. Yet they may also be its lingering effects, suggesting that deeper forces are at work.

We believe that three sets of forces will shape the global economy over the coming decade. The first two are stimulus policies and shifting energy markets. These are near-term forces, whose effects are felt on

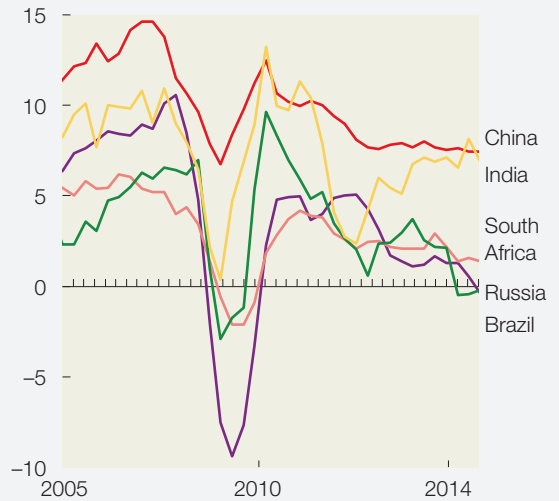
Exhibit 1

A wider divergence in growth has surfaced among emerging and advanced economies.

Real GDP growth in advanced economies, year over year, %



Real GDP growth in emerging economies, year over year, %



<sup>1</sup>France, Germany, Italy, and Spain.  
Source: Haver Analytics

a daily basis. The next two forces, urbanization and aging, are powerful, inexorable trends aggravating ongoing structural challenges. Finally, two forces are of uncertain and variable magnitude: technological innovation and global connectivity. All of these trends could intermittently disrupt and transform sectors.

Near-term factors

**Stimulating aggregate demand.** Of immediate concern is the persistent problem of weak aggregate demand relative to overall economic capacity. The International Monetary Fund estimates that production in the ten largest advanced economies was 2 percent below potential in 2014. This gap was smaller than it had been in 2009 (3.3 percent) but significantly worse than the surplus of 0.8 percent that prevailed in the early 2000s.<sup>3</sup> All major economies except China experienced significantly weaker demand in the aftermath of the global financial crisis. Many governments and central banks responded with fiscal and monetary stimulus programs that fostered the low real-interest-rate environments

which have endured for over five years. The McKinsey Global Institute reviewed the recent performance of advanced economies and found that they had all increased rather than reduced their overall debt levels—in some cases, by more than 50 percent.<sup>4</sup>

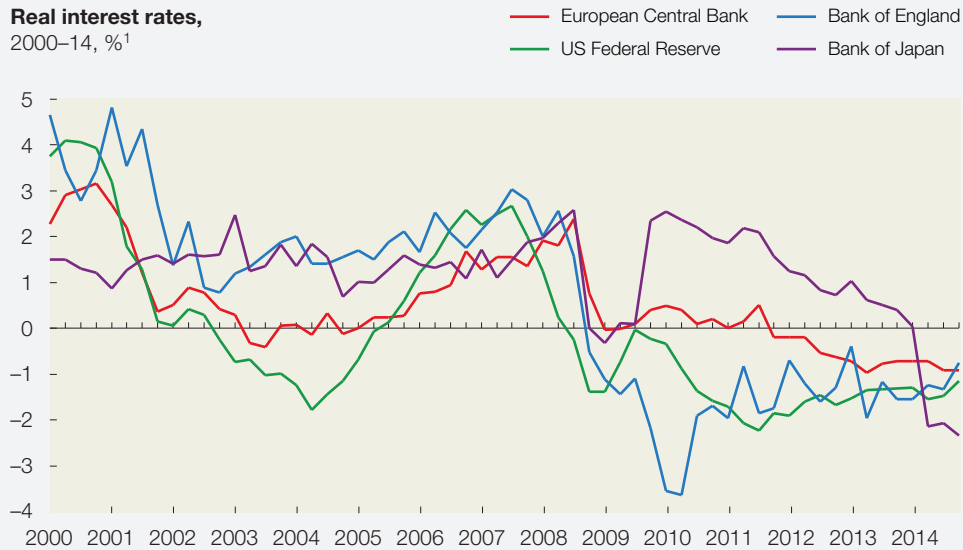
Complicating the picture is the question of whether real interest rates will remain low (Exhibit 2). Persistently low interest rates encourage investors to search for yield and safety, creating the preconditions for asset bubbles and further volatility in international financial flows.

Economists are concerned that unconventional monetary policies have distorted rather than bolstered the demand picture. In the United States, for example, the Federal Reserve signaled for months that it would raise rates by the end of 2015, heralding a return to a more conventional, interest rate–driven monetary policy. In the interim, however, results were tepid and now a rate hike may be further delayed. The challenges faced by the Federal Reserve in timing rate

Exhibit 2

**Real interest rates, long negative in the United States and the United Kingdom, have slowly turned negative in the eurozone and Japan as well.**

**Real interest rates,**  
2000–14, %<sup>1</sup>



<sup>1</sup>Policy rates less the rate of inflation in the GDP deflator.

Source: Haver Analytics

increases will be encountered in the eurozone and Japan in due time. Demand in major markets remains weak enough, furthermore, that a misstep in any one of them will be felt by the others.

**Energy-market transformations.** Oil prices fell by 50 percent in the latter half of 2014. Even after a slight rebound, they remained well below average levels of the past five years. For energy consumers, the lower energy prices have provided a welcome respite; for producers, they challenge fiscal stability. The breakeven oil price—the price at which a fiscal surplus turns into a deficit—is estimated at \$57 for Kuwait and \$119 for Algeria.<sup>5</sup> Countries have so far managed the crunch by drawing down reserves and through exchange-rate movements, but these are short-term actions and direct fiscal adjustment lies on the horizon. Elsewhere, the fall in oil prices is slowing further investment in energy sectors, notably unconventional oil and gas.

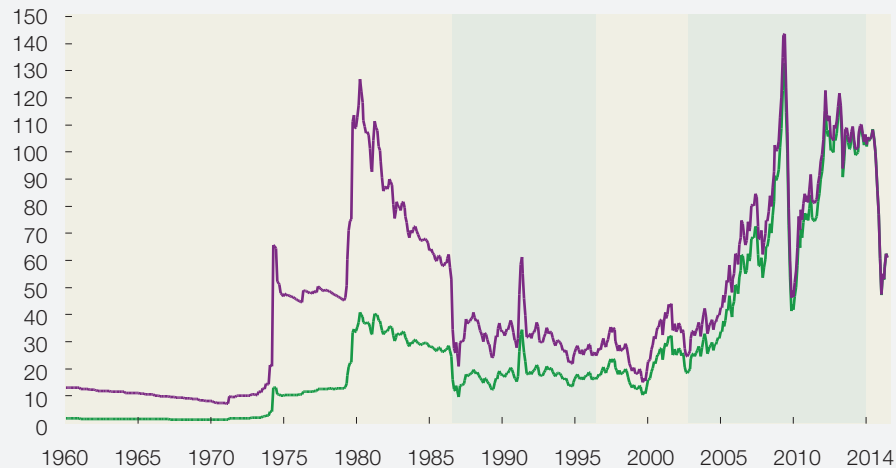
Global energy intensity has fallen over the past several decades, so oil-price shocks are felt

differently in different parts of the globe. The energy productivity of the ten largest advanced economies today is 74 percent of what it was in 1980.<sup>6</sup> Beyond the advanced economies, however, the picture changes. Thanks to the increasing size of the emerging economies, world energy productivity was able to rise by 33 percent between 1980 and 2002 (remaining relatively flat thereafter).

In assessing the ultimate impact of recent energy-market shifts, strategists are seeking to discover what will happen not in the next year but in the next decade. Only on two other occasions during the past 30 years, in 1985 and 2008, did the oil price fall as steeply as it did in 2014. The recoveries from these two events were very different affairs and are instructive for today. In 1985, excess production capacity led to stable prices for nearly a decade after the initial price decline. The 2008 decline in prices was part of the financial crisis; prices dropped precipitously and then quickly rebounded as demand recovered, especially in emerging markets (Exhibit 3).

### Exhibit 3 Shifts in energy markets raise possibilities of flat or reviving oil prices.

Crude-oil price in actual and inflation-adjusted terms, 1960–2015, % per barrel<sup>1</sup>



<sup>1</sup>Based on World Bank crude-oil average and US Consumer Price Index re-referenced to 2014.  
Source: US Bureau of Labor Statistics; World Bank

Persistent demand weakness and falling oil prices are the stuff of daily headlines, but associated effects could drive alternative economic outcomes for the next decade. The complication is that deeper forces are at work.

#### Inexorable factors

Unlike the variegated impact of demand stimuli and energy-market shifts, the effects of urbanization and aging are predictable and are tilting the global economy in one general direction: toward emerging markets. Increasing urban congestion and an aging labor force impose burdens—among them, lower productivity, falling demand, and rising health and pension loads—on all economies. The challenges are clear. The uncertainty lies in how economies will adapt to them.

**Rapid urbanization.** From Brazil to China, emerging economies are urbanizing with unprecedented rapidity. Rural populations are responding to rising industrial opportunities and burgeoning growth, and the economic weight of cities in the world

economy continues to rise. McKinsey research indicates that 46 of the world's 200 largest cities will be in China by 2025, a sign too of the eastward migration of the global economy's center of gravity.<sup>7</sup> In recognition of the urbanization challenge China faces, the Chinese government is moving with astonishing speed to meet its climate goals, because the pollution produced by outmoded power generation and manufacturing is starting to interfere with the quality of life in urban areas. India is facing similar and intensifying urban challenges but has not yet moved with China's determination.

**Demographic pressures.** The labor force, on which economic activity depends, is both aging and shrinking. It is expected to contract by 11 percent in China by 2050, even as the country's economy expands. The shrinkage in continental Europe is expected to be even more dramatic. As life spans are growing and birthrates falling, furthermore, an aging working population in advanced and emerging economies will be supporting ever-higher



numbers of retirees. Among the major economies, only the United States has a demographic profile favorable to long-term economic growth. For the rest of the leading economies, expected productivity improvements will not bridge the gap. Without a fundamental economic and cultural shift, favoring continued participation of older workers and the introduction of more women workers and immigrant labor, many economies would face serious growth constraints within ten years (Exhibit 4).

#### Uncertain factors

The direction and potential impact of the final factors in our review are less certain than the effects of urbanization and aging. In one sense, technological innovation and global connectivity are already familiar phenomena. As the science-fiction author William Gibson remarked 15 years ago, “The future is already here—it’s just not very evenly distributed yet.”<sup>8</sup> Technological disruption has become a pervasive feature of the modern global economy, but its extent is uncertain. Especially

important is the question of how much innovation will come from China, India, and other emerging economies. The opening of markets has accelerated the growth of global supply chains and productivity, but will this growth continue?

**Technological innovation.** Technological innovation has reached a level in the major economies where significant structural changes are in process or have already occurred. Digitization has transformed the telecommunications, media, financial-services, and retail sectors. Consumers are using mobile devices to connect to an ever-widening range of goods and services, while businesses embed such devices more deeply in functional processes and industrial activity. High-tech innovations in robotics and 3-D printing could enable mature and emerging economies alike to boost labor productivity and rapidly expand industrial horizons, while also shifting global trade patterns.

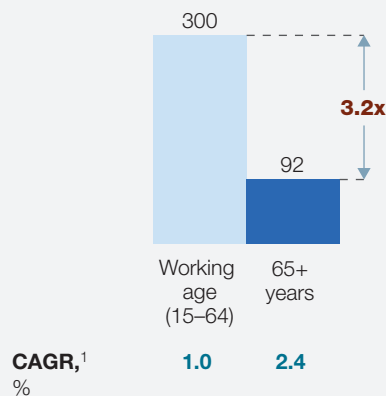
The deep innovation and structural shifts at the industry level have also given rise to concerns

Exhibit 4

### In the past decade, the working-age population outgrew the retirement-age population; in the next decade, it will barely keep pace.

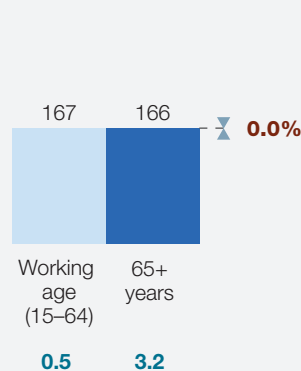
From 300% growth in the last decade . . .

**G-20 population growth,**  
2005–14, millions



. . . to barely keeping pace

**G-20 population growth,**  
2015–25, millions



<sup>1</sup>Compound annual growth rate.

Source: McKinsey Global Growth Model, April 2015

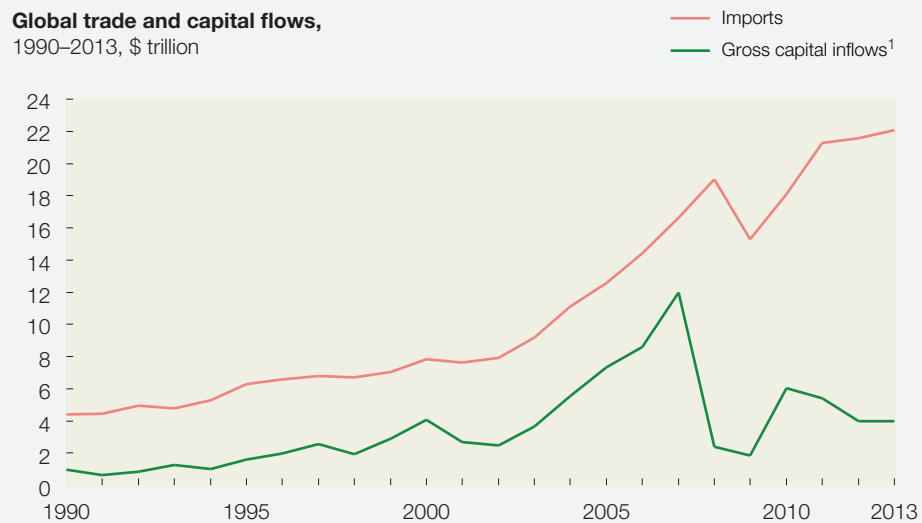
about market power and privacy. The theft of credit-card numbers, industrial espionage, and breaches in personal data all raise new questions about the security of information. Major technology companies face rising antitrust scrutiny. Assuredly, innovation will continue, but to what extent will it occur more globally, and how rapidly will it spread across borders?

**Global connectivity.** The constituents of the global economy in 2015 are more deeply interconnected than ever before. Trading relationships are increasingly dense and complex, and they have rebounded rapidly since the global downturn. Today, China is a peerless world-trade hub and Latin American, Indian, and Middle Eastern trade has risen in world-economic weight. Among other factors, the recapitalization of banks, regulatory change, and monetary stimulus have exercised countervailing effects on financial flows, which remain well below pre-crisis levels (Exhibit 5). Concerns about the transmission and impact of financial shocks remain high on the global regulatory agenda.

More than 20 years have passed since the conclusion of the last round of multilateral trade negotiations in 1994. More economies have been opened since then, and the scope of trade agreements has widened. The focus in developed economies has shifted toward the opening of investment opportunities and easing of restrictions on services; in emerging markets, agricultural subsidies have been a priority. These areas have proved especially intractable in a multilateral context, but regional and bilateral trade agreements of widening scope have nonetheless proliferated since 1994.

As the last two decades have demonstrated, increasing international trade flows can reshape national growth trajectories. A rising caution pervades public debate about deepening economic linkages among countries, however. The principal concerns go beyond the potential impact on growth, even within specific sectors. The reservations are more focused on the wider question of whether nations can agree on global rules that are appropriate and supportive for an evolving economy.

**Exhibit 5 Financial and trade flows surged together until 2007 but have since taken different paths.**



<sup>1</sup>Includes foreign direct investment, portfolio equity, portfolio debt, and other investments.

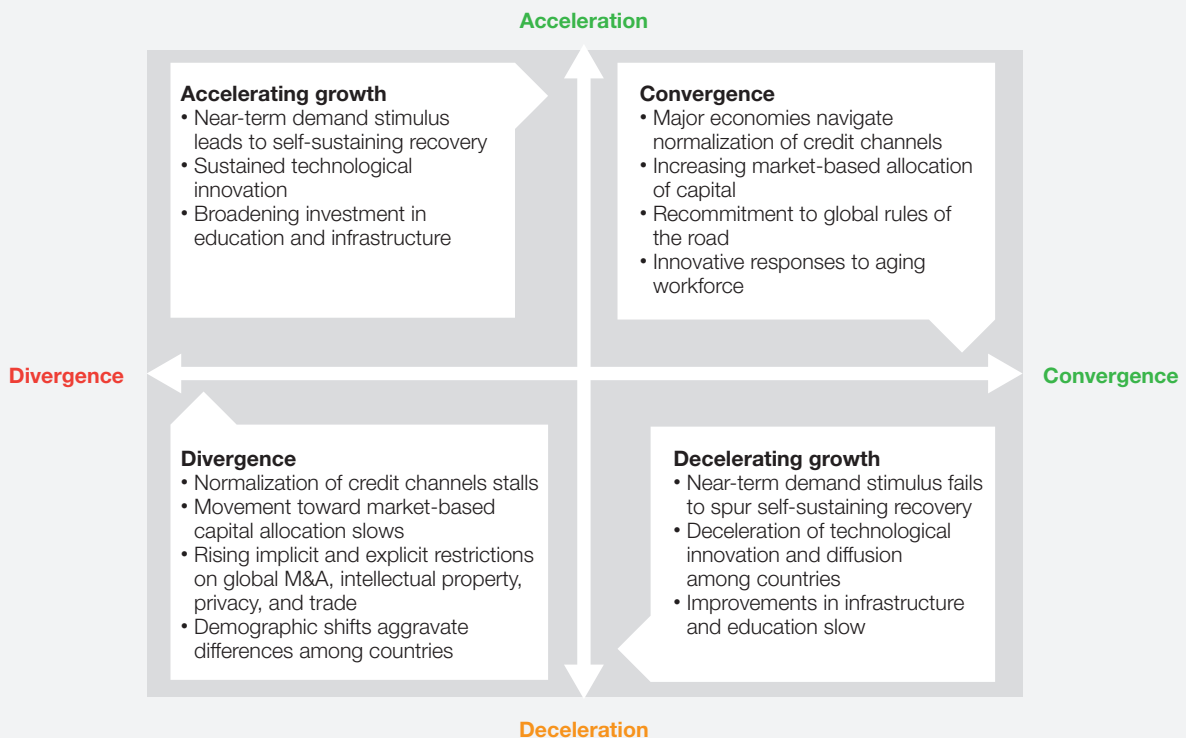
Source: McKinsey analysis

### The four scenarios

Our scenarios for 2015 to 2025 have been shaped by the three tightly linked sets of factors outlined above—near term, inexorable, and uncertain. The interaction of these factors will govern a number of crucial outcomes. Is weak growth in advanced economies going to undermine the will to open more politically sensitive markets and sectors? To what extent will inadequate infrastructure or restrictive markets stall growth in emerging countries? How will falling commodity prices complicate efforts to diversify commodity-driven economies? The longer-term factors discussed above—urbanization, aging, technological innovation, and global connectivity—anchor our four scenarios. The near-term factors—monetary stimulus and energy prices—inform the path to the longer-term outcomes. These dynamics have been framed by the intersection of two axes (Exhibit 6).

The vertical axis measures the acceleration or deceleration of growth and thus how well (or poorly) economies have tackled their long-term structural challenges. Successful economies drive up productivity and overall growth. The horizontal axis measures the extent to which global growth is convergent. This is determined by a combination of near- and longer-term factors. Countries can converge toward higher (or lower) growth rates, for example, according to how successful they have been in implementing and then unwinding their monetary and fiscal stimulus. In the long term, increasing convergence is also determined by the global evolution of economic rules of the road, covering the extent of economic activity, including goods and services, migration, investment, and intellectual-property rights.

**Exhibit 6** Intersecting variables reflect the speed and divergence of global growth expressed in the scenarios.





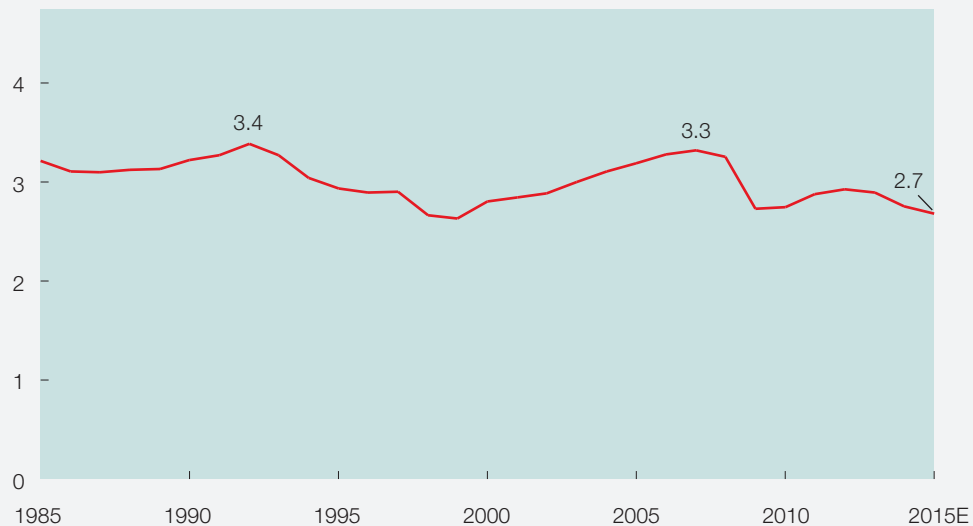
A convergent world would not be impervious to shocks, but it would be better able to absorb them. Higher global systemic resilience means that individual economies can recover more quickly. Divergent outcomes, on the other hand, result when the policies of individual countries are at odds, creating internal systemic imbalances that can magnify the effects of a shock in a particular country. Divergence can also slow the movement of shocks across borders—a movement that, unfortunately, is common in an internationally linked world.

A final consideration is the historical pace of global growth, which provides context for the scenarios. This indicator has been remarkably stable since the mid-1980s. The rolling ten-year average real growth rates hovered between 3.4 and 2.7 percent (Exhibit 7).

Exhibits 8 and 9 illustrate how the intersection of the growth and divergence axes over the next decade defines the four scenarios. “Global synchronicity” (scenario 1) describes a world where most major economies tackle their structural challenges, and are able exit from aggregate demand stimulus smoothly. “Rolling regional crises” (scenario 4) describes the opposite outcome. With structural challenges remaining largely unaddressed, the world economy becomes more vulnerable to regional crises and grows increasingly insular. Two other scenarios capture the cases in which growth accelerates but the major economies diverge (scenario 2, “Pockets of growth”), and where the major economies converge to lower growth rates (scenario 3, “Global deceleration”). In Exhibit 8, the four scenarios are illustrated, with a growth breakdown for major economies and for energy- and commodity-driven sector growth.

**Exhibit 7 Long-term global growth has stayed within a narrow band since the 1980s, even after the 2008 economic crisis.**

**Real GDP growth rates,  
1985–2015, %<sup>1</sup>**

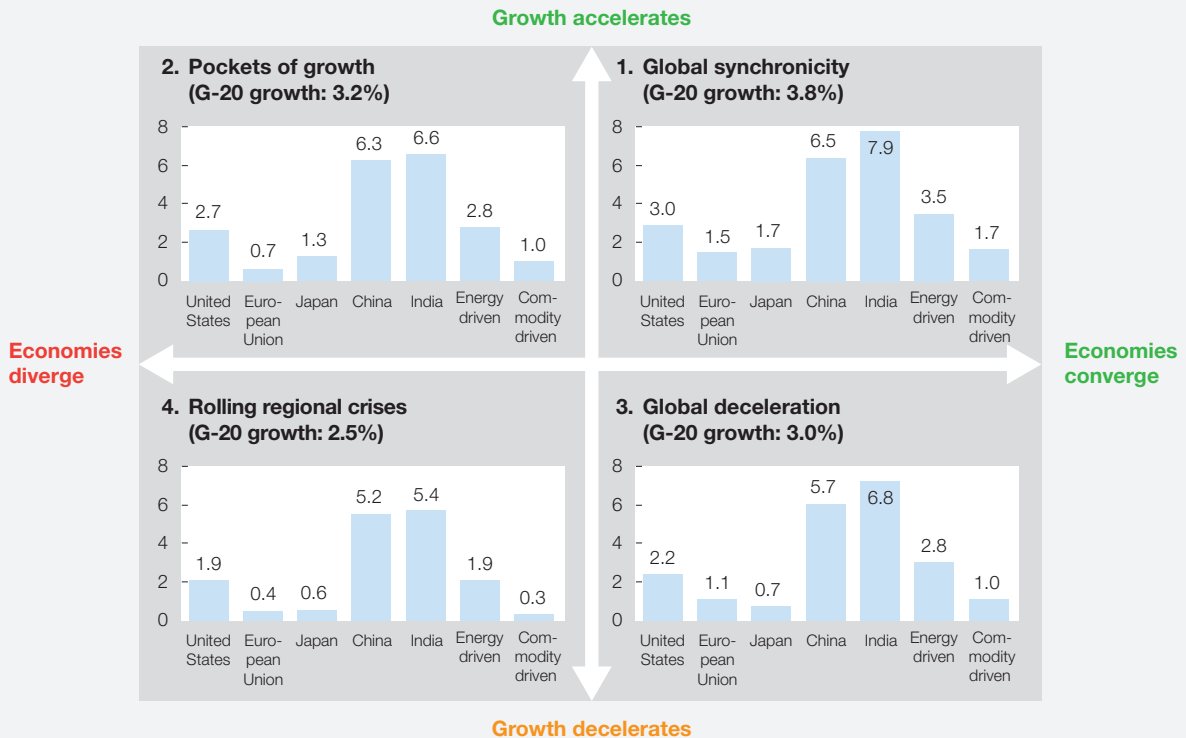


<sup>1</sup>Including the following countries: Argentina, Australia, Brazil, Canada, China, France, Germany, India, Indonesia, Italy, Japan, Mexico, Russia, South Korea, Spain, Turkey, United Kingdom, and United States or their preceding entities as defined in Maddison. Extended data were not available for Saudi Arabia or South Africa.

Source: The Maddison Project, accessed April 2015

## Exhibit 8 Growth scenarios of G-20 nations 2015–25.

Real GDP annualized growth, %



Note: G-20 accounts for more than 75% of global economy; its members are Argentina, Australia, Brazil, Canada, China, France, Germany, India, Indonesia, Italy, Japan, Mexico, Russia, Saudi Arabia, South Africa, Turkey, United Kingdom, and United States, as well as European Union as a region.

Source: McKinsey analysis

Exhibit 9 presents the scenarios at a glance; more detailed descriptions of each scenario follow.

### Scenario 1. Global synchronicity: Convergence and rapid growth

In this scenario, the global economy experiences the most robust long-term growth it has seen in more than three decades, reaching 3.7 percent per year through 2025. The United States, the eurozone, and Japan are able to make the transition to more sustainable growth while exiting from their monetary stimuli with minimal disruption. Likewise, policy makers in China implement incremental changes and guide economic growth smoothly and gradually downward to a sustainable level. India emerges as the fastest-growing

economy over this period as it rides a wave of reform, investment, and robust demographics. By 2025, the global economy will have grown to \$90 trillion in constant 2015 dollars, from \$62 trillion in 2015.

As global growth gathers momentum, liquidity from unconventional monetary policies is gradually absorbed or withdrawn in the United States, eurozone, and Japan. Proliferating trade agreements lead to the lowering of barriers in critical service industries and to revivals of cross-border activity and technology transfer. The rapid diffusion of innovation, bolstered by broader global trade arrangements, boosts the share of exports in GDP for the G-20 from 25 percent today to 29 percent by 2025, or roughly at the growth rate of the early 2000s.

**Exhibit 9 Global economic scenarios 2015–25 at a glance.**



Financial-sector reforms in emerging economies foster more market-driven and robust capital markets. Global interest rates return to the “old normal” levels of the pre-crisis years. Energy and commodity prices are buoyed as productivity-induced supply gains cannot keep pace with emerging-market demand. As might be expected in such an environment, employment growth rebounds and most countries see unemployment rates fall and participation rise. India, China, and commodity-driven economies account for 80 percent of employment growth. Elsewhere, policy changes in advanced economies encourage aging workers to stay in the workforce longer, while making it easier for women and part-time workers to stay employed.

**Scenario 2. Pockets of growth: Divergence with rapid growth**

In this second high-growth scenario, the growth picture becomes more uneven, as countries tackle

structural challenges in fits and starts. Global growth reaches 3.2 percent a year over the course of the decade, a relatively high historical level, and by 2025 the global economy reaches \$88 trillion in 2015 dollars.

The United States, China, and India achieve satisfactory and even sporadically robust growth, while the eurozone and Japan struggle. The unevenness of the expansion makes agreements harder to reach on international protections for investors, intellectual property, and agricultural subsidies. As a result, trade growth starts to slow and remains effectively flat relative to GDP at 25 percent.

Some countries find it difficult to exit from unconventional monetary policies, which continue to distort credit channels and capital flows. The search of investors for higher or more stable yields quickens, adding to volatility. Oil prices gradually revive on

higher demand, and producers of other commodities encounter more frequent supply constraints.

### Scenario 3. Global deceleration: Convergence with slower growth

This lower-growth scenario is defined by global convergence to a slower path. Global growth manages to reach 2.9 percent over the course of the decade, slightly below average for the past three decades. The expansion is especially reliant on positive outcomes in emerging markets. By the end of the decade, the global economy reaches \$86 trillion in 2015 dollars.

Structural challenges remain largely unaddressed but are offset in the near term by partly successful efforts to revive demand. China avoids the worst effects of a “hard landing,” but confidence in the financial and fiscal system is shaken, further weighing on growth. China still accounts for nearly 23 percent of global GDP by 2025, however. In the advanced economies, fiscal and monetary buffers to address structural reforms are exhausted.

Near-term demand revives globally, creating an opportunity for Europe and the United States to make progress on financial services, privacy, and M&A activity, which becomes a benchmark for global emulation. Trade is a more important driver of growth in this scenario than in the previous one. The lower growth curve is a constraint, but trade still accounts for 27 percent of the global economy. Demand for energy (including oil) revives, but the availability of additional supply keeps prices from recovering more quickly.

### Scenario 4. Rolling regional crises: Divergence and low growth

This scenario is the negative image of the global-synchronicity scenario. Growth stalls and the world economy is \$11.4 trillion smaller than it would be in that scenario. “Rolling regional crises” describes a world where structural reforms broadly stall, and aggregate demand, especially in advanced economies, does not return in a sustainable way.

Deleveraging remains a drag on household balance sheets, and corporate-debt levels continue to rise.

Increasingly, countries rely on conventional and unconventional forms of fiscal and monetary stimulus. Real interest rates remain in negative territory, but the growth outlook fails to encourage renewed investment growth. Incremental fixed investment in the G-20 countries totals little more than half the level in the global-synchronicity scenario.

With not enough economic incentive, companies fail to invest in R&D and technological innovation remains confined to a few regions. The diffusion of technology also slows down as economies increasingly turn inward. Implicit and explicit restrictions on international M&A activity proliferate, as do regulations inhibiting the expansion of trade and technology. As a result, the share of exports in GDP for G-20 nations rises more slowly, from 31 percent today to 34 percent by 2025. Similarly, employment growth slows and the G-20 nations add 60 million fewer jobs than they would in the global-synchronicity scenario. In a repeat of the 1980s, global oil supplies remain abundant and energy prices stay flat in real terms.

In this scenario, the world economy remains much more vulnerable to economic shocks, particularly from financial flows. Low interest rates, combined with expanded financial liquidity, create the conditions for volatile flows seeking yields in response to the slightest hint of a change in the growth outlook.



Our global economic scenarios suggest that the major economies face significant structural challenges. To revive growth, these countries must tackle the challenges while navigating constant reverberations from an interconnected world economy. Urbanization and aging are tilting growth toward emerging markets; other trends are complicating the picture. For strategists, the course of trade and information flows is of crucial importance, as the direction and





forces behind the flows determine how industries will be affected. Rising south-to-south trade in goods creates a very different set of opportunities than does increased services-driven trade or increased investment based on production location.

Volatility and shocks are an ever-present feature of the world economy. To take an example: in 2013, the Federal Reserve suggested that it might slow its bond purchases later that year. Soon yields on US bonds rose dramatically and capital flows to emerging markets reversed, as investors now sought higher and safer yields in the United States (and other developed markets). The World Bank later estimated that the loss in capital flows to emerging markets from this one event amounted to hundreds of billions of dollars in GDP. In many parts of the world, the policy

tools and financial reserves needed to absorb such shocks have been expended in dealing with previous events. Understanding susceptibility and resilience to shocks, from a national and global perspective, will allow strategists to make better decisions about market entry, new investment, or market exit.

We hope that companies will find the scenarios laid out in this paper helpful in strategy planning. They have been designed as baselines against which different corporate strategies can be tested, to reveal how industry-specific dynamics may evolve in response to macroeconomic shifts. We believe that most companies will find that regular pressure testing of their strategies in response to both macroeconomic and industry shifts helps sustain growth in the face of challenging conditions. ■

# The McKinsey Global Growth Model: Methodology

The analyses presented in this paper are based on estimates produced by the McKinsey Global Growth Model. The model provides an integrated framework for understanding how macroeconomic trends interact with the processes that drive global growth.

The McKinsey model incorporates more than a dozen major international databases from such institutions as the United Nations, the World Bank, the International Monetary Fund, and the Bank for International Settlements. Selection of data sources is based on their authoritativeness, comparability, extended time series, and country and concept coverage. The result is a historical database that provides complete time-series data for more than 150 concepts and 110 countries over 30 years.

The structure of the model emphasizes the drivers of economic growth, including demographic factors, education, energy supply, physical capital, and some determinants of total factor productivity.

It captures the long-term effects of urbanization and industrialization, as well as the impact of sociopolitical institutions, especially on finance and governance. Because business-cycle fluctuations affect growth in the short term, the model also links trade and international capital flows, credit and asset markets, and the monetary relationships that determine inflation, interest rates, and exchange rates.

Model estimates are generated using a series of advanced econometric techniques. In particular, we use dynamic error-correction-estimation techniques to address issues of nonstationarity in the data. We use two-stage least-squares techniques to mitigate potential simultaneity biases. In addition, because we aim to characterize the drivers of growth over long time horizons, we pool the information across a sample of countries with widely varying levels of development. The result is a simulation tool that allows us to generate plausible ranges for future growth for 20 core countries and nine regions.

<sup>1</sup> Koh Gui Qing and Kevin Yao, "China signals 'new normal' with higher spending, lower growth target," Reuters, March 5, 2015, [reuters.com](http://reuters.com).

<sup>2</sup> Anna Yukhananov, "World Bank sees slower global growth, urges Fed to wait on rates," Reuters, June 10, 2015, [reuters.com](http://reuters.com).

<sup>3</sup> World Economic Outlook Database, International Monetary Fund, April 2015, [imf.org](http://imf.org).

<sup>4</sup> For more, see "Debt and (not much) deleveraging," McKinsey Global Institute, February 2015, on [mckinsey.com](http://mckinsey.com).

<sup>5</sup> *Regional economic outlook update: Middle East and Central Asia*, International Monetary Fund, May 2015, [imf.org](http://imf.org).

<sup>6</sup> Measured as dollars of GDP per metric ton of oil equivalent.

<sup>7</sup> McKinsey's CityScope Database; see also Richard Dobbs, James Manyika, and Jonathan Woetzel, *No Ordinary Disruption: The Four Global Forces Breaking All the Trends*, New York, NY: PublicAffairs, May 2015, page 21.

<sup>8</sup> "The science in science fiction," *Talk of the Nation*, NPR, November 30, 1999, [npr.org](http://npr.org).

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