

FUTURE OPPORTUNITIES, FUTURE SHOCKS

Key Trends Shaping the Global Economy and Society

Citi GPS: Global Perspectives & Solutions

October 2014



Ian Goldin

With contributions from Andrew Pitt and Citi Research

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From 1996 to 2001 he was Chief Executive and Managing Director of the Development Bank of Southern Africa and served as an advisor to President Nelson Mandela. He succeeded in transforming the Bank to become the leading agent of development in the 14 countries of Southern Africa. During this period, Ian served on several Government committees and Boards, and was Finance Director for South Africa's Olympic Bid.

Previously, Ian was Principal Economist at the European Bank for Reconstruction and Development (EBRD) in London, and Program Director at the OECD Development Centre in Paris, where he directed the Programs on Trade, Environment and Sustainable Development.

He has a BA (Hons) and a BSc from the University of Cape Town, an MSc from the London School of Economics, and an MA and Doctorate from the University of Oxford. In addition to being Director of the School and the University of Oxford Professor of Globalization and Development and a Professorial Fellow at Balliol College, Oxford, Ian serves as a Non-executive director on a number of Boards and is a trustee of Comic Relief and other charities.

Ian has received wide recognition for his contributions to development and research, including having been knighted by the French Government and nominated Global Leader of Tomorrow by the World Economic Forum. He has published over 50 articles and 18 books, including *Globalization for Development: Meeting New Challenges* (Oxford University Press, 2012), *Exceptional People: How Migration Shaped our World and Will Define our Future* (Princeton University Press, 2011), *The Economics of Sustainable Development* (Cambridge University Press, 1995) and *Divided Nations: Why global governance is failing and what we can do about it*, (Oxford University Press, 2013). Ian's most recent books critical global themes are: *The Butterfly Defect: How Globalization Creates Systemic Risks, and What to Do about It* (Princeton University Press, 2014) and *Is the Planet Full?* (Oxford University Press, 2014).



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FUTURE OPPORTUNITIES, FUTURE SHOCKS

Key Trends Shaping the Global Economy and Society

Andrew Pitt

Global Head of Citi Research

With this report, I am very pleased to launch a major research partnership between Citi Research and the Oxford Martin School. The Oxford Martin School (OMS) is a unique inter-disciplinary community within the University of Oxford comprising more than 300 scholars working in over 30 research teams to address the most pressing global challenges of the 21st century. The School was founded thanks to the philanthropy of Dr James Martin who believed that humanity was at a crossroads, with the 21st century set to be our best or our worst depending upon society's ability to harness extraordinary potential while managing unprecedented levels of risk and uncertainty. Research projects conducted within the OMS are selected on the basis of their global scale and impact and there are few communities working within a top tier global university that combine the caliber of academic scholarship with the relevance to global markets of the OMS.

I have been following the work of the OMS for a number of years and I have been hugely impressed with the research framework of the School which balances analysis of risk and reward in addressing the key questions that concern our future. These questions are of great significance for investors, corporates and governments alike and it is for this reason that we are partnering with the OMS to enhance our research platform and to strengthen our analytical framework. An appendix at the back of this report gives more details of the OMS mission and research capabilities.

At Citi Research we believe that it is increasingly important to analyze the shorter term trends driving financial markets and impacting upon corporate behavior within a framework that addresses the major potential changes in society and technology that can be predicted over the coming decades. We launched the *Citi GPS* thought leadership series in 2011 to do exactly this. *Citi GPS* reports are not about saying that something is going to be important but *why* it is going to be important. As we build our analytical framework more extensively we shall always pay regard to analyzing issues that inform today how and where institutions and corporates should invest.

Figure 1 outlines at a high level our *Citi GPS* thematic framework where we group subject questions under the three pillars of Economics & Markets, Society and Technology. It is immediately clear that many of these subjects inter-relate across the three classifications and, indeed, understanding these interconnections is critical to analyzing global growth. This is not an exhaustive list of the topics that we believe need to be better understood or that our global research teams are working on. Instead, this is a summary of the major thematic questions which we believe can be most effectively analyzed through inter-disciplinary collaboration and with the support of expert partners. Some of these subjects have already received extensive coverage through our *Citi GPS* series and through related Citi Research publications and events. In particular, I would highlight our work on global trade flows, energy, disruptive innovation, China, frontier markets, mobile payments and on political risk. In much of this work we have already brought expertise together across Citi and also accessed insights from Citi's unique physical footprint in over 100 countries around the world.

Figure 1. Citi GPS Thematic Framework

Economics & Markets	Society	Technology
<ul style="list-style-type: none"> • Global growth generators • Geopolitics • Changing trade flows and global imbalances • Systemic risk • Financial market stability • Energy markets of the future • China & the global economy • Frontier market opportunities • The future of Africa 	<ul style="list-style-type: none"> • Demographics • Urbanization • Infrastructure • Popular protest, insurgency & conflict • Income inequality • Pensions • Governance • Climate change • Pandemic 	<ul style="list-style-type: none"> • Disruptive innovation • Automation of the workforce • Nanotechnology • Super machine intelligence • Healthcare innovation • Cyber security • Internet privacy • Mobile payments • Transport in the future

Source: Citi GPS

One thing is certain: growth and progress is not a one way street. Demographic changes and international migration will substantially shift the economic potential of regions and countries while technological innovation will change how products are designed, made and bought everywhere. As complexity rises in an increasingly integrated world, systemic risks will rise too. The trajectory of these trends will all be shaped by geopolitics, popular protest and global governance.

I am delighted that the Director of the OMS, Ian Goldin, has partnered with us to produce this report on future opportunities and risks to accompany the launch of our partnership with the OMS. Ian is Professor of Globalization & Development at the Oxford University and the author of numerous books on major global issues such as globalization, economic change, governance and systemic risk.

In this report we examine the drivers of globalization and the global megatrends that will shape the future as well as the potential shocks and risks to the global system. We attempt to rank these issues in order of importance to investors, corporates and governments and we make suggestions as to how global change can best be managed. Throughout this report we have added sections of contextual analysis produced by our analysts at Citi Research on the trends identified and discussed.

In partnership with the OMS, we shall be following this report most immediately with deeper studies on the impact of workforce automation on employment and growth and separately on systemic risk within the global economy. We then plan a series of further reports and related events that develop sub-themes from the three pillars of Economics & Markets, Society and Technology as outlined above. I know that you will enjoy this report and also future reports through which we develop a long-term research partnership with the OMS on key global issues.



Andrew Pitt

Global Head of Citi Research

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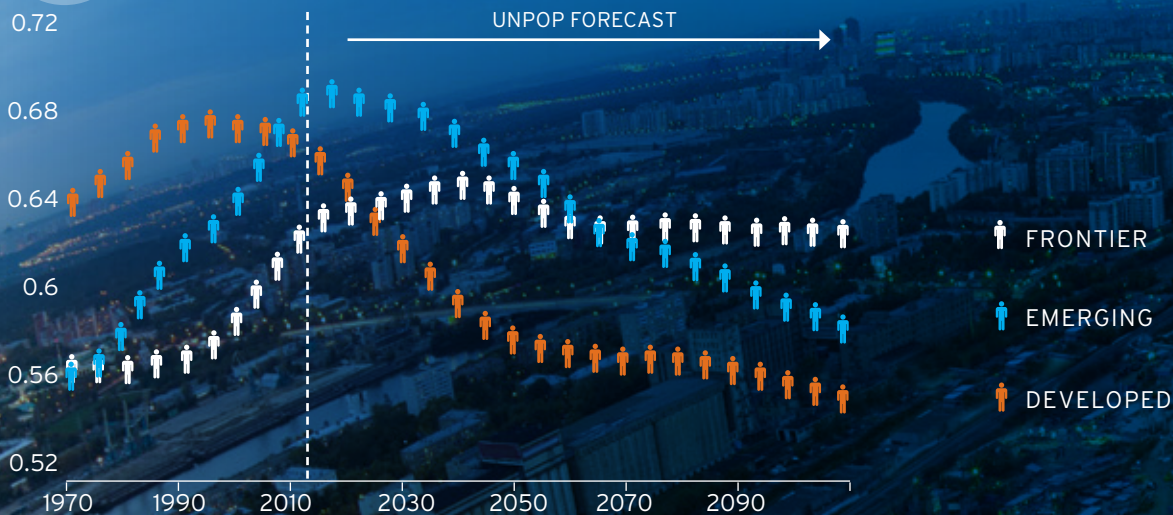
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Megatrends: The Drivers of Globalization

Mapping out the effects in a connected world



Demographics: Window opening for Frontier markets



Source: Citi GPS



Economics: Global GDP is shifting South and East

1990



2050



Source: Citi Research

Systemic Risk: Increasing number of natural disasters causing disruption



Technology: The revolution continues



Global Governance: Not keeping up with a changing world order

Real GDP, Global Rank

1956	\$bn
1. US	1,645
2. UK	347
3. Soviet Union	334
4. Germany	302
5. India	273



2030	\$bn
1. China	24,356
2. US	23,376
3. India	7,918
4. Brazil	6,817
5. Japan	4,883

Permanent UN Security Council (UNSC) members

Source: Council on Foreign Relations, PwC

The Winds of Change

Globalization creates unparalleled opportunity coupled with the potential for systemic risk

This report examines the key drivers of global opportunity and risk and sets the scene for future research reports on many of the sub-themes that we discuss

The importance of policy making in creating inclusive and resilient globalization

Our world will change more this century than during any other time in human history. Change will happen faster than ever before. It will also affect more people than ever before.¹

Globalization has linked us all together, with countries, companies and individuals connected as nodes in a global system of unprecedented complexity. Economic fortunes will rise and fall dramatically. Demographic shifts will transform geopolitics and growth prospects. Technology, education and income growth will drive innovation. All of these changes present extraordinary new opportunities but simultaneously new systemic risks that threaten the entire system. Good governance will mitigate those risks and create unparalleled opportunity. Bad governance will invite chaos and crises.

Those who grasp the direction of the wind and harness its power will be separated from anyone stuck in outdated 20th century ways of understanding this new world. This report forecasts the winds of change—their direction, speed, and intensity. It provides, like most weather forecasts, cause for hope but also concern. Forecasts are not predictions. We nevertheless are confident about the key choices. The 21st century could hail an era of unprecedented prosperity. It could also usher in cataclysmic shocks, making the recent financial crisis a harbinger of more severe storms to come. The changes created by globalization, demographics, technology, economic growth, systemic risk, and governance will serve as a guide to 21st century businesses, investors, and governments. This report examines each of these key drivers of change.

Globalization: Inclusion in an Interconnected World

Since the Berlin Wall fell and the Iron Curtain was drawn back at the end of 1989, the world has become significantly more interconnected. Political borders have opened. Economic flows have expanded and accelerated. Digital networks draw us closer together with cables and clicks. These changes have been disruptive, with positive and negative effects. On the one hand, globalization has helped disrupt the vicious cycle of poverty, lifting billions of people out of its devastating trap with rapid economic growth. On the other hand, rapid change inevitably produces shocks, disrupting societies and dislocating workers.

Globalization is not an inevitable force. It could be reversed. That would, however, be a mistake, although there are some who do not see it that way. This is particularly the case for a significant minority of global citizens — perhaps as many as 1.5 billion — who have not felt the benefits of globalization. The answer is not to reject globalization. Instead, it should be expanded, and made more inclusive, creating a wider web of beneficiaries. And, because globalization inevitably brings more shocks and surprises, not least in the form of systemic risks, more safeguards are required to protect against shocks and short-term dislocation. This will be a choice in the 21st century; if the global community rises to the challenge and creates a more inclusive and resilient globalization, shared prosperity is forecast. If not, the

¹ **Acknowledgements:** The author is most grateful to Andrew Pitt for his guidance in the framing of this GPS and to Andrew and Willem Buiter for their incisive and constructive comments on the drafts, as well as to Kathleen Boyle for her tremendous support in producing this GPS. Brian Klaas and Jonathan Levin, graduate students at Oxford University, have provided excellent research assistance for this report, while Anushya Devendra in the Oxford Martin School has provided wide-ranging help to facilitate the collaboration with Citi.

progress of the last two decades could be reversed by a storm of isolationism, protectionism and cascading systemic risks².

Demographics: The Silver Developed World & Young Emerging Markets

Age pyramids and “demographic windows”

While globalization links us all together, the advanced economies of the world are becoming the silver economies, as birth rates plummet, Baby Boomers mature, and people live longer. There were 200 million people over the age of 60 in 1950. Today, that number has grown to nearly 800 million. By 2050, it is projected to stand at 2 billion. Age pyramids are becoming age funnels, and they are siphoning off economic power from the dominant economies of the late 20th century.

In emerging markets, the storyline is inverted. Many countries are just cracking open the “demographic window,” a period when a solid base of labor will support a much smaller population of dependents. This window is projected to remain open until 2020 in China, 2025 in Brazil, 2030 in Turkey, 2035 in Indonesia, 2040 in Malaysia, and 2045 in India.³ When the window is open, the country is primed for growth—though it will take more than good demographics to ignite the engine of growth.

Like all of these trends, new opportunities exist side-by-side with new challenges. If advanced aging economies do not adapt to face demographic realities, they will stagnate. Pension structures must be reformed, health care costs need to be reigned-in, retirement ages need to be extended, and workplaces will need to find innovative ways to keep their employees working productively for longer. Finally, advanced economies that are open to migration to plug labor gaps will be better equipped to thrive in the 21st century than those that are closed off and exclude new workers.

Because of the lagged effects of demographic change, we can be reasonably certain about the contours of demographic shifts; what we do not know is how well the new silver economies will adapt or how well the young emerging markets will harness their demographic potential.

Technology: From Age of Discovery to Age of Mastery

Revolutionary technological change is a double-edged sword

The aging global population today has seen revolutionary technological change during its lifetime. Yesterday's science fiction is today's reality. We are beginning to understand the natural world to such an extent that we can manipulate it to our own ends. In 1990, we barely understood genes, now we can manipulate them. In 1990, a mobile phone was the size and weight of a brick, now the nanotechnology industry is creating electronics that float on air and that you cannot see without a microscope. Twenty years ago, there were fewer than 3 million people with Internet access; now there are nearly 2.5 billion. Mice can grow human ears. Robots make cars. Guns can be manufactured with a 3-D printer⁴.

² For a study of the policy challenges in creating inclusive and resilient globalization, see *Now for the Long Term: The Report of the Oxford Martin Commission for Future Generations* (Oxford Martin School, 2013).

³ Centre for the Study of Financial Inclusion (2013).

⁴ For studies on the power of disruptive innovations to challenge economies and to create investment opportunities see *Disruptive Innovation: Ten Things to Stop and Think About* (Citi GPS, April 2013) and *Disruptive Innovation II: Ten More Things to Stop and Think About* (Citi GPS, May 2014)

Technology is a double-edged sword. It unleashes new potential and has been central to human progress. Technology can level the playing field, helping the emerging economies of the world catch up more swiftly, and continuing to lift more and more people out of poverty. However, technological change also can wreak havoc either through its misuse (deliberate or otherwise) or through its impact on employment if not managed with sensitivity for its impact on human capital⁵.

Seven key technology trends to follow: nanotechnology; biotechnology; mobile networking; a faster and more accessible Internet; 3-D printing; the spread of sensors; and the automation of labor

Forecasting beyond the near future, however, is a foolish effort. Google was founded less than 15 years ago. Facebook was founded less than 10 years ago. Twitter was founded just over five years ago. What new technologies will define our lives in 2030 or 2050? We cannot be sure. But we can be sure that the immediate trends of the future which will shape the ongoing technology revolution are relatively clear: nanotechnology, biotechnology, mobile networking, a faster and more accessible Internet, 3-D printing, the spread of sensors, and the automation of labor. These will affect our daily lives, the operations of companies, and the prospects of global markets.

Economics: From North to South

Changing patterns and corridors of economic growth

The outlook for the world economy as a whole is positive. Even after the setbacks of the recent financial crisis, there will be steady growth, averaging between three and four percent out to 2050 if current projections hold. The key to understanding economic prospects in the 21st century, however, is that new emerging markets will eclipse the traditional economic powerhouses. Globally, growth will be uneven.

Most of the growth will come from countries that currently are playing “catch up” with the advanced economies that dominated the late 20th century, such as the United States, France, Germany, the UK, and Japan. China and India inevitably will catch up in terms of market size, as they will likely become the first and third largest economies in the world by the middle of the century. The Emerging 7 (or E-7, which includes China, India, Brazil, Russia, Indonesia, Mexico, and Turkey) could possibly hold a greater share of the world’s GDP than the G-7 by 2020 (in purchasing power parity (PPP) terms, at least). Expectations of growth in the advanced economies, particularly in Europe, should be modest at best, while there is room for optimism about the continued higher growth of emerging markets, especially in Asia.

Demographics and migration policy

There are a few safe bets and a few wild cards in the economic game of the 21st century. The safe bet is that low- and middle-income countries will drive global growth, while unfavorable demographics and macroeconomic weaknesses drag down the prospects of the major developed economies. However, everything else is less certain. Even though developing countries are primed for a major economic expansion, countries that create the necessary institutional infrastructure for growth will be far more successful than those that do not implement overdue reforms. Likewise, while Europe, the United States, and particularly Japan will find themselves facing daunting demographic hurdles, the advanced economies could use innovation and more liberal migration policy to dampen the impending economic slowdown.

These are therefore the major wildcards: which countries in the emerging markets will put in place the right policies to take advantage of favorable demographics and create a market ripe for investment, and which advanced economies will be savvy enough to overcome the inevitable barriers to robust growth? Either way, the overall

⁵ For a relevant study of the impact of technology on employment conducted with the Oxford Martin School see the paper *The Future of Employment: How Susceptible Are Jobs To Computerisation?* (Carl Benedikt Frey and Michael A. Osborne, 2013)

picture is certain: growth will happen much more in the developing world, and firms and investors operating in developed economies would be wise to seek opportunities for more substantial returns in newly emerging markets, the powerhouses of the 21st century economy.

Systemic Risk: Managing the Inevitable Perils of an Interconnected World

Rapid global changes create systemic risks with aftershocks potentially felt far away from any given epicenter

These rapid changes — globalization, demographics, technology, and economic shifts — are tremors that could rock the foundations of the 20th century world as we continue deeper into a much more integrated 21st century. The tremors create risk and, with increasing connectivity, the aftershocks will create damage far away from any given epicenter.

The havoc wreaked by the 2008 and 2009 financial crisis is instructive. The freeze in interbank lending caused by what could be viewed as a relatively isolated collapse in the US subprime market had the destructive power to spread recession and stagnation worldwide. With such a high level of interconnectivity, a single “fat finger trade” could send the stock market spiraling down, or rocketing upward with speculative phantom gains. Never before has financial systemic risk been so acute.

Supply chain risk

Likewise, as our markets are more closely networked together, so too are our supply lines. Containerization and more efficient logistics have enabled firms to spread their manufacturing across the world enabling production to be situated where it is most efficient. This has come at the cost of embedding endemic risk into the system. A failure at a single node on the global production map can bring entire networks to a halt. When a fire broke out in a Philips owned semiconductor plant in New Mexico in March 2000, the supply networks of a Nordic and another European telecommunications company were hit by a supply shock. Both relied on chips manufactured in the burned-down plant to power their mobile phones. The combination of globalized commerce and improved logistics mean that supply chain systemic risk is growing rapidly.

Cyber security and risks to physical infrastructure

We are also more vulnerable in cyberspace, which now provides the nervous system for the global economy. Not only are there risks associated with cyber security — in terms of software and hardware malfunctions and malicious attacks — but there are also risks to the physical infrastructure. The world's longest fiber optic cable is 24,000 miles long and connects 31 countries to the Internet. If those lines are severed, either intentionally or due to a fluke event such as a ship's anchor dropping on one (as happened in Egypt in early 2013) it could cut off the digital backbone of an entire region. Likewise, intentional attacks are a major risk to cyber networks. Bots, malicious spam, viruses, worms, and even government-sponsored attacks are all major risks in the 21st century. Never before has a ship's anchor had the power to accidentally cripple economies and shut off global communication, or a hacker anywhere in the world had the power to shut down commerce, steal information, and create volatility a continent away.

Natural disasters and climate change

Natural disasters also pose a substantial risk. Climate change means that more intense storms occur more often. The damages from these storms can shave full percentage points off of a country's GDP figures, as economic investments are redirected toward rebuilding rather than expanding. Superstorm Sandy, which hit the eastern seaboard of the United States in October 2012, caused billions in damage and disrupted global trade as Wall Street closed for two days.⁶ Other disasters that have nothing to do with human activity, such as volcanic eruptions,

⁶ *Forbes* (2012).

are now more disruptive. The Eyjafjallajökull volcano that erupted in 2010 in Iceland is estimated to have cost the world economy more than \$4.5 billion in damages, disruptions, and lost revenues. Never before in recorded history have so many intense storms struck at such frequent intervals, and never before has a volcano in Iceland or a hurricane had such potent capacity to disrupt worldwide economic growth. Increased population density, settlement on marginal lands, and rising wealth and connectivity have greatly increased the cost of natural disasters, even before we begin to account for the increased frequency or strength of these events, as a result of human activities which affect the climate and other natural systems.

It would be foolish to ignore pandemic risk

Finally, while all of these risks are severe, none is as threatening as the specter of a virulent, deadly global pandemic. The global influenza of 1918 is estimated to have killed around 50 million (but possibly as many as 100 million) people, and that occurred in an era when viruses spread much more slowly, as people were less mobile.⁷ The possibility of a pandemic rising up with similar ferocity has been forewarned with the less severe test runs of Avian Flu, H1N1 and SARS. Never before have dangerous pathogens traveled so freely, stowing away inside unsuspecting people in airliners, cars, ships, and trains as they crisscross thousands of miles spanning the globe with ease.

These systemic risks are not all new, but they are more threatening than ever before. They represent the sources of threats we must confront in the 21st century.

Global Governance: Reconfiguring the 20th Century Alphabet Soup

The lack of resilient global governance institutions is a concern at a juncture of such rapid global change

The alphabet soup of international agencies charged with managing global problems is woefully outdated. Most organizations such as the United Nations and the Bretton Woods institutions have changed little since they rose phoenix-like from the ashes of World War II. They deserve credit in the second half of the 20th century, not least for averting another world war, eradicating smallpox and polio, and until 2008 helping avoid a global depression. However, they are increasingly unprepared for the 21st century. Their mandates have mushroomed and their capabilities have not evolved as quickly as the challenges they face.⁸

The term global village is more apt than ever, but there are not village elders in place to guide us. Looking to the future, countries with diminishing geopolitical strength increasingly are unable to provide world leadership, while the new economic powerhouses have not yet shown the capacity to resolve global challenges, either alone or in concert with the old powers. As a result of the failure to establish global management systems which are fit for 21st century purposes, systemic risks are festering. The ability to resolve these is *the* challenge of our time and will determine whether the 21st century will be the best of times, or the worst of times.

Investing in a Turbulent World

This report is not an exercise in global fortune telling. There is a great uncertainty. The world's future chapters are blank, waiting to be written. However, the key trends outlined in this report — as well as the critical risks that threaten our shared future — are driving change today and will continue to be important factors in shaping and understanding the coming decades. We live in a turbulent world. Knowledge will help you ride the winds and avoid the storm.

⁷ Johnson, NP. and Mueller, J. (2002)

⁸ For more information see Oxford Martin School (2013)

1. Globalization

The Economic Global Village as the New Normal

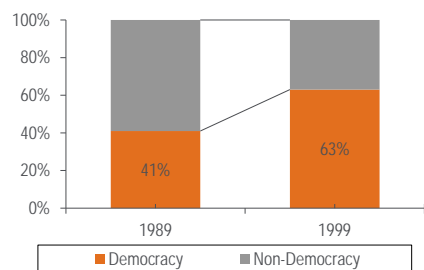
Political change and democratic processes

In recent decades globalization has accelerated at a remarkable pace. The fall of the Iron Curtain and collapse of the Berlin Wall marked the beginning of an epoch of increased political and economic openness. Increased integration has been associated with a surge in economic growth because ideas, goods, and services travel more freely across borders. The Internet has in part facilitated these flows by radically reducing the cost and increasing the speed of data transmission across the globe. As a result, commerce has built a global platform on top of increased economic integration. These processes are shaping the business landscape and will continue to do so for the 21st century. The economic global village has become the new normal. The stability and the continued integration of global villages will be underpinned by the megatrends discussed in the chapters that follow.

Political Globalization: Crumbling Walls, Open Borders, New Democracies, and Global Governance

During the Cold War, barriers — both physical and ideological — divided the world. East rivaled west, communism against liberal democracy, and command economies versus (largely) open markets. Most countries chose sides. Even cities were divided, with the Berlin Wall as the physical manifestation of global chasms.

Figure 2. Democracy grew in just a decade



Source: Citi Research

The tearing down of the Berlin Wall reflects the tearing down of barriers everywhere and 25 years later only North Korea is truly isolated from the world. In 1989, there were 69 democracies, 41% of the world's countries. A decade later, there were nearly twice as many — 120 democracies — comprising 63% of the world's nations, with many more countries having come into existence.⁹ In Africa, the change has been even more pronounced, with only 3 electoral democracies in sub-Saharan Africa as of 1989 and 24 (almost half of African countries) just a decade later.¹⁰

As the number of democracies surged, borders became more permeable, especially in Europe. In 1995, seven signatory countries agreed to reduce customs and immigration controls, creating the Schengen zone (Figure 3). This grew to 26 nations as more signed on after its initial success.¹¹ Over the last 18 years, nearly 5,000 miles of land borders were opened, freeing 400 million citizens to live and work where they choose across 1.6 million square miles.¹² Even in non-democratic societies such as China, the regulation of global trade has allowed significantly more cross-border flows—not only of people, but also of finance and goods.

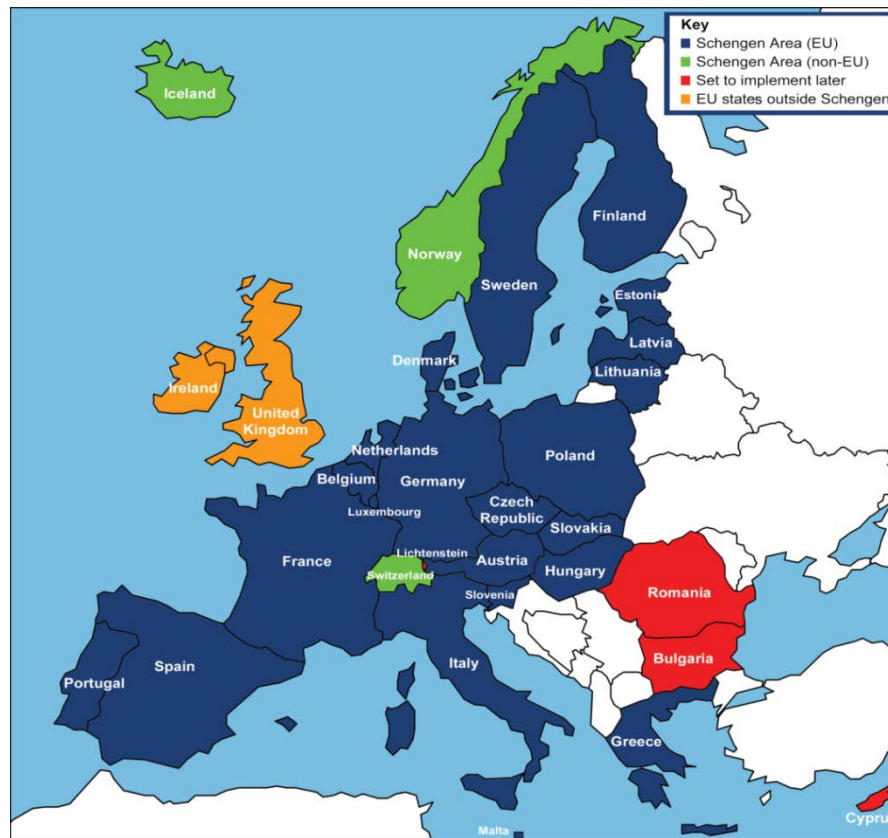
⁹ Freedom House (2013).

¹⁰ African Elections Database (2012).

¹¹ BBC News (2013a).

¹² The European Commission (2008).

Figure 3. The EU's Schengen zone has facilitated the movement of goods, services and people



Source: European Commission (2008).

Globally, integration has been facilitated by the standardization of governance ushered in by the World Trade Organization (WTO) and codes advanced at the Organization for Economic Co-operation and Development (OECD) and elsewhere. There are now 159 countries that are members of the WTO, controlling economic flows across borders worldwide. Since Russia joined in 2012, all economies of global significance have now agreed to subject their commerce to the global trade rules based on reciprocity and non-discrimination — the guiding principles of the WTO.¹³

The easing of the trade barriers and the growth of both physical and virtual connectivity

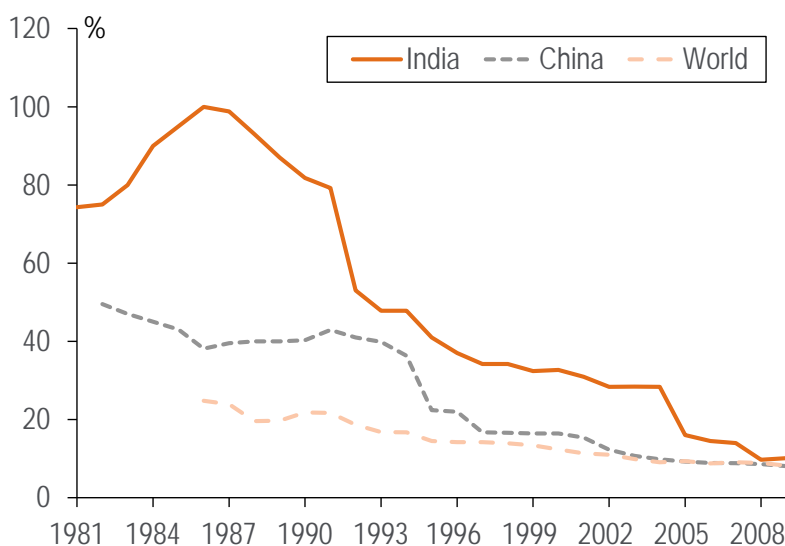
Alongside negotiations held under the auspices of the WTO, there have been significant movements in unilateral and multilateral dismantling of trade barriers. India has been among the countries which have championed this approach, reducing its peak tariffs on industrial products from over 200% in 1990 to less than 10% in 2009¹⁴. The reduction in trade barriers ease up more than just the movement of goods and services as they often serve as a catalyst for both domestic and foreign direct investment. Some regional trade agreements have also sought out broader goals of deeper economic and political cooperation and integration. Whilst repeated attempts to resuscitate the Doha talks¹⁵ appear unlikely to salvage the ambitious target of a global agreement, regional liberalization efforts continue to gain momentum.

¹³ WTO (2013a).

¹⁴ UNCTAD (2012).

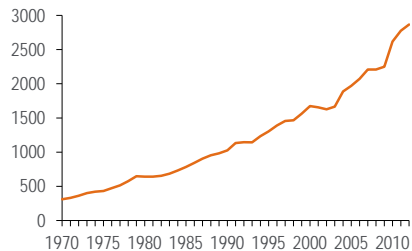
¹⁵ The latest of the multilateral trade negotiations talks carried out in rounds starting at the end of World War II

Figure 4. Average tariff rates have come down significantly since the 1980s



Note: All tariff rates are based on unweighted averages for all goods in ad valorem rates, or applied rates, or MFN rates, whichever data are available in a longer period. Missing values interpolated. MFN = Most Favored Nation
Source: Citi GPS (2011)

Figure 5. Steady increase in global air passengers



Source: World Bank

Both physical and virtual connectivity have grown in leaps and bounds in recent decades. In 1970, global air traffic ferried just over 300 million people to their destinations, both domestically and internationally. By 1990, that figure increased to just over 1 billion, and by 2012 it had grown to 3 billion passengers.¹⁶ As will become clear in the next chapter, this trend — and the migration flows it enables — underlie a critical transformation in the 21st century economy.

Political globalization, in short, has meant a change not only in the composite parts of the international community but also in the governance of that system. As the world has democratized, previously rigid borders are being softened. Global agreements on trade, human rights, and justice have promoted unprecedented integration. However, an elusive global agreement on climate change and the breakdown of the Doha trade talks are indicative of the complex challenges that lie ahead. The accelerated pace of technological, demographic and economic change, and the stagnation of governance is a key risk to more inclusive globalization.

Economic Globalization: Financial Integration, Cross Border Flows, (More) Free Trade

As the political winds blow holes in borders, the global economy has become more integrated too. Just as air traffic has soared and gone global, so has the transport system itself. For example, London's Heathrow Airport — the world's third busiest, with more than 70 million passengers annually — is owned by companies that have their headquarters in Qatar, Quebec, Connecticut, Singapore, Madrid, and Beijing.¹⁷ British firms own no share of Heathrow, even though it is by far the largest airport in the United Kingdom, a financial structure reflecting the globalization of commerce.

¹⁶ This does not mean that 3 billion people flew, simply that 3 billion passengers were moved on airlines in that annual period, with some undertaking multiple journeys. From World Bank (2013c).

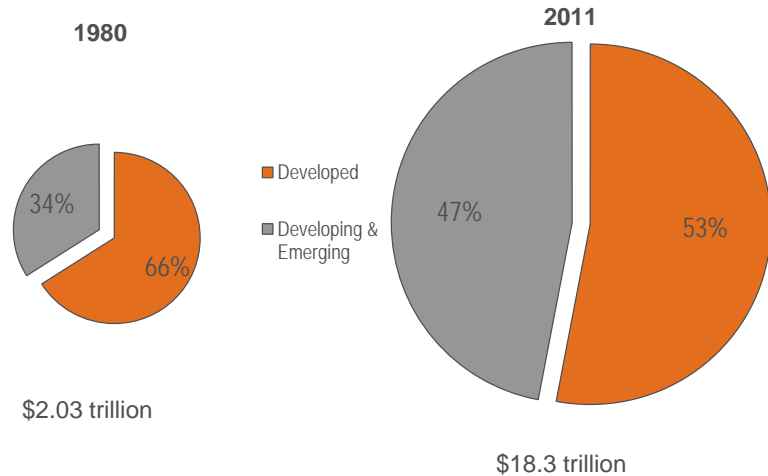
¹⁷ Heathrow Airport Holding Ltd. (2013).

A more integrated global economy

Greater penetration of global brands

Goods and financial instruments now flow more freely across borders due to reductions in trade barriers. Global brands like Coca-Cola are consumed in over 190 countries, representing remarkable global market penetration.¹⁸ Around 70 million people in 118 countries eat at McDonald's every day.¹⁹ These anecdotes are indicative of a larger trend. According to WTO trade statistics, the value of world merchandise exports rose from \$2.03 trillion in 1980 to \$18.3 trillion in 2012 which is equivalent to 7.1% average growth per year.²⁰ As trade value rose, so did trade volume, substantially outpacing GDP growth over the least three decades.²¹

Figure 6. World merchandise exports by level of development



Source: World Bank, Citi Research.

Shifting global trade balances

The distribution of the growth in trade has shifted dramatically as well. In 1980, developed economies contributed two-thirds of all world merchandise exports. By 2011, that share had dropped to half. Much of that shift is due to the rise of China, which held 1% of the share in 1980, and 11% of global trade three decades later.²² The swing away from advanced developed economies towards emerging markets will accelerate further in the future.

¹⁸ Due to political decisions (including sanctions), Coca-Cola is not currently legally sold in Cuba, North Korea or Iran. It was introduced to Myanmar (Burma) in 2013. See Smith, R. (2013).

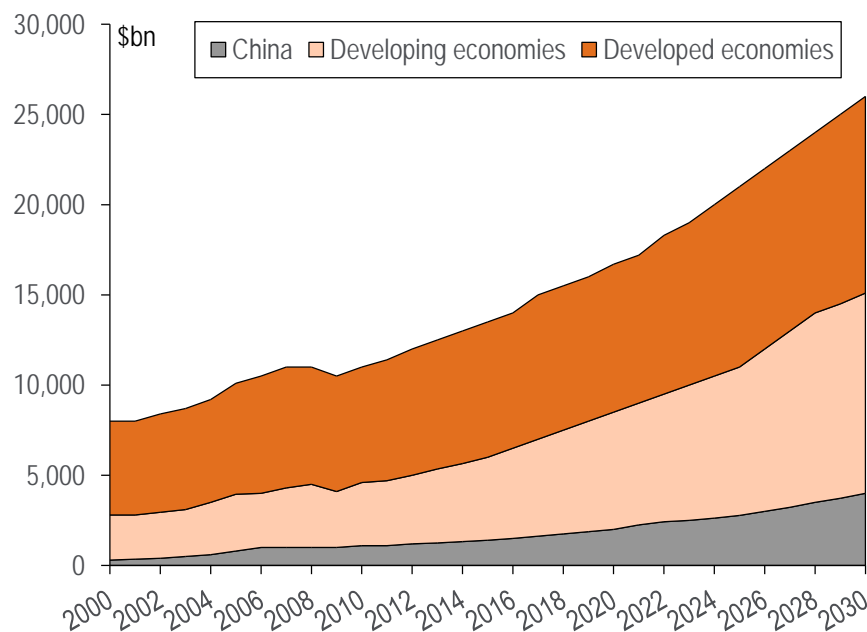
¹⁹ McDonald's (2013).

²⁰ WTO (2013b) p. 55.

²¹ Ibid, p. 57.

²² Ibid, p. 58. China's 11% share marks it as the largest exporter in the world. The United States is now responsible for just 8% of global share.

Figure 7. The share of developing countries real exports is expected to continue to rise



Source: WTO (2013b)

Global supply chains and much lower transport costs

Part of the reason for the marked growth in global trade is the advent of global supply chains as the cost of global communications and transport plummet. Take the iPhone, for example. The memory and touch screen are made by Toshiba in Japan. The processor is made by Samsung in South Korea. The camera and GPS receiver are made by Infineon in Germany. The Bluetooth unit is made by Broadcom in the United States. All of the products are then assembled in China, where they are assembled by a Taiwanese company, Foxconn. In total, ten companies in six countries are involved in the manufacturing of a single iPhone.²³

Such supply chains are made possible by containerization and improvements in shipping, making it feasible to move freight for much lower cost. In just the last decade, shipping container traffic between countries has increased by 142%, from 235 million container units in 2001 to 572 million in 2011 (with a projected rise to 618 million units in 2012).²⁴ The largest container ship in the world is a quarter mile long and can hold 18,000 shipping containers — enough to hold 36,000 cars, or to form a train sixty miles long on land.²⁵

Globalization has reduced poverty but it can be exploited leading to greater inequality both between countries and within countries

Container ships make global supply chains possible, but they also create new challenges: systemic risk from disruptions in the chain as well as gaps in global governance. For example, in 2006, a local company in Côte d'Ivoire unloaded "a Greek-owned tanker flying a Panamanian flag, leased by the London branch of a Swiss trading corporation whose fiscal headquarters are in the Netherlands" at the port of Abidjan. The contents of the tanker — about 400 tons of caustic, toxic sludge — were dumped in densely populated urban areas, causing many deaths, scarring children for life, and making tens of thousands of people sick.²⁶ The price tag for safe disposal of the waste in Europe was \$300,000, so a cheaper solution was found and the toxic sludge ended up on the doorstep of poor people in sub-Saharan Africa.

²³ Xing, Y., and Detert, N. (2010).

²⁴ World Bank (2013a).

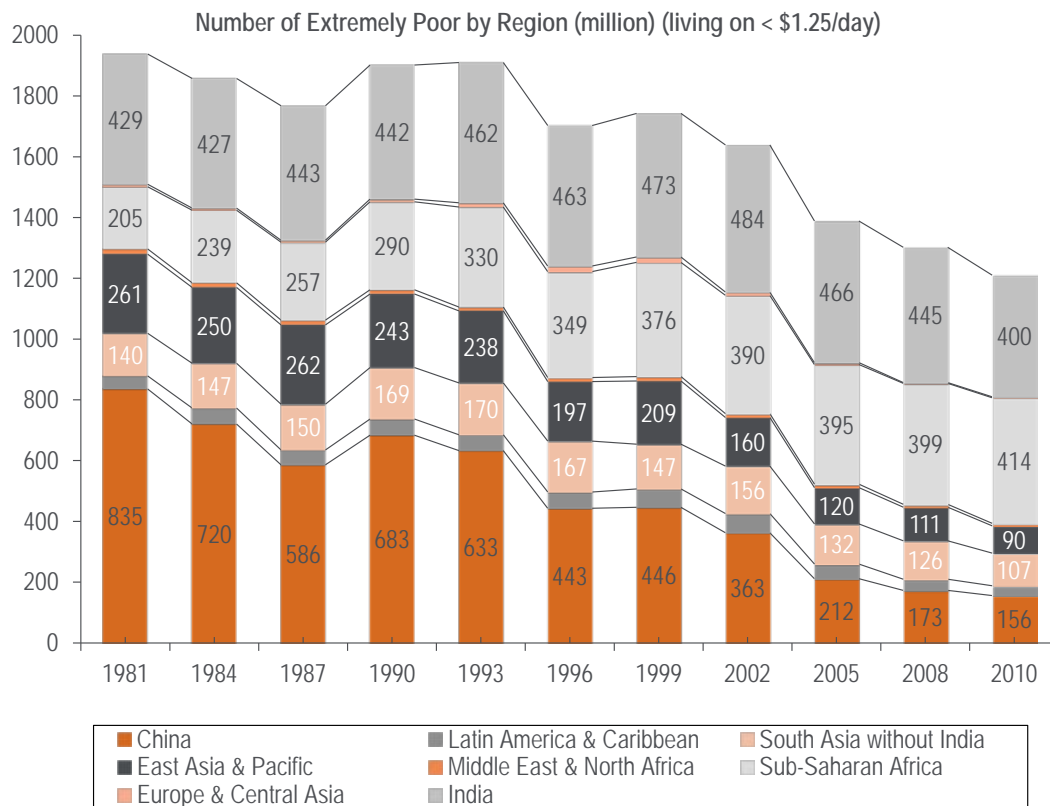
²⁵ Kremer, W. (2013).

²⁶ The New York Times (2006).

This example illustrates one of the downsides of globalization. Sometimes, comparative advantages are derived from exploiting minimal regulation. Over time, globalization has produced plenty of discontents, with inequality rising both between countries and within countries.²⁷ Many have been left out, and some have been left worse off.

On the other hand, globalization has also ushered in the largest drop in global poverty in world history. Throughout the world, the number of extremely poor people was cut in half between 1990 and 2010.²⁸ In East Asia, 77% of people lived on less than \$1.25 per day in 1981; by 2008, that number was reduced to 14% — largely driven by a drop of 663 million fewer extremely poor people in China during that period.²⁹ Other areas, such as sub-Saharan Africa, have not fared as well. While overall rates of extreme poverty have fallen from 58% in 1999 to 48% in 2010, the reduction is not as impressive in historical terms given that 51% of sub-Saharan Africans faced extreme poverty in 1981. Moreover, while the ratio has been reduced, there were more than twice as many extremely poor people living in sub-Saharan Africa in 2010 (414 million) than in 1981 (205 million).³⁰

Figure 8. Globalization has been coupled with a large decrease in world poverty



Source: World Bank (2013b)

²⁷ Goldin, I. (2012).

²⁸ World Bank (2012a).

²⁹ Ibid.

³⁰ World Bank (2013b).

Growth and poverty reduction can (and should) go hand in hand

These mixed results raise an important question: is globalization a force for economic good? There has long been a false dichotomy between pro-growth and pro-poor economic policies. This mentality has done globalization a disservice by leaving millions on the margins of its benefits. Poverty reduction and global growth are, in fact, complementary aims. Ironically, part of the problem facing many developing countries is that the rich countries do not have free enough markets and restrict market access. Perverse subsidies and protection for agriculture in Europe, the US, and Japan increases the instability of world markets and therefore reduces the potential for developing countries to exercise their comparative advantage in agriculture. Growth and poverty reduction can (and should) go hand in hand. Globalization can work for everyone. It is critical that it does, or those that feel left out in the cold will spark a reversal of pro-globalization policies, which would be bad for everyone.

Social Globalization: Connections across Borders and Shared Culture

As globalization ushers in political transformation and economic expansion, it also alters the social and cultural landscape. More than 1.1 billion people use Facebook each month.³¹ There are more than 124 billion “tweets” a year.³² In more traditional media, more than two-thirds of Hollywood’s revenues are now coming from markets outside the United States.³³

Global standardization and local adaptation

Globalization has created two simultaneous trends. On the one hand, uniformity is a key component of cultural globalization. Nearly sixty-percent of the revenue for the \$1.5 billion Hollywood blockbuster, *The Avengers*, came from markets outside North America — a fact that represents millions of people all around the world sharing the same cultural experience.³⁴ On the other hand, the phenomenon of “glocalization” has demonstrated that firms that adapt their products to local markets are often more successful. That is why, for example, McDonald’s serves the Maharaja Mac in India, the Ebi Filet-o in Japan, the McKebab in Israel, and the McLobster in Canada.³⁵ These competing trends — global standardization and local adaptation — will continue into the 21st century, both changing the landscape of the global marketplace.

Threats to globalization from the political process

Is Global Integration Sustainable in the 21st Century?

Globalization could be reversed. The inevitable shocks and risks associated with an increasingly integrated world are having an adverse effect on the lives of citizens and are leading to a growing disillusionment with openness and integration. While the benefits are diffuse and long term, the threats are real and immediate. The risks associated with financial crises, pandemics, cyber-attacks, or terrorism are among those that people feel come from over their borders. They may drive politicians in the midst of crisis to surrender to immediate pressures, sacrificing long-term growth in favor of protectionism borne of short-term fears³⁶. Borders that have previously been opened are finding increasing restrictions on movements, and trade restrictions introduced. Such moves are a threat to integration. It is therefore essential that globalization be inclusive, with maximum effort made to minimize inequality and exclusion.

³¹ Facebook (2013).

³² Twitter (2012).

³³ Kolesnikov-Jessop, S. (2011).

³⁴ Barnes, B. (2012).

³⁵ Johnson, R. (2011).

³⁶ For a relevant study of the impact of the popular pressure on government action see *Taking It to the Streets: What the New Vox Populi Risk Means for Politics, the Economy and Markets* (Citi GPS, May 2014).

We now live in a globalized world. Against this fact, which serves as the critical backdrop of understanding the 21st century, are a series of important megatrends that will shape the form of global integration. Demographic changes and international migration will substantially shift the economic potential of regions and countries, altering the global balance of power. Technological innovation will change how products are designed, made, and bought everywhere. As complexity rises in an increasingly integrated world, systemic risks will rise too, reverberating across the globe quickly and, sometimes, disastrously. Finally, the trajectory of these trends — and of globalization itself — could be shaped by global governance, which is sorely needed as we chart new territory. In the face of resource depletion, environmental degradation, and climate change, new systems of governance to reconcile the complex trade-offs of the global commons will come to the fore. These are the megatrends of the 21st century that will affect businesses, investors and governments.

2. The Age of Aging

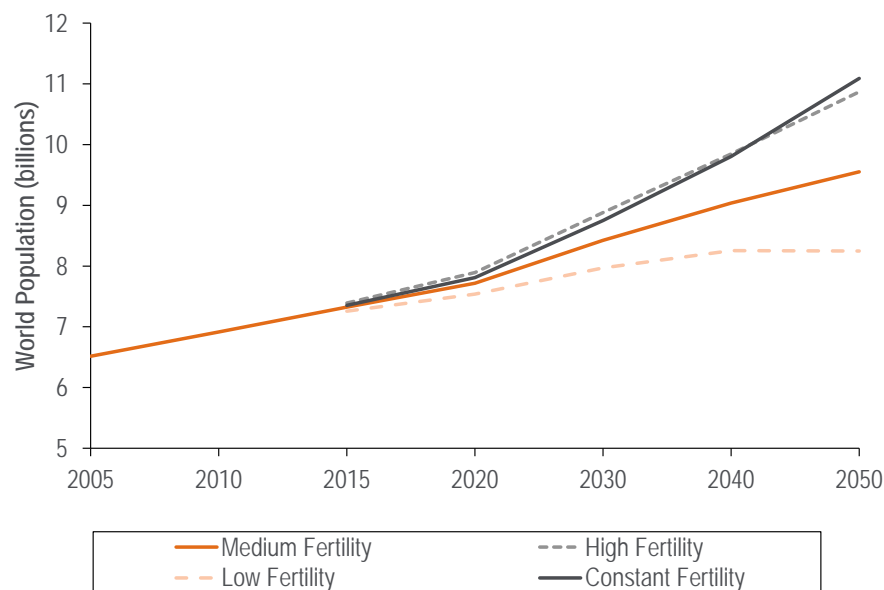
Global Population Trends

The opportunities and risks around demographic trends

Our demographic future is remarkably uncertain. The UN population forecasts for 2050 range from a high of around 11 billion people to a low of less than 9 billion. Nevertheless, one thing is clear: the global population is becoming dramatically older. Changing demographics alter the global economy and will have a powerful influence over markets and investment opportunities.

The combination of rising demands on state and private pensions, a surge in health care costs, and a smaller labor force to pay for these needs creates what may be called “a perfect storm” of demographic change. The impact of the storm will be uneven. It will hit some places hard while missing others completely, before returning with a vengeance in decades to come. Everywhere, the demographic storm can be weathered, even harnessed by businesses and governments alike with the right preparations and policy adjustments. Governments and investors ignore demographic trends at their own peril. While demography is not destiny, demographic transitions offer tremendous opportunities for shrewd planners in business and government.

Figure 9. World population projections in 2060 have a range of over 2 billion people



Source: United Nations (2013)

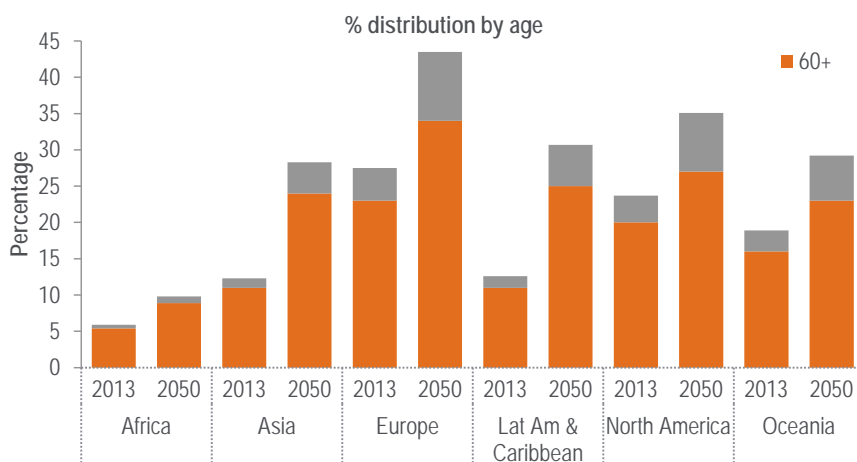
Why is the Population Aging?

Factors driving an aging population

There are three main factors accounting for an aging population. First, a sustained global drop in fertility rates is increasing the proportion of older people. The fall has been largely produced by greater access to contraception, reduced infant mortality, female education and employment. Second, mortality has also steadily declined across the world. Improvements in health care and a sharp drop in global poverty have facilitated the increase in average life expectancy. Third, babies born during the so-called “Baby Boom” in the post-World War II era are now growing old. This means that a former spike in fertility rate is becoming a spike in the number of elderly people in society.

Substantial demographic change will drastically affect economic dynamics. The global population aged 60 and over has increased from 200 million in 1950 to around 760 million today. According to the UN, by 2050, it is projected to reach 2 billion.³⁷ Likewise, while there were only 14 million people over the age of 80 living in 1950, compared to more than 100 million today and “near 400 million by 2050 if current projections prevail.”³⁸ These changes are most pronounced in the developed world, particularly Japan, where there will only be one productive laborer for each elderly person in the society by 2050.³⁹ The developing world (especially outside sub-Saharan Africa and parts of the Middle East) is exhibiting similar dynamics: by 2050, 20% of India’s population and 31% of China’s will be aged 65 or older.

Figure 10. The aging global population



Source: Oxford Martin School (2013)

Economics and Age: the “Demographic Window”

Understanding the “demographic window”

Demographic variations between countries and regions will have significant implications for economic and investment prospects. The United Nations uses the term “demographic window” to refer to times when the working-age population of a country or region is high relative to young people (under the age of 15) and the elderly.⁴⁰ With effective governance and economic policy, this “window” can usher in a period of comparatively high growth—as a higher share of workers in the country satisfies the needs of those outside the labor force. While the window has already closed for many advanced economies (including much of Europe, Japan, and the United States) and is closing for China (whose labor force is now falling by over 3 million a year while its elderly population grows even more rapidly) it is forecast to remain open until 2025 in Brazil, 2030 in Turkey, 2035 in Indonesia, 2040 in Malaysia, and 2045 in India.⁴¹ In other countries, including most in sub-Saharan Africa, the window will not open for some time. For example, current projections suggest the “demographic window” will not open until 2070 in Nigeria and may not open this century in Zambia, due to one of the world’s lowest life expectancies

³⁷ Bloom, D., Canning, D. and Fink, G. (2011).

³⁸ Ibid.

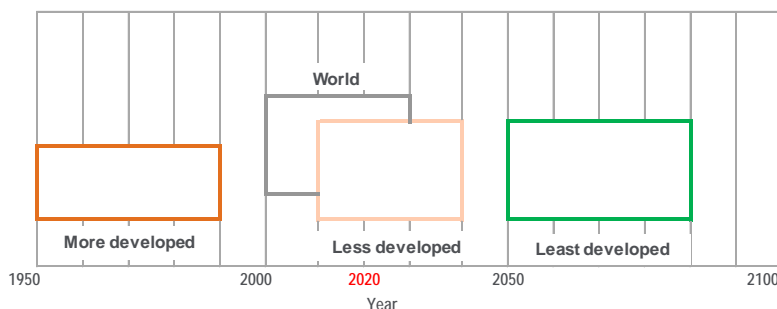
³⁹ Population Reference Bureau (2010).

⁴⁰ Specifically, when children 15 year and younger are less than 30% of the population while those 65 years and older are less than 15% of the population. *Centre for the Study of Financial Inclusion* (2013).

⁴¹ *Centre for the Study of Financial Inclusion* (2013).

decimating productive labor.⁴² Figure 11 plots the “demographic windows” for different regions showing that more developed economies have already seen the biggest window of opportunity in terms of positive demographics while less developed economies are looking forward to that window opening from 2020 onwards and least developed economies hoping it opens post 2050.

Figure 11. The “demographic window” varies with stages of development



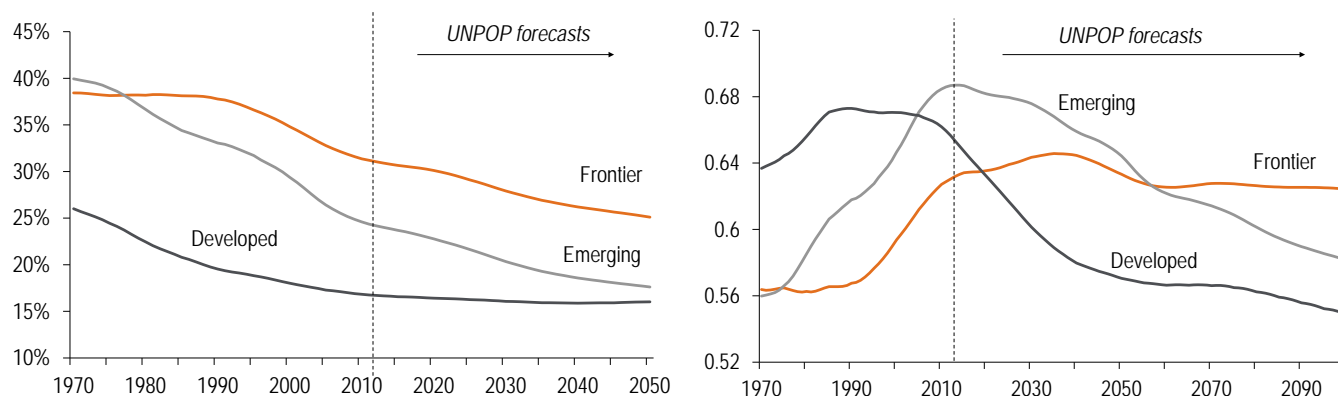
Source: Centre for Financial Inclusion (2013)

The implications of the “demographic window” depend on the ability of the society to utilize its labor force effectively to drive growth. In Indonesia, for example, (with the window predicted to remain open from 2005-2035) there are currently over 100 people working for every 50 dependent people — a strongly favorable ratio. In the frontier markets, the working age as a percentage of the total population is on average lower than that in emerging markets or developed economies. However this trend is expected to reverse. By 2020, the ratio of active workers in the population is predicted to exceed that in the developed markets (Figure 12).

Figure 12. Population growth between developed, emerging and frontier markets exhibit different trends

Population <15 years, as % of total population (1970-2050E)

Population of working age, as % of total population (1970-2050E)



Source: Citi GPS (2013)

In more developed countries, there have been attempts to raise the pension age to widen the “demographic window”. However, the official retirement ages for most OECD countries fall within a fairly narrow band of 60 to 65 and governmental reform proposals are fairly modest within that range. Societal attitudes to changes in the retirement age are entrenched. In France, in 2010, President Sarkozy’s proposal to

⁴² Ibid. Such long-term projections are inevitably uncertain (especially given Zambia’s recent successes at reducing HIV/AIDS mortality), but nonetheless demographic trends, at least with respect to aging, brew over decadal time periods.

raise the retirement age from 60 to 62 was met with a strike of one million workers.⁴³ Policymakers are also now more sensitive to the growing electoral block of older people making drastic changes untenable. Furthermore, high rates of unemployment due to financial crisis also stand in the way of fast progress. Governments, businesses and society will need to form a more realistic assessment of the official retirement age in conjunction with allowing more flexible working hours and continued learning and training of the working population to widen their “demographic windows”.

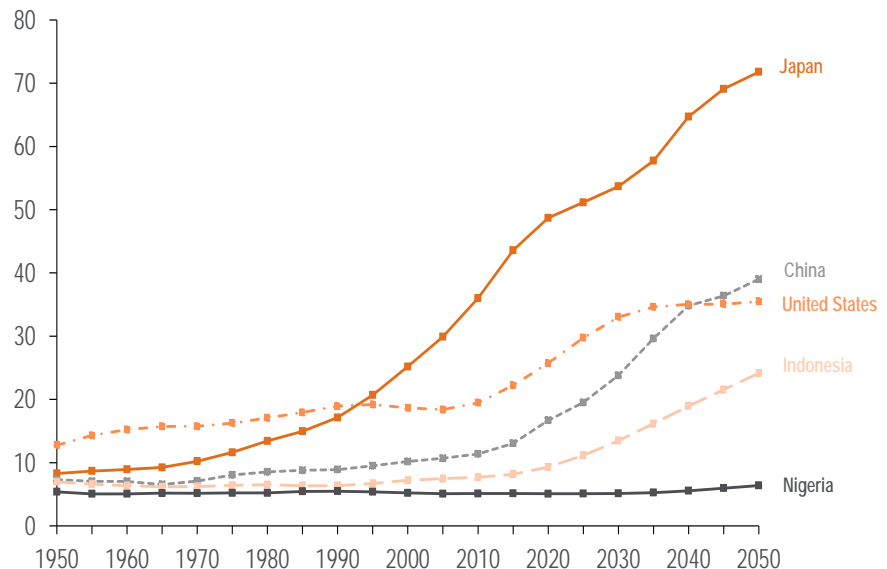
Investors and governments need to pay attention to how demographics affect economics prospects; in societies where good governance and sound economic policy are in place, betting on growth in “window” countries seems a wise strategy.

What to Do When the “Window” is Closed? Challenges and Opportunities

Rapid divergence of dependency ratios across countries

In the emerging markets, sound macroeconomic management will in general be reinforced by favorable demographics. By contrast, in the European Union, Japan and to a lesser extent the US, the troubling macroeconomic balances are likely to be further aggravated by rapidly rising dependency ratios and the decline in working population. Advanced economies urgently need to recognize and address the demands that come with a steadily aging population: smaller workforces, greater strain on pension purses, and higher health care demands.

Figure 13. Elderly dependency ratios are expected to diverge further



Source: United Nations (2013).

Retirement ages and life expectancy

In most OECD countries, retirement ages have held steady over the last 65 years, and have even fallen in some places (such as Canada and Ireland, where the “pensionable age” dropped from 70 in 1949 to 65 today).⁴⁴ The disparities between these common retirement ages and the beginning of pensions is stark — while the pensionable age for men in Greece is 57, life expectancy for Greek males is 78, a

⁴³ World Economic Forum (2012b).

⁴⁴ OECD (2011).

far cry from the historical antecedents which were characterized by near parity in these measures. In 1935, for example, in the US Social Security eligibility and average life expectancy were 65 years.⁴⁵ By contrast, the average American who retired in early 2013 was 61 years old, with full Social Security benefits from age 66, while average life expectancy is just under 79 years — a long way from the previous equilibrium.⁴⁶ Moreover, women retiring today from the labor force in South Korea can expect to live an *average* of 25 years after they become eligible for pensions.⁴⁷

Life expectancy versus investment returns

On top of the relatively simple impact of extended periods of benefits comes the compounding impact of lower returns on investment. The decline in risk adjusted real returns has dramatically decreased the returns to savings. For pension and other long-term investors, regulatory and other pressures following the financial crisis have pushed asset managers to hold short-term rather than long-term assets, with the increasing mismatch between the long-term liabilities and short-term assets providing an additional source of concern. This undermines the security of pensioners and other wealth accumulators and also wastes the potential for a natural hedge between the needs of society for investors in long-term infrastructure and the needs of pensioners to hold long-term assets. While in the US, the availability of a wide range of municipal and other bonds as well as a more favorable regulatory environment provides a more positive environment for long-term asset managers, in most European countries, including the UK, this is not the case.

The politics of pension reform

The politics of pension reform is unfortunately getting more difficult as older people become an increasingly important voting constituency. Politicians face a very real risk of losing elections if they propose cuts in expenditure on the elderly. In Japan, for example, 44% of voters are over 60 while only 13% of Japanese voters are in their twenties.⁴⁸

The impact of rising healthcare costs

Rising health care costs are another challenge, especially as the twilight years of life are often the most expensive in terms of cost of care. In the United States, for example, the most expensive 10% of patients in Medicare (health care coverage that is provided to Americans older than 65) accounted for 64% of total state health care costs.⁴⁹ Such statistics are alarming to governments overseeing steadily aging populations. However, there is hope. There is growing evidence that a “compression of morbidity” is occurring — that people are living longer, but living *healthier* for longer as well.⁵⁰ If this trend continues, it could help overcome some of the most daunting aspects of an aging population. The rapid progress in extending physical health is unfortunately not matched by progress in neurological degenerative diseases. As a result, for the next twenty years or so Alzheimer’s, dementia and Parkinson diseases are expected to continue to be a barrier to an extension of productive years and to place enormous burdens on health care systems.

⁴⁵ Ibid. See also: *Social Security Administration* (2013).

⁴⁶ Brown, A. (2013). The problem is even more pronounced than these figures suggest because life expectancy is dragged down by early life deaths.

⁴⁷ These figures refer to life expectancy upon reaching adulthood; life expectancy figures are generally lower because they take into account infant mortality. This measure is more accurate for computing actuarial needs in pension programs because infant mortality has little to no bearing on pension funds, except in lagged effects of the total size of the workforce.

⁴⁸ Harney, A. (2013).

⁴⁹ Medicare is the state pension scheme in the United States, for Americans 65 years and older. See Adamy, J. and McGinty, T. (2012).

⁵⁰ Bloom, D., Canning, D. and Fink, G. (2011).

Working Elders, Workplace Productivity and Leadership

The need for changing labor dynamics

As the population gets older, labor force dynamics must change. Some companies have already successfully identified the need to retain older workers and have invested in sustaining their productivity. For example, BMW uses robotic technology to mitigate the loss of physical strength in older workers relative to younger workers. The assembly plant adapted for elderly workers has proved itself as productive as facilities with much younger workforces, but quality has been higher among the older workers — a demonstration that experience is perhaps an undervalued commodity.⁵¹ The combination of older workers with younger ones can be a boon to business, though employers may have to make adjustments — including grappling with the common practice of age-based advancement (which could lead to top-heavy staff with an excess of senior personnel). Encouraging skilled laborers to stay in the workforce for longer will be a key component of competitiveness throughout the 21st century, especially as the shortage of skilled labor globally becomes more acute.⁵²

Government policy imperatives

Government policies will also be needed to help corporations unlock the social capital of aging older workers. Encouraging more flexible payment systems and working hours will allow older workers to maintain a healthy work-life-care balance. Increased investment in healthcare systems with a focus on preventative measures will enable a more reliable workforce and increase the incentives for businesses to change their cultures. Whilst not every person reaches old age with the blessing of good health, there are those who can bring significant contributions to society and should not be held on the sidelines.

Opportunities for harnessing the dynamics of an aging population

There are other opportunities. As the global population grows older, the health care and elder care industries are likely to grow. Additionally, bond markets will become more liquid, as people entering retirement shift their assets into more stable financial instruments.⁵³

In addition to contributions in the workplace and drivers of new economic activity, older people have much more to contribute—in community leadership, volunteering, and advising. The establishment of “The Elders”, a group of world leaders over the average retirement age who address certain global issues, is indicative of the benefits that older people can bring to society. Original elders included Desmond Tutu, Nelson Mandela and Jimmy Carter. Active engagement in society can occur at the highest levels regardless of age. The attribute of leadership in elders can be harnessed in local communities and can be leveraged in business in our modern service economies.

Global Mobility and Migration as a Key Tool to Offset Demographic Challenges

As demographic changes lead to labor shortages, international labor migration is inevitable — and should be embraced. More open countries will be better equipped to tackle the challenges of demographic change than their closed counterparts. Already, cross border migration has increased by 42% over the last decade, from 150 million in 2000 to 214 million in 2011.⁵⁴ The economic crisis and high unemployment have increased the pressure on governments to reduce immigration, but in the longer term demographic fundamentals will drive more open policies

⁵¹ Wuestner, C. (2012).

⁵² World Economic Forum (2012b).

⁵³ Stothard, M. (2013).

⁵⁴ Ernst & Young (2011).

Migration can make economies more dynamic, create jobs, and spark long-term growth

towards immigration. Businesses that cannot recruit labor will find that their competitiveness is undermined, leading firms to be engaged in a war for talent.⁵⁵

Moreover, migration makes economies more dynamic, creates jobs, and sparks long-term growth. In the United States, migrants have been founders of companies such as Google, Intel, PayPal, eBay, and Yahoo! and migrants file more than 25% of American patent applications each year. On a global scale, according to the World Bank, increasing migration equal to three percent of the workforce in developed countries between 2005 and 2025 would generate worldwide economic gains of \$356 billion.⁵⁶ Recent studies have found that up to a third of all economic growth over the past decade in the US, UK, and Eurozone is derived from migration.⁵⁷ Another study predicts that if borders were completely open and workers were allowed to go where they pleased, it would produce gains as high as \$39 trillion for the world economy over 25 years.⁵⁸ Diversity, innovation, and dynamism are the economic by-products of more open borders.

This offers hope to sagging economies burdened by unfavorable demographics. Even small additional inflows of migrant labor can boost GDP growth by a few tenths of a percentage point annually, which, in aggregate, could be integral to offsetting the detrimental effects of an aging labor force in the developed economies. This is particularly true given that migrant labor may be essential to filling new positions in sectors like elder care and health care that grow rapidly as the population ages.

Migration also improves developing markets. While labor outflows risk creating a “brain drain” effect, the substantial impact of remittances sent home by migrants creates large inflows of capital. Moreover, countries like the Philippines — which is one of the leading providers of migrant nurses to developed economies — has higher rates of nursing care for their domestic labor force than many major economic powers, including the United Kingdom.⁵⁹ Furthermore, migration is not always permanent with significant flows of migrants returning to their home countries.⁶⁰

As with trade, migration should provide substantially more benefits than costs

In both advanced and developing countries migration requires careful management and free movement remains an elusive ideal. However, as with trade, migration provides substantially more benefits than costs with global and national gains in both the short term and long term deserving far greater attention in policy debates.

International migration is the quietly ignored orphan among the alphabet soup of global governance organizations and agreements. It should not be. If harnessed, labor mobility on a worldwide scale will not only help provide an economic buffer in an era of unfavorable demographic shifts, it will also spark dynamism and growth above and beyond what would normally be possible in unfavorable demographic contexts. Governments need to start collaborating and establish more open borders to reap these mutual benefits.

⁵⁵ See Goldin, I., Cameron, G. and Balarajan, M. (2012).

⁵⁶ World Bank (2005) p.31.

⁵⁷ Sheets, N. and Sockin, R (2013).

⁵⁸ Anderson, K. and Lomborg, B. (2008).

⁵⁹ Aiken, LH et al. (2004).

⁶⁰ For the policy implications see McLoughlin, S. and Munz, R. (2011).

The World Population has Changing Needs and Wants

Proper planning and mitigation can convert demographic challenges into economic opportunities in advanced economies

Because people drive economies, demographics matter. The impending shifts will create substantial changes in the global economy. These effects will be uneven—not only because demographic change varies from place to place, but also because policymakers and businesses will have varying levels of success in their strategic planning to cope with inevitable changes. As the population ages in Europe, Japan, and North America, a new window of opportunity is opening in many, but certainly not all emerging markets. In the OECD countries, aging populations present perilous challenges to pensions, health care, and the labor force, but proper planning and mitigation can convert such demographic challenges into economic opportunities.

The reform of pension systems should bring new opportunities for asset managers and create new investment opportunities

The economic needs of aging societies have put strain on pension systems. These systems need reform and will require a combination of different initiatives to ensure their viability. Defined benefit schemes are likely to face extinction, with individuals increasingly relying on defined contribution schemes. A continuing rise in the amount of capital managed by pension and life funds is inevitable as individuals choose voluntarily to save for their extended elderly years, or even face mandatory obligations to do so. The reform of pension systems, not least in emerging markets, will bring new opportunities for asset managers and create new investment opportunities.

Regulatory drivers

With a growing need to hold long-term assets, there is an urgent need for the reform and removal of regulatory and other pressures which force banks and even pension and life funds to hold short-term assets. While the improved matching of assets and liabilities in the long-term market is essential for individual savers and asset managers alike, it also has important broader benefits. In particular, the urgent need for greater investment in infrastructure could be met by increased allocations by long-term savers. Globally, pension funds currently allocate barely 0.9% of their portfolios to pure infrastructure investments,⁶¹ and given the urgent need for higher levels of investment in infrastructure as well as sustainable long-term assets, this reflects a significant market failure. In Europe, the US and Japan, levels of indebtedness in the public sector have restricted public sector investments and demand uncertainty has constrained project finance. However, with record low interest rates and flat or even inverted yield curves, the relatively low cost of raising long-term infrastructure finance makes this an attractive proposition, especially if it can help to close the mismatch between assets and liabilities in pension and life products. With rapidly aging populations, this is an urgent priority.⁶²

Encouraging a longer productive contribution to the workforce

In addition to sound policy and preparation, migration is critical. We shut ourselves off from labor flows at our own economic peril. Not only do migrants contribute to the dynamism of societies and to reducing dependency ratios, but it has recently been shown that increased migration can help facilitate later retirement among women as migrants help reduce the price of labor in the home-care sector freeing women to stay longer in the workplace.⁶³ Encouraging a longer productive contribution to the workforce provides twin economic benefits: increasing the number of contributors to finance social protection and reducing the number of pensioners to be supported.

⁶¹ Infrastructure assets defined by unlisted debt and equity. See OECD (2013a).

⁶² Llewellyn Consulting (2013).

⁶³ Peri, G., Romiti, A. and Rossi, M (2013).

Consumption patterns will change and
create new opportunities for growth

With the changing composition of the world population, consumption patterns in developed economies are also changing. Lower fertility rates have meant that more money is now spent on children. Households will continue to invest more in children's education and spend more on children's toys and clothes. Smaller families tend also to invest more in pets, with businesses around the nurturing and health of pets expected to record robust growth. Health care services as well as leisure industries such as travel and tourism that are suitable for the elderly are similarly anticipated to record sustained growth.

As the “demographic window” passes over different countries, each culture will have their own norms that will guide how each country experiences these changes. As populations age everywhere, the differential geographical impact on macroeconomic developments and associated market opportunities and risks requires careful attention. Whether we respond appropriately will be a measure of whether we are not only becoming older, but also becoming wiser.

3. Frontiers of Technology in the 21st Century

Technology will exert a powerful influence over global economic trends in the coming decades

The last 20 years have been a period of exceptionally rapid technological change. This will continue for decades to come. The implications of new technologies will ripple across every aspect of the economy. From high-tech industry to menial labor, and the most developed economies to the poorest populations on Earth, economies everywhere will be affected by the technological revolution that is currently taking place.

Sustaining as well as disruptive innovations

Some technological advances, such as mobile Internet technology, are significant but emerge as extensions resulting from the compounding application of earlier inventions. Others, such as nanotechnology, genetic advances and 3-D printing reflect new leaps that are yet to have a broad impact in society. Together, the results of the horizontal spread arising from widespread application of advances and previous inventions, and the refreshing of these waves through vertical leaps arising from new inventions, will exert a powerful influence over global economic trends in the coming years and decades.

Mobile Internet: Surging Usage and Prospects for Growth

The power of mobile technology

The number of mobile phones in the world now exceeds the global population and over 1.1 billion people are already using smartphones and tablets to access the Internet on mobile devices.⁶⁴ Over the coming decade, it is likely that number will surge, with two to three billion people entering the digital world and global marketplace via mobile connectivity.⁶⁵ Most new users will come from the developing world, but mobile usage will also surge in advanced economies.

Mobile technology will produce spillover growth prospects. Further usage can lower barriers to business start-ups, not only because entrepreneurs can now easily tap into global markets from anywhere, but also because challenges such as building permit bureaucracy are eliminated in cyberspace. According to a 2013 report by the McKinsey Global Institute, mobile technology growth can also increase productivity, sometimes by up to 25%, and will have an estimated economic impact of between \$3.7 trillion to \$10.8 trillion by 2025.⁶⁶ For example, service delivery is being improved in health care by mobile technology. There are fewer product-processing errors and significantly fewer patient deaths at a cheaper cost due to mobile prescription verification and remote patient monitoring.⁶⁷

Mobile technology has not only facilitated cheap communication channels which were previously non-existent, it has also allowed other goods and services to be delivered on the mobile platform. M-Pesa in Kenya took Kenya's payment system into the 21st century. After first using minutes as the currency of exchange, the mobile operator, SafariCom, started offering the service to transfer Kenyan shillings from mobile to mobile and erected a network of agents who exchange M-Pesa for cash. Launched in 2007, over 17 million Kenyans now use the service and

⁶⁴ Manyika, J. et al. (2013). p. 29. Available at:

http://www.mckinsey.com/insights/business_technology/disruptive_technologies.

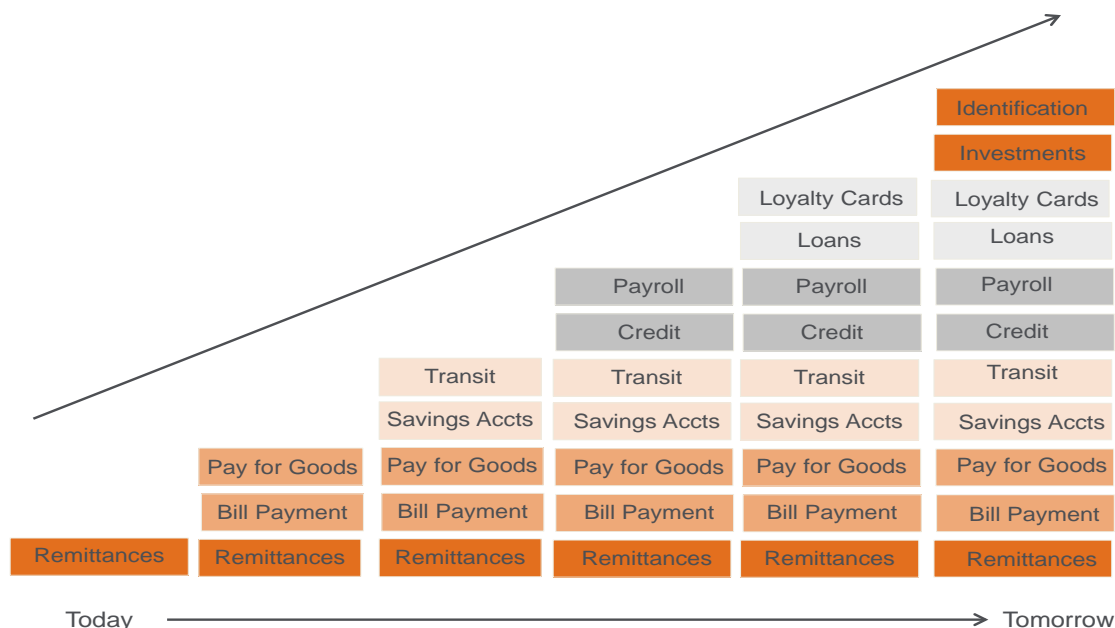
⁶⁵ Ibid, 29.

⁶⁶ Manyika, J. et al (2013).

⁶⁷ A Brookings Institution analysis undertaken by economist Robert Litan found that remote monitoring technologies could save as much as \$197 billion over the next 25 years in the United States. See West, D. (2012).

approximately 25% of the country's gross national product flows through it.⁶⁸ More financial products such as salary payments, loans, and savings products are now being offered, leading to additional benefits such as saving time queuing at banks and removing the high costs of handling cash (Figure 14). Other countries, such as India and Afghanistan, are following suit, attempting to lower the costs for the unbanked to access financial services.

Figure 14. Mobile financial services are expected to proliferate as adoption is on the rise



Source: Citi GPS (2012a)

Automation of Labor and Artificial Intelligence in the Knowledge Economy

Robotics and work force automation

Robots, automated computer-controlled machines that operate with humanlike (or better) skill, are becoming increasingly central to manufacturing. Already, millions of robots are creating products in factories across the global economy. Over the coming years, more than a million robots will be installed just to produce the iPhone in China.⁶⁹ In addition to providing lower error rates and increased precision, robots can work 24 hours a day, 7 days a week. This will create a spike in productivity, usually while lowering costs. If a \$250,000 robot can replace two employees that each make \$50,000 a year that could represent a savings of \$3.5 million in labor costs and large productivity gains over the 15 year lifespan of an automated machine.⁷⁰ This transformation risks dislocating workers, but also gives rise to new industries, such as robotics manufacturing. There is, however, the possibility that robotics may begin to slow growth in developing economies as their cheap labor comparative advantage is undermined by machine labor — especially if cutting edge knowledge economies in the United States, Japan, and Europe are able to corner the market on robotics technology sufficiently to regain the upper (robotic) hand on manufacturing.

⁶⁸ The Economist (2013a).

⁶⁹ Markoff, J. (2012).

⁷⁰ Ibid.

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Factory Automation – China is the Growth Area

Factory automation (FA) is a rather generic term encompassing many processes and end markets: industrial robots and their components; computerized numerical controls (CNCs) and servo motors used in machine tools; semiconductor production equipment (SPE) and chip mounters; and other discrete components such as sensors and programmable logic controllers. The global market for robots is estimated by the International Federation of Robotics (IFR) to be worth \$26 billion (including the value of software, peripherals and system engineering) with the largest market being Japan, followed by North America, and China.

All robot makers are focused on expanding their operations in China due to strong growth prospects. The main drivers for higher robot demand in China are: 1) the continuing expansion of manufacturing capacity, in general; 2) the ongoing shift up the quality curve (including more processes requiring greater precision, faster speed and throughputs, and fewer defects); 3) the rising trend of wage costs (up by 12% year-over-year in 2012 after a 14% rise in 2011); and 4) the low level of robot diffusion.

Robot density (per 10,000 workers in the auto industry) in China in 2012 was 213 versus 1,091 in the U.S., 1,133 in Germany and 1,562 in Japan. There has been tremendous expansion over the past six years in this statistic — from only 51 in 2006 — but there is still significant room for growth. In addition, manufacturer Yaskawa notes that nearly 90% of Chinese robot demand is currently from the auto industry, indicating there is massive upside potential from other industries.

The IFR believes robot installations will increase by 6% on average per year from 2014 to 2016 with about 4% growth in the Americas and Europe and about 8% in Asia/ Australia. They believe the auto industry will continue to be a driver of demand growth and an innovator of new technology in robotics but also note growing global demand for electronic products and new production technologies is boosting investment in retooling of existing production processes and expanding production capacities of the electrical/ electronics industry, particularly in Asia.

Artificial intelligence systems

In addition to manual labor, artificial intelligence systems are being enlisted in the service of health care improvements. For example, oncologists in New York's Memorial Sloan-Kettering Cancer Center are using IBM's Watson supercomputer to reference patient data against "knowledge from 600,000 medical evidence reports, two million pages of text from 42 medical journals, and 1.5 million patient records and clinical trials in the field of oncology".⁷¹ This tactic substantially reduces costs created by medical error while improving patient care.

Smart Grids and Automated Driving: The Power of Sensors

The potential of digital sensors and automated control systems

If knowledge is power, digital sensors are poised to become the data providers of the 21st century. In electrical power systems, by providing real time data to processing centers and automated control systems, sensors can reduce electricity usage and waste, improve supply efficiency, and isolate electrical failures thereby minimizing the impact of blackouts.⁷²

Similarly, radio frequency identification (RFID) tags affixed to garbage and recycling bins in Cleveland and Cincinnati allowed those cities to cut unnecessary pickup

⁷¹ Manyika, J. et al. (2013).

⁷² Ibid.

routes and reduce operating costs substantially, while also registering a major drop in waste and a 49% increase in recycling.⁷³

Smart grid technology was also deployed recently in London, Houston, and Singapore to streamline traffic. Control routing centers effectively decreased average commuting times by 10-20%, enhancing productivity for workers.⁷⁴ This technology is also being deployed to farming, with real time crop moisture readings ensuring that drip irrigation is able to maximize efficiency, a critical component in feeding a substantially growing population.

In addition to infrastructure improvements from smart grids and sensors, automated driving is becoming a reality. An automated Google car has already driven 300,000 miles on American roads with no accidents.⁷⁵ Driverless cars have multiple benefits but primarily it frees up the would-be driver to other tasks. This is a substantial improvement, given that the average American car commuter spends 750 hours per year driving, while the average European car owner spends about 300 hours per year behind the wheel.⁷⁶

Additionally, automation with sensors will allow cars to drive far closer together, reducing wind drag (allowing lower fuel consumption per mile traveled) while also diminishing congestion without the need for additional infrastructure. Given that 1 million people die in traffic accidents per year — with 70-90% of those caused by avoidable human error — automation could also improve safety on the roads substantially.⁷⁷

Finally, sensors will also transform distribution, as every item being moved — on the assembly line or across oceans — can be easily tracked in real time. This will reduce errors in the movement of goods globally and allow substantially more precision.

⁷³ Ibid.

⁷⁴ Ibid.

⁷⁵ Lardinois, F. (2012).

⁷⁶ McKinsey & Company (2012).

⁷⁷ von Holst, H. (1997) .

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The Connected Car: Telematics Becomes the Norm

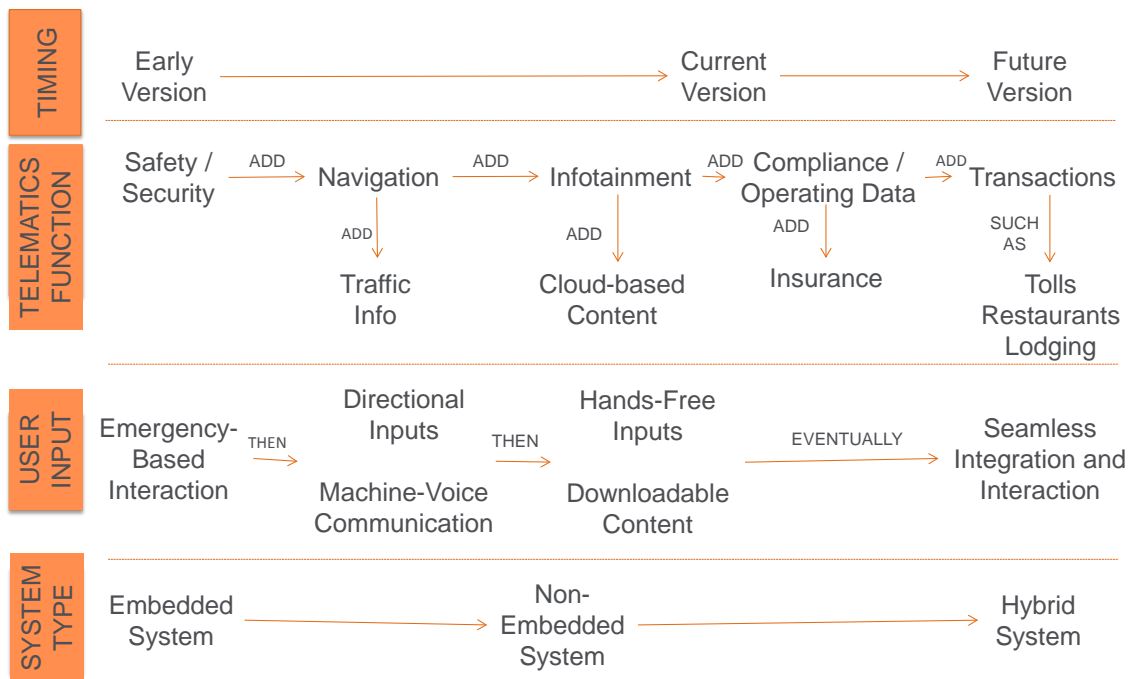
Vehicle Telematics has been around for a while, but the early versions had limited functionality and consequently, also had limited appeal among consumers. General Motors' initial 1996 implementation of OnStar provided accident notification and emergency use. BMW was the next market entrant in 2011. Over the last decade several technological and market advances have taken this from a niche offering to the verge of becoming mainstream. The primary change was the proliferation of mobile phones, which led to an increased desire among consumers to always be connected. The rise of smartphones further fueled this trend as the Telematics system no longer had to be embedded, i.e. built into the car, and non-embedded systems with access to Internet-based applications became a possibility. The growth of non-embedded systems also opened up the market to aftermarket players in addition to Auto companies. This increasing functionality and consumer demand led to a larger number of Auto companies launching their own Telematics offerings.

Automotive Telematics has shown a steady growth trajectory which should continue. We believe it will continue because Telematics:

- Improves the customer relationship by engaging more frequently with the customer, based on usage data;
- Tracks customer usage of car features to determine use frequency, which can eliminate wasted features or highlight less-used features that should be modified;
- Provides potential for new revenue streams — premium features like streaming audio, video (to backseat) and usage-based insurance;
- Lowers maintenance cost as some updates and changes can become software-based rather than hardware-based; which would imply they can be done over-the-air (OTA);
- Satisfies legal requirements; and
- In the case of electric vehicles, promotes peace of mind by providing a current map of charging locations.

The skepticism around Telematics largely stems from the fact that users have so far been resistant to subscriber-based payment models—in other words, it is not clear how the investment could be effectively recouped. Competition from non-embedded systems (smartphones) is also a concern but we do not buy into this concern because fully functional Telematics systems should have access to car operations data and that can arguably be better accessed via embedded systems. We do believe, however, that a lot can be done to improve the current user experience associated with Telematics systems by making the look and feel similar to popular smartphone interfaces.

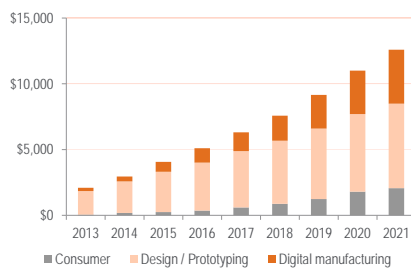
Figure 15. Evolution of connected car feature / functionality



Source: Citi GPS (2014)

3-D Printing: The Perils and Potential of Quick, Easy Product Customization

Figure 16. 3D Printer market grows to \$12.5 billion by 2021



Source: Citi Research

3-D printers are machines that print out physical objects rather than words on a page. Using design blueprints, they print out a substance — currently most often a plastic — with layers upon layers that eventually form a tangible object. The scale of these items is no longer small. A Dutch firm is currently in the process of creating an entire house from specialized 3-D printers.⁷⁸ 3-D printing is also being used to produce a car, the Urbee 2.⁷⁹

As the technology is being proven, it will transform a variety of processes in product design, development, and manufacturing. It will become significantly easier for both established companies and start-ups to produce prototypes for new items. This will reduce design costs and allow better testing and design tweaking before products come to market. Moreover, products can easily become customizable to the specifications of individual consumers at low-cost. For example, UPS, a US shipping and logistics company, is introducing 3-D printers to several of its stores in the United States, allowing consumers the option of creating their own objects easily.⁸⁰

Technology is also emerging that is allowing scientists the ability to 3-D print living tissue, with printers emitting cells rather than ink. The possibilities of this nascent technology are obvious; already, custom-made cartilage has been printed for damaged knees, and there is the possibility that eventually doctors will be able to 3-D print customized organs.⁸¹

⁷⁸ The Telegraph (2013).

⁷⁹ Bloomberg News (2013).

⁸⁰ The Economist (2013b).

⁸¹ Fountain, H. (2013).

This technology, while impressive, also presents perilous new frontiers. With production passed onto consumers easily, there is substantial opportunity for counterfeit products, lack of quality control, and safety issues. For example, a 3-D printed gun has already been produced and successfully fired.⁸² Piracy is also a major concern.

In spite of these challenges, 3-D printing offers tremendous benefits and could enhance product design, testing, and customization, unlocking new growth sectors in the process while increasing the profitability of existing ones.

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3D Printing – Rewriting Global Manufacturing

3D printing, or additive manufacturing, is the process of repeatedly applying thin layers of materials to build objects generated from 3D computer animated design (CAD) files. We believe this ~\$2 billion market is beginning to attract customers beyond the traditional concept modeling and prototype engineers crowd. Larger manufacturing companies are looking to add elements of additive manufacturing into the production process and specialty end-markets such as medical, dental and jewelry are already printing end-use parts and goods for commercial use. General Electric is incorporating 3D printed components for its next generation LEAP engine due to the ability to create more complex and intricate geometries. Companies within the health vertical such as hearing aid maker Phonac and Invisalign braces manufacturer Align have already based their entire manufacturing process on the technology.

While advance manufacturing applications currently account for 10-15% of total sales, over the long term we believe direct digital manufacturing (DDM) could represent the biggest share of the 3D printing market. Additionally, the recent “Maker” movement has created a flood of consumer curiosity and interest which we believe will materialize into a significant new market segment. We see the addition of those two opportunities as more than tripling the addressable market and believe as customer awareness of the technology’s capabilities evolves, demand for print systems, materials and custom parts will accelerate.

We see plenty of open field for market participants to roam, but the competitive environment is getting warmer. While 3D Systems and Stratasys are the clear leaders in the sector accounting for a disproportionate share of the current market (combined market share is around 75%), the industry is still early enough such that it is not yet a zero sum game. At present, each system manufacturer offers relatively unique print capabilities and materials. Our discussions with those in the industry suggest it is not unusual for customers to have machines from multiple vendors running side by side in order to address different needs and applications. Merger and acquisition activity has been picking up in the space creating overlap across technologies. Over time, we anticipate that as consolidation gets more pronounced, the product overlap could eventually create a more intense competitive environment. For now, we believe a rising tide lifts all ships.

⁸² Neal, R. (2013).

The potential economic impact of nanotechnology is far reaching

Nanotechnology: Microscopic Products with Macro-level Economic Impact

Nanotechnology refers to products and properties that exist and emerge on compounds that are less than 100 nanometers long.⁸³ For comparison, the average human hair is 100,000 nanometers wide. In nanotechnology the basic building blocks are individual molecules and atoms. The potential economic impact of this is far reaching.

There are several examples that demonstrate this potential. Nanoparticle ink is being used to allow free hand drawing of electrical circuits. This technology could also be used to create disposable and digestible wireless capabilities, with far reaching applications, including in the fabrication of digestible transmitters attached to tablets to monitor the use of prescription medicines.⁸⁴

In health care, nanotechnology is being applied in a variety of ways. Researchers have developed ways to use gold nanoparticles as cancer “sniffers” that are not only able to detect cancer before visible symptoms or tumors exist, but also can pinpoint exactly which kind of cancer is present in the body.⁸⁵ Nanoparticles generated by IBM are able to kill antibiotic-resistant bacteria, attaching to the bacteria and poking tiny holes in it — a critical breakthrough in the fight against global disease.⁸⁶

Recently discovered properties of absorption at the nano-level also offer substantial applied value. The low-cost nanocarbon grapheme can be used as a filter to remove salt from saltwater, sifting out the salt crystals while letting the water molecules pass through.⁸⁷ This method could be used to desalinate seawater, and improve the prospects for recycling, a key to overcoming global water shortages in an era where already 780 million people do not have access to clean, safe drinking water.⁸⁸

Similarly, a scientist working to develop nanomaterial that could detect explosives recently accidentally discovered a new compound that can absorb all impurities from water — particularly oil and phosphates — making it ideal for oil spill cleanup or ensuring that fertilizer runoff is kept out of the water supply.⁸⁹ The material, “Osorb” is reported to swell up to 14 times its original size enabling it to capture a wide range of dissolved and dispersed organics from water and can simply be wrung out and re-used.⁹⁰

Nanotechnology can also be used to make resilient futuristic coatings. By coating surfaces with nanoparticles, scientists have been able to actively repel sunlight from skin, potentially making sunburns a thing of the past.⁹¹ Paper can be made magnetic, waterproof, and antibacterial — the latter having impressive potential usage ranging from making wallpaper in hospitals actively repel germs to being used as a much safer form of food packaging.⁹² Scientists have recently developed

⁸³ OECD (2010).

⁸⁴ Huang, L. Huang, Y., Liang, J., Wan, X., Chen, Y. (2011).

⁸⁵ Agence France Presse (2010).

⁸⁶ Bourzac, K. (2011).

⁸⁷ Reuters (2013).

⁸⁸ UNICEF (2012).

⁸⁹ ABS Materials (2013).

⁹⁰ Ibid. See also: Boyle, R. (2012).

⁹¹ Fragouli et al. (2012). See also Zhao, Y. et al. (2012).

⁹² Ibid.

New frontiers in nanotechnology

fabrics that actively repel dirt using nanoparticle coatings. We may, therefore, look forward to an era where spills, dust, dirt, and grime are deflected off our clothes.

In addition to these technologies, there are new frontiers in nanotechnology that have not yet been realized but are both plausible and revolutionary. For example, Eric Drexler explains in *Radical Abundance: How a Revolution in Nanotechnology Will Change Civilization* that current advances allow us to imagine a world where solar arrays and laptops can be manufactured with such atomic precision and low-cost that they may one day be as cheap as cardboard. Already, scientists have constructed prototypes for circuit boards built on millions of precisely arranged atoms — making Drexler's predictions perhaps less futuristic fantasy and more a question of when.⁹³ Molecular-level manufacturing could dramatically transform global production.

The economic possibilities associated with nanotechnology are hard to calculate because the technology is advancing so rapidly. It is clear that tiny particles may well have a revolutionary impact, ranging from cancer treatments to everyday use. However, as in so many other revolutionary areas of progress, the potential negative and harmful applications are inadequately understood, and these, together with the consequent regulatory implications need urgent attention.

Biotechnology: The Future of the Genome and the Human Body

Biotechnology and genetic science

The human genome was successfully mapped and declared complete in 2003. The implications have been impressive. Scientists can now use genetic screening to determine whether an individual patient is prone to a wide range of genetic diseases. Such screening is becoming increasingly mundane and affordable; Counsyl, a Silicon Valley company, already offers a \$600 genetic test that can screen children for more than 400 mutations and 100 genetic disorders.⁹⁴

In addition to knowledge about genetic coding, changes can be made to patients using genetic material. Gene therapy has already effectively cured patients with hemophilia, a debilitating blood disorder.⁹⁵ The ability to manipulate genetic code will open new frontiers in research and ethics. It will soon be technologically possible for parents to choose desirable traits using genetic screening with in vitro fertilization.⁹⁶ This is a particularly stark reminder that as we enter the Age of Mastery, we must tread carefully. Even when the economic incentives and technological breakthroughs allow advancement, they may be ill advised. In addition, as we highlight in our discussion on systemic risks, the potential abuse of these technologies to create new bio pathogens, reminds us that all technologies are potentially dual use.

⁹³ Drexler, K.E. (2013).

⁹⁴ Cutler, KM. (2013).

⁹⁵ Nathwani, A. et al. (2011).

⁹⁶ *The New Scientist* (2013).

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Immunotherapy – Writing the Next Chapter for the Cancer Revolution

Cancer accounts for a quarter of deaths in the West with an enormous social cost. Immunotherapeutic approaches to cancer leverage the patient's immune system to eliminate or slow the growth and spread of cancerous cells with the potential to dramatically improve the economic and medical outlook for cancer patients. New advances in tumor biology are enabling the development of newer potent T-cell mediated therapies that prevent the tumor from evading immune detection with a manageable safety profile.

While existing chemotherapy or even newer oral drugs have a powerful initial effect on tumor shrinkage (the so called "response rate"), the durability of these responses are typically very short, after which the tumor begins to grow again and starts to spread (metastasize). In contrast, the durability of responses with immunotherapy can last a decade or longer, due to the induction of an ongoing immunological memory, targeting cancer cells for an indeterminate length of time and making it a potential tool to transform a significant percentage of cancers into something akin to a chronic disease. We draw parallels with the much smaller HIV population where HIV therapies have transformed life expectancies, with significant medical and economic implications. The primary treatment goal for almost all advanced cancers will be to maximize the responsiveness of a given patient's cancer to immunotherapy.

We estimate the peak market potential for immunotherapy is \$35 billion and this represents sales in just metastatic melanoma, non-small cell lung cancer and renal cell carcinoma. The potential size of the immunotherapy opportunity across multiple tumor types and chronic viral infections is three times this size.

New Gas and Oil Extraction Technologies; Plus the Potential of Renewables and Electric Transport**Energy technologies**

As economic growth continues around the world, our energy needs are also expanding. New technologies are under development to make previously uneconomical resources fit for extraction, reduce carbon emissions of current extraction methods, and use renewable sources of energy.

The combination of horizontal drilling and hydraulic fracturing makes it possible to reach oil and gas deposits that were known to exist in the United States and other places but that were not economically accessible by conventional drilling methods. The economic consequences from this supply and demand revolution are potentially extraordinary. Citi Research estimates that the cumulative impact of new production, reduced consumption, and associated activity may increase real GDP by 2.0%-3.3%, or \$370-\$624 billion (in 2005 \$) respectively.⁹⁷ The growth in this energy source has spillover effects on the petrochemical industry with the viability of Gas to Liquid plants (GTL) currently under consideration.⁹⁸ With large payoffs at stake there are further new types of reserves, including coalbed methane, tight sandstones, and methane clathrates that could potentially usher in another energy revolution.

⁹⁷ Citi GPS (2012b).

⁹⁸ *Wall Street Journal* (2012).

Technological change and carbon emissions

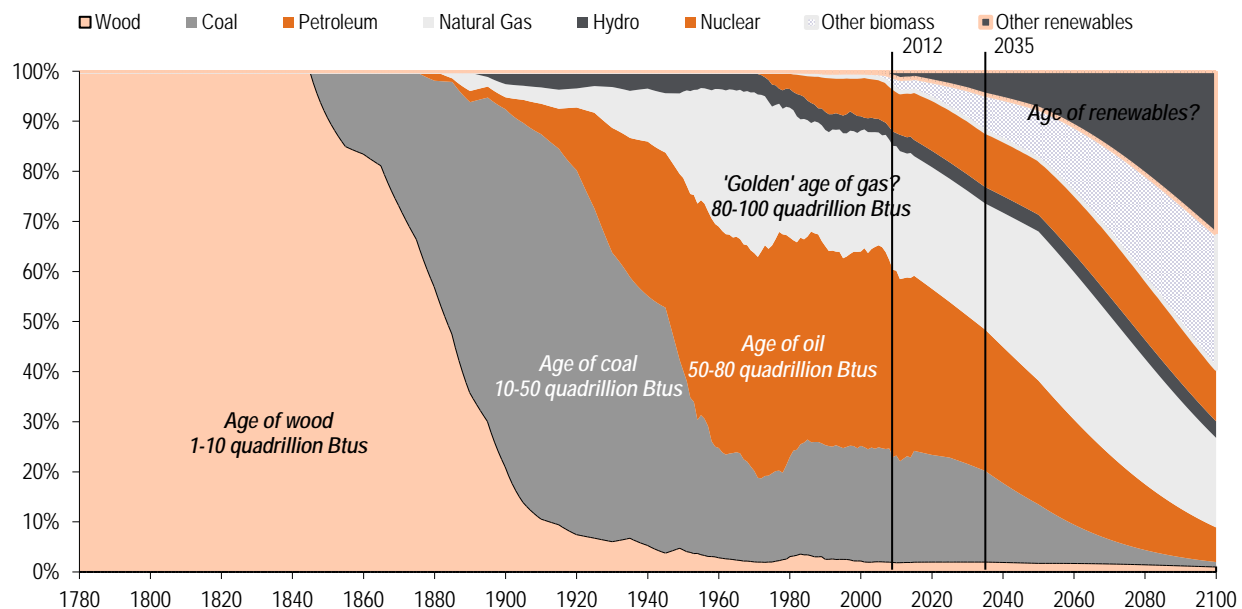
Technological shifts in industrial processes will need to be realized in order to meet domestic and regional targets on carbon emissions reductions. In the EU, there is an aim to reduce carbon emissions by 80% by 2050 from 1990 levels.⁹⁹ Each industry is called upon to develop techniques that will aid in achieving this target. The steel production industry is one of the industries that are likely to pilot and experiment with new carbon capture and storage technology (CCS). The technical and economic feasibility of achieving these efficiency gains rests on incentives for further research and funding for these types of technologies. Already it is clear that price incentives alone from the EU carbon-trading scheme will not be enough to prompt such investment.

Renewable energy

Renewable energy, if achieved, presents a way for society to move from being driven by processes that strip the earth of its natural resources, create political conflicts, and pollute the atmosphere to a self-sufficient endless supply of energy. Such promise holds great economic benefits if it can be unlocked. However, the cost of energy generation from these methods is still far from oil, coal and gas. As a result, the development of the sector is highly dependent on subsidies and high carbon taxes on polluting sources of energy. Despite mixed global policies over renewables, the investment costs for solar photovoltaic (PV) and onshore wind have fallen rapidly.¹⁰⁰

Beneath these gains lies an uncomfortable truth: the carbon intensity of the global energy supply has barely changed in 20 years, despite successful efforts in deploying renewable energy.¹⁰¹ Investment in this sector is likely to increase in order to facilitate the transition to a more sustainable future.

Figure 17. The move to renewables is a substitution away from alternative forms of energy



Source: Citi GPS (2013).

⁹⁹ The European Council (2011).

¹⁰⁰ International Energy Agency (2013).

¹⁰¹ Ibid.

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Energy Darwinism: The Evolution of the Energy Industry

History tells us that typically in the world of energy we don't tend to move gradually to a more balanced energy mix as new fuels or technologies come along, rather, we tend to embrace (or actually over-embrace) those new technologies at the expense of incumbent technologies or fuels. Figure 17 shows the evolution of the US primary energy mix from 1780 to present and projected out to 2100. While we are currently in the midst of a more balanced energy mix, we believe it would be naive to ignore the waterfall progression that history suggests is likely; as conventional fuels become gradually more scarce and expensive (assuming the lower hanging fruit has been harvested first) and as new technologies improve, the long term transformation becomes ever more inevitable. Moreover, this ignores the potential for the advent of new technologies equally as unforeseeable now as solar would have seemed a few decades ago.

However, as Figure 17 suggests, the “balanced transition” part is likely to continue for some time — certainly beyond the boundaries of any normal investment timeframe. So isn't this the analysis of substitution just an academic exercise? We believe that the answer is an emphatic no. This substitution effect is already happening to a degree but isn't being widely recognized. Moreover, sizeable investment decisions being taken now by E&P companies, oil majors, utilities, and renewables developers will be affected by the changing shift within the lifecycle of those projects, and in some cases the early years of those projects.

21st Century Technology in a Globalized Marketplace

The rate of global change is accelerating, largely due to the breakneck pace of technological innovation. The economy will be transformed in many ways, from expanded existing technology, innovative new methods such as 3-D printing, and the no longer science fiction frontiers of nanotechnology and biotechnology. Developing economies — and their billions of people — will enter the digital age, lowering barriers to growth and unlocking an enormous amount of creative potential. Developed economies will continue to drive innovation and begin competing with developing economies to harness the fruits of that innovation. Companies and countries that are successfully able to invest in and harness emerging technologies will be better suited to thrive in this new era.

Policy makers and societies need to prepare for the inventions that will emerge and disrupt the global economy

Policy makers and societies need to prepare for the inventions that will emerge and disrupt the global economy. Not every invention will change the way society functions nor even work at all. Technological progress rises out of the ashes of dead-end research programs, useless inventions, and failed commercial ventures. Many of our greatest inventions have come through partnerships between states and corporations. The American railroad network and the underlying infrastructure of the Internet were initially funded by a federal initiative.¹⁰² Investors and entrepreneurs joined these initiatives and have made them into what they are today, huge communication and transportation networks. In order to provide these for future generations, policymakers need to decide how to partner with business to invest in new forms of infrastructure and education. In particular, law makers and regulators are faced with a difficult challenge of new moral dilemmas relating to the human condition and the protection of citizen's rights in new domains, where technological progress is leaping ahead of our knowledge of its potential applications and consequences.

¹⁰² Janeway, W. (2012).

4. Economics

By 2030 the Emerging Economies Will Emerge, Igniting Global Growth

Global economic growth will be driven not only by an increase in population, but primarily by a sustained and widespread increase in incomes and living standards

Although emerging markets have grown, there is still a lot of “catch-up” growth coming

Catch-up, investment rates and consumption growth in Emerging Markets is shifting the economic center of gravity eastwards

This shift will also be driven by demographic challenges in advanced economies

By 2030, the OECD projects that the world economy will be twice the size it is now. By 2050, it expects it to be double again. Global economic growth will continue steadily into the foreseeable future at around 3% per year,¹⁰³ driven partly by further increases in population but with the bulk of the gains expected to be derived from a sustained and widespread increase in incomes and living standards. However, this growth will be uneven, with average growth rates for GDP per capita expected to be highest in developing Asia and Africa. Growth in non-OECD countries will likely grow faster than the OECD average and emerging economies will become the economic powerhouses of the century. In the next decade, China will surpass the US and Germany and become the top country by trade. By 2050, India will also beat out the US and Germany for the number two spot.¹⁰⁴

Other things being equal, poorer countries tend to grow faster than richer countries, i.e. there is a catch-up and convergence in productivity, income, and living standards. Although convergence is neither automatic nor inevitable, we think it should be expected. Despite the spectacular growth in China since 1980 and India since the early 1990s, real convergence of economy-wide productivity and income levels has barely started, with China's real per capita GDP at barely 20% of that of the US and India still well below the 10% mark. There are, given the right institutions and policies, decades of catch-up growth in prospect even for China and generations of catch-up growth in India and other countries.

Because of this, the global economic ‘center of gravity’ has started to shift eastwards and towards the south and we believe it will continue to do so. The spectacular catch-up growth in Asia has been accompanied by high investment rates. Despite these investment rates, consumption growth is already a significant driver of domestic demand and total consumer spending in the fast-growing Asian economies is likely to exceed total consumer spending in the US within a dozen years. The most rapidly growing cross-border trade is international trade involving emerging markets with China and this is the main driver of the emergence of new trade corridors that are intra-emerging market. A steady transformation of Asia from an export and investment-led economy, to a consumption-driven economy will have profound consequences and should ultimately: 1) raise world prices of consumer goods relative to investment goods; and 2) lower commodity prices (or just temper their increase). We note that some of this is already happening. The share of gross investment spending in GDP in advanced economies has been declining since the 1970s. Part of the reason for this decline is that investment has become cheaper relative to other types of spending. This fall could be explained by more rapid productivity growth in the capital-goods producing sectors, not least as many Asian countries became major producers and exporters of capital goods over the past few decades.¹⁰⁵

This geographic shift of growth has important implications. Advanced economies and China will face substantial demographic challenges and economies such as Europe could face this challenge amidst a sluggish recovery and therefore the region could struggle to find its place and maintain prominence in the age where developing economies develop and become dominant. China and India will continue to be harbingers of growth while outside the G20, countries such as Malaysia, Vietnam, and Nigeria also could become exceptional engines of growth.

¹⁰³ Chateau, J. Rebolledo, C. and Dellink, R. (2011).

¹⁰⁴ Buiter, W.H. and Rahbari, E. (2011)

¹⁰⁵ Buiter, W.H. and Rahbari, E. (2014).

These trends will shape business prospects. According to a study done by Citi Research, some of the emerging markets, and in particular China and India, are expected to shift from investment-led demand to demand led by the growth in their large consumer markets. At a time when trend annual growth is projected to be no more than around two percent in advanced economies, companies seeking growth will need to look increasingly to these emerging markets and new frontier markets.

Figure 18. OECD growth rate projections and employment growth rate projections (%)

	2012-2017		2018-2030		2031-2060	
	Average annual growth rate	Average annual employment growth rate (%)	Average annual growth rate	Average annual employment growth rate (%)	Average annual growth rate	Average annual employment growth rate (%)
India	6.90%	1.80%	6.80%	1.80%	4.30%	0.60%
China	8.40%	0.50%	5.40%	-0.30%	2.10%	-0.90%
Non-OECD	6.80%	1.00%	5.30%	0.60%	2.80%	-0.20%
Indonesia	6.30%	1.90%	5.20%	1.00%	3.40%	-0.10%
South Africa	4.60%	1.90%	4.90%	2.00%	2.30%	0.40%
Brazil	3.70%	1.40%	3.60%	0.80%	2.00%	-0.40%
Mexico	3.20%	2.10%	3.60%	1.60%	2.70%	0.40%
World	3.70%	0.98%	3.60%	0.60%	2.20%	-0.10%
Russia Federation	3.30%	-1.10%	2.80%	-0.70%	1.30%	-0.70%
United Kingdom	1.70%	0.80%	2.60%	0.60%	2.00%	0.40%
Canada	2.00%	0.90%	2.20%	0.40%	1.90%	0.30%
US	2.00%	0.50%	2.10%	0.40%	1.70%	0.50%
Euro Area	1.00%	0.10%	2.00%	0.20%	1.30%	-0.20%
Japan	0.80%	-0.40%	1.10%	-0.50%	1.10%	-0.70%

Source: OECD Economic Outlook No. 93 (2013)

Europe: Modest Growth in an Era of Demographic Change

Europe is at a crossroads following the financial crisis

Europe has been a long-time beneficiary of stable governance. The formation of the European Union embracing over 500 million people has raised growth and development, not least for the poorest European countries. Yet Europe currently stands at a crossroads, hesitatingly emerging from the sovereign debt crisis and the lingering effects of the financial crisis. The crisis is not expected to unravel the EU or weaken its integration, but it is providing a particularly severe test. Much stronger fiscal rules, with credible monitoring and enforcement are required to ensure the sustainability of the Union. For uncompetitive economies in the Eurozone, this necessarily implies real devaluations and the associated decline in living standards for wide segments of society. Although growth in principle can offset the effect on living standards of real exchange rate depreciations, the tepid pace of growth means this is unlikely to occur in the short-term. Another consequence of the crisis and determination of the major creditors not to repeat the past breaches of fiscal promises is that more power will be ceded to Brussels and the European Central Bank (ECB); this is inevitable, but politically unpopular.

Austerity has intensified protectionist sentiment which further undermines one of the fundamental drivers of competitiveness

As a result of the financial crisis, much of Europe is underinvesting in the key determinants of growth, notably education and research, health, and physical infrastructure. In some countries — the UK, the Netherlands, France, Italy and Germany — economic austerity has intensified protectionist sentiment, particularly with respect to labor markets and immigration. These attitudes further undermine one of the fundamental drivers of competitiveness.

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***Vox Populi* and the Rise of the NEAPs**

When analyzing the rise of politically generated events across the globe, one anomaly we found was the absence of large-scale social unrest during the darkest days of the Eurozone crisis. Although a rapid reversal of living standards is historically associated with protests and revolutions, our analysis underscored the fact that austerity-related protests were limited, generally failing to meet Citi's definition of a mass protest. Even the Eurozone periphery countries hardest hit by the crisis have seen limited social unrest. This finding is consistent with our long-standing view that political risk would be expressed through the ballot box in advanced economies, rather than on the streets. In the case of the Eurozone, the political calendar helped minimize the impact of *Vox Populi* risk — the presence of shifting and more volatile public opinion — at the most fragile time for markets. European Parliamentary elections in 2014 were the first major political test and culminated in the largest-ever results for non-mainstream parties which were often anti-euro and anti-EU parties.

This rise in NEAPs — new, extreme or alternative political parties — especially in Europe has been substantial; representing around 10% of EU Parliamentary members today from just about 4% in 2011. The rise of the Tea Party as a major faction in the Republican Party represents a similar phenomenon in the US. As a rule, these movements and political parties are anti-establishment and, in the European context, euroskeptic. Some represent single issues or simply a generalized “anti”-orientation rather than the broad platforms that could draw in a wider coalition. Even if not elected, NEAPs are having a significant influence on the policy debate as mainstream parties are likely to adopt some NEAP policy positions as they try to maintain their constituencies.

Against this backdrop of discontent and mistrust for institutions, several developed market governments are struggling with regionalism, secessionism and a drive for the return of national sovereignty. Even a failed vote may set the stage for a market-moving surprise in Europe, in what we call *referendum risk*. Scotland held an independence referendum in 2014 that was voted down, while Catalonia plans to hold one in November and in 2017 there is a possibility that the UK would hold an in-out referendum on EU membership. Though none of the upcoming ballots are expected to translate into victories at the moment, they add to the sense of political uncertainty and fragmentation which is weighing on confidence and sentiment.

Demographics in Europe are not favorable with an aging population and a shrinking labor force

The greying of Europe is already starting to be observed in the latest population the statistics. For example, the average French person was 36 years old in 1980, 40 years old in 2007 and will be 43 years old by 2030. Moreover, in 1980 there were 7.5 million French people over the age of 65, just 14% of the overall population. By 2030, the number of French people aged 65+ is projected to double to more than 15 million — just shy of a quarter of the anticipated total population.¹⁰⁶ As the population ages, the percent of the population in the labor force will decline. Some projections suggest that in absolute terms, the working age population will decline by 12.5 million in the EU between 2011 and 2030.¹⁰⁷ This could further depress growth. The great unknown in all this is the scale of immigration. Europe cannot effectively control movement of people within the EU and illegal immigration from outside the EU's borders is proving difficult to control. Immigration could change the demographic picture very rapidly, unlike changes in death and birth rates. It however is difficult to imagine European politicians allowing immigration on a scale sufficient to reopen the “demographic window” and reverse rising dependency ratios.

Europe has three potential routes: 1) “struggle on”; 2) run at a “multi-speed”; or 3) move towards a “federal Europe”.

A “struggling on” scenario anticipates a Eurozone that fails to adapt or undertake fundamental structural reforms. As countries muddle on, the long-term problems of government deficits, uncompetitive economies and unemployment will remain unsolved. In that scenario, average GDP growth is projected to average a measly 0.8% per year from 2010-2030.¹⁰⁸

The second scenario, of a “multi-speed Europe”, suggests that while a significant group of countries undertake much-needed reforms and benefit from the advantages of a single market, others fail to do so and require recurring bailouts and support or bail-ins and debt restructuring. Institutions of the EU would be strengthened, while multiple currency areas continue to co-exist around the Euro center. In this scenario, growth would hover around two percent per year on average between 2010 and 2030.¹⁰⁹ The third scenario, “federal Europe” would entail sovereign governments (with the exception of the UK and perhaps a handful of other outliers) ceding much greater authority to Brussels which then would engage in more coordinated planning and redistribution of income. This scenario, which currently seems unlikely, could drive average growth rates modestly above two percent between 2010 and 2030.¹¹⁰

The best case scenarios point to sustained growth in Europe, but even the most optimistic outcomes would continue to see Europe, and indeed the other advanced economies, grow at rates which are well below half those anticipated for emerging markets. Companies looking to invest should continue to consider Europe a critical market (and maybe even find strong, fast-paced growth in countries like Poland, where growth rates could surge beyond three percent annually) but would be wise to diversify investment elsewhere too.

¹⁰⁶ McKinsey & Company (2010).

¹⁰⁷ AUGUR (2012) p. 3. See also Trippel, M, and Groth, H. (2011).

¹⁰⁸ Ibid.

¹⁰⁹ Ibid.

¹¹⁰ Ibid.

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Europe: Strengthening through Banking Union

Banking union matters a great deal. In fact, its official aims of increasing financial stability, improving access to credit and reducing financial fragmentation by decoupling national sovereigns and the banks in their jurisdictions, are probably necessary for the Eurozone to survive and prosper. In our view, the commitment to move towards banking union — notably the decision to improve and centralize supervisory standards and to create more effective laws and institutions to resolve and potentially jointly recapitalize banks across the Eurozone — in turn was a major factor in the ECB's decision to create the Outright Monetary Transaction (OMT) program in 2012. These developments jointly were hugely significant in ending the most acute phase of the Eurozone crisis. But banking union's significance for ECB policy continues. We expect the partly reciprocal interplay between ECB policy and other Eurozone policies to continue, but with banking union entrenched, the ECB should generally be more willing (and, through its supervisory role, more able) to act supportively, which should also apply to a potential quantitative easing decision around the beginning of 2015.

Currently, the most visible part of the banking union efforts is the ECB's Comprehensive Assessment (CA) — including an asset quality review and a stress test — of 128 Eurozone banks, accounting for approximately 85% of the assets of the banking system. For the CA to achieve its objectives, it needs to be rigorous to help burnish the ECB's credibility as an effective supervisor and to reliably reveal potential capital holes in Eurozone banks. To make it likely that these holes are revealed and to assure that these are filled, sufficient backstops must also be available.

In the near-term an *indirect* effect of banking union is most important: efforts towards banking union raise the likelihood that the ECB will provide both actual policy stimulus and insurance against adverse shocks. This has been true in the more distant past (such as the ECB's OMT decision) and recently (for the targeted longer-term refinancing operations) and probably also for a future quantitative easing decision. But even in the medium-to-long term, when the original banking union aims have more significance, these indirect effects efforts will still be important. This is because the ECB will continue to play a key role in a new banking union setup on top of its supervisory role, namely as a much-needed lender (and potentially market maker) of last resort, for both banks and sovereigns.

The United States: Not Graying so Fast but Increasingly Less Dynamic

The US economic outlook is helped by better demographics than Europe

The United States has the most positive short-term economic outlook of the major advanced economies. The undermining of the past sources of dynamism nevertheless leaves no room for complacency regarding its long term prospects. Key past drivers of competitiveness, including relative openness to migrants and trade are being reversed, while the complexity of regulation and legal labyrinths are fast eroding the US's reputation as a natural home to entrepreneurial activity and an investment destination. Meanwhile, a severely aging infrastructure and gridlock on much needed federal reform agendas, including with respect to falling educational standards relative to competitors and the rising burden of chronic diseases, threaten to undermine future dynamism. In California and elsewhere, pressures on water resources are rising rapidly and on energy, although shale gas and tight oil are helpful in improving energy balance, they do not fundamentally change the dynamics of the overall economy.

Growth rates are expected to average 2.2% this decade and 2.3% from 2020-2030.¹¹¹ Unlike Europe, the United States is not graying quite so fast and, far from contracting, the United States population is expected to rise from an estimated 321 million residents in 2015 to 358 million in 2030 and 400 million by 2050.¹¹² The proportion of 65+ residents will nonetheless rise from around 15% in 2015 to just over 20% in 2030.¹¹³ These predictions bode well relative to a rapidly graying Europe, but the United States will still need to boost productivity if it hopes to offset the effects of a slowly aging population.¹¹⁴

Whether it is able to boost productivity is an open question. In addition to addressing the infrastructure, education and other drivers of productivity change, the US needs to reverse the significant decline in public funding for R&D, which historically has been catalytic as a driver of innovation in key sectors. Migrants have historically played a key role in innovation too, and reversing the decline in the US share of global patents will require not only that US universities are able to attract top-rated technically and scientifically oriented graduate students, but that a significant portion of them will be encouraged to stay after graduation. Despite being home to less than 5% of the global population, 28% of patent applications filed in the world in 2008 arose from the United States.¹¹⁵ Since then, there has been a significant decline in public funding for R&D and World Intellectual Property Organization (WIPO) data showed that in 2012 North America accounted for 24.6% of patent applications; with some of this coming from Canada the share of the US has declined sharply.¹¹⁶

Education, migrant labor and innovation help drive the economy more than population growth

But many challenges lie ahead, specifically regarding inequality, healthcare spending and education

The future dynamism of the US requires that it addresses a number of important challenges. Healthcare spending is inefficient and expensive, with 50% more spent per capita than the next highest OECD country without any better performance as regards health, morbidity, and other relevant indicators.¹¹⁷ The US's education edge — which was largely the driving force behind its rise to global dominance — has slipped with their 15-year old students ranked 31st of 65 countries in mathematics scores and 22nd in science scores.¹¹⁸ Finally, inequality is rising in the US as it is in many advanced countries and emerging markets. In the US, median household real incomes have been on the decline since 1999 while the incomes of the top 1% have soared.¹¹⁹ That trend has been longstanding. Between 1993 and 2012, the top 1% of earners in the US saw their nominal incomes rise by 86.1%. In comparison, the incomes of the bottom 99% have risen only 6.6% in the same period. The economic recovery since the most recent crisis has further exacerbated the divide with 95% of income gains accruing only to the top 1% (Figure 19).¹²⁰ Income inequality is only one indicator of the fault lines within the US economy along with the burden of debt that the economy carries forward.

¹¹¹ Chateau, J. Rebolledo, C. and Dellink, R. (2011) Table 4, p. 22.

¹¹² U.S. Census Bureau, Population Division (2012b).

¹¹³ Ibid.

¹¹⁴ US National Intelligence Council (2012), p. vi.

¹¹⁵ Ibid. p. 98

¹¹⁶ World Intellectual Property Organization (WIPO)

http://www.wipo.int/export/sites/www/freepublications/en/statistics/943/wipo_pub_943_2013.pdf

¹¹⁷ US National Intelligence Council (2012), p. 99.

¹¹⁸ Ibid, p. 99.

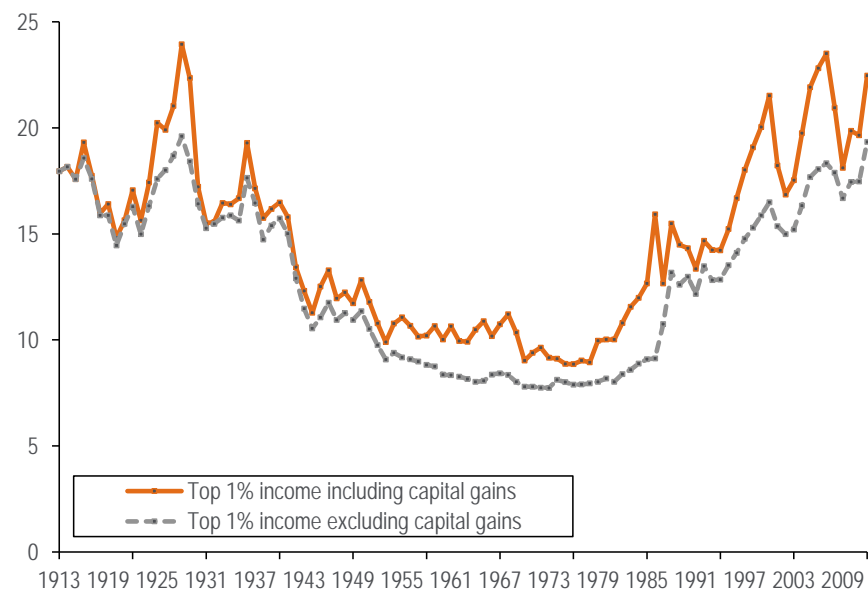
¹¹⁹ Ibid, p. 99.

¹²⁰ Saez, E. (2013).

Political stalemate at the federal level in the US needs to be addressed

From the October 1 through October 16, 2013, the US federal government went into shutdown over its inability to pass the federal budget. A constitutional system based on checks and balances requires broad consensus and a willingness to compromise for it to work effectively. With the polarization of the US polity and the Congress, there is effective political paralysis in the US, with any action that requires the support of the White House and both Houses of Congress effectively impossible. Whilst its debt obligations have possible intergenerational trade-offs its macroeconomic significance has been overplayed by the political usage of the debt ceiling. This political process needs to be altered, as a default by the US would wreak havoc on global risk premiums and markets. The fault lines in the US require the overcoming of the increasingly sectarian divisions which have stymied the capacity of successive governments to implement much needed reforms. At the level of cities and states there has been much greater progress. However, while a number of city Mayors and state Legislators have embarked on significant reform efforts, the political capacity to enact reforms is also required at the federal level. As conditions for this appear not to be found within the Washington beltway, we believe that on balance the US will continue in the medium term to perform economically well below its potential and not be able to sustain growth at levels much above the current levels of over 2%.

Figure 19. Top one percent income share in the United States



Source: World Top Incomes Database

Asia: China's Slowing Surge, India's Rise and the Possibilities in Indonesia

Although the entire region is important, a small number of countries drive growth

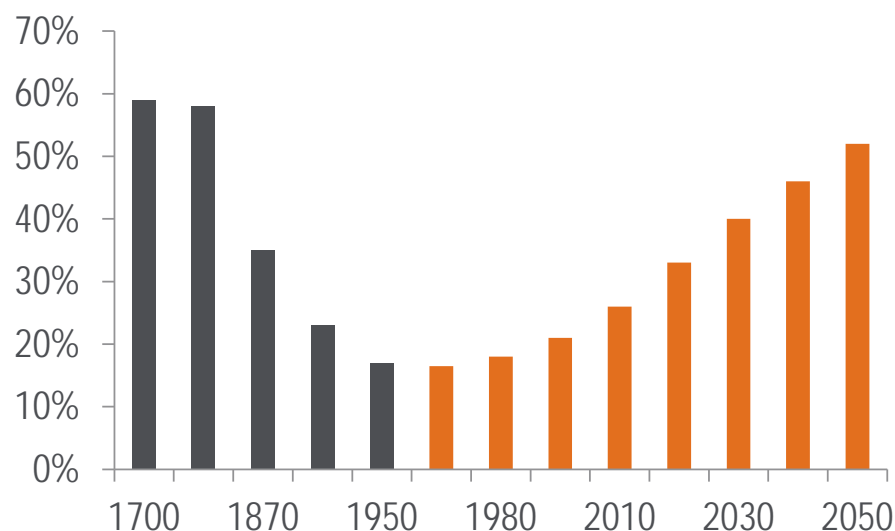
Asia's growth will be impressive, and the 21st century may well be the "Asian Century", at least in terms of economic growth. The engines of this "Asia Century" are likely to be just seven economies—Japan, Republic of Korea, China, India, Indonesia, Thailand and Malaysia.¹²¹ These economies are already major contributors to the region, with a combined total population of 3.1 billion (78 percent of total Asia) and accounted for 87% of Asia's GDP in 2010.¹²² Using growth

¹²¹ Asian Development Bank (2011)

¹²² Ibid

forecasts from the IMF, these seven economies could increase GDP to \$132.4 trillion in 2050, up from \$14.8 trillion, and account for almost 45% of global GDP, as much as 87% of total GDP growth in Asia, and almost 55% of global GDP growth. There are challenges to achieving this level of growth, however. Income inequality within countries could lead to political and social unrest while competition for finite resources, global warming and climate change as well as governance and institutional capacity which are always a possibility in the region, continue to be a hurdle.¹²³

Figure 20. The rising economic power of the Asian countries: Asia's share of global GDP



Source: Asian Development Bank (2011)

China's Slowing Surge

Growth in China is slowing but this is not necessarily a bad outcome

Under a business as usual scenario, the OECD forecasts China's yearly GDP growth to be 5% on average from 2014 until 2030, then slowing to around 2.4% average annual growth from 2031 to 2060.¹²⁴ Slowing growth is the natural consequence of a maturing economy and is not necessarily a bad outcome, as it will reflect more stable consumer-driven and environmentally sustainable growth. However, any major deviations from the projection — for example if China grows much slower than forecast — will have large-scale ramifications for global economic health. The IMF estimates that each percentage point in reduced Chinese real GDP growth erodes global growth by about a tenth of a percentage point.¹²⁵ This may well be conservative and an underestimate of the interdependencies. The impact of China's slowdown would be highly differentiated, with the balance on economies depending on the extent to which they would benefit from reduced commodity and oil prices, and would be harmed from lower exports to China.

China is aiming to rebalance the economy through new growth engines

In order to avoid performance that is below expectations, China must actively "rebalance" its economy away from a purely export-oriented, investment-driven, energy- and commodity-intensive, physical output-dominated economy and toward one that encourages domestic consumption, service-sector orientation, environmentally sustainable production and demand. The invention of new growth engines will only be rewarded if the urbanization required is achievable. In the way of this stands the *hukou* system (a system of household registration) and much needed reforms of this and the social welfare and land systems are now beginning.

¹²³ Ibid

¹²⁴ Johansson, Å., et al. (2012)

¹²⁵ Kahn, R. and Tananbaum, S. (2013)

China must also increase investment efficiency. Creating greater flexibility for both its currency and interest rates (allowing a more market-based exchange rate), developing bond markets, and opening the capital account will encourage both domestic and foreign private investment. Liberalization of the capital account (“Renminbi internationalization”) should not be attempted until the domestic financial sector is more fully developed and internal financial sector liberalization is much more advanced, with a consistent regulatory and supervisory framework for the banking sector, the shadow-banking sector, and domestic financial markets. Premature capital account liberalization would be a disaster. Whilst reform is imperative to secure this growth, there is a trade-off with short-term stability and long-term growth. In the absence of reform, there are significant risks of a hard landing in the form of an investment cliff, a credit crunch (China is experiencing a corporate credit bubble and a potentially worrisome housing and residential construction boom/ bubble), a banking sector or debt crisis, and a middle-income trap¹²⁶.

China is likely to overtake the US as the biggest economy by 2030

In spite of these risks, China will most likely overtake the United States as the biggest economy by 2030, even with challenging demographics. Part of that rise will be driven by increased labor productivity which is expected to rise by an average of between one and two percent through 2030.¹²⁷

GDP is predicted to increase slower than productivity growth after 2020 due to the decreasing size of the labor force. World Bank projections suggest that overall GDP (in current dollars) will rise from \$8.2 trillion in 2012 to roughly \$15 trillion in 2020, and just over \$25 trillion by 2030, surpassing the US and well above India.

Figure 21. Statistics on China diverge on growth prospects

Potential GDP Growth Rates	2015	2020
Citi: Assuming no significant rebalancing	7.7%	5.5%
Citi: Assuming urbanization takes place	8.4%	6.8%
	2011-2015	2016-2020
World Bank and Development Research Center of the State Council	8.6%	7.0%
	2012-2016	2017-2021
OEF	8.3%	7.2%
	2008-2016	2017-2025
Conference Board	6.5%	4.3%
	2011-2015	2016-2020
DRC Aggregated Provincial Data	8.2%	7.3%
	2012-2016	
The State Information Center	7.9%	
Source: OEF, World Bank, Development Research Center of the State Council, The State Information Center, Citi Research		

¹²⁶ For deeper analysis on China's rebalance through Citi's GPS research series see *China & Emerging Markets: China is about to rebalance. How we EM be affected?* (Citi GPS, July 2012) and *China in Transition: What We Know, What We Don't Know* (Citi GPS 2012).

¹²⁷ Johansson, Å., et al. (2012)

India's economy is driving forward

India's Rise

As China's economy transitions towards slower growth, India's is expected to drive forward. Current projections from the OECD suggest that India will average 6.7% growth from 2011 to 2030 and 4.0% from 2030 to 2060.¹²⁸ The demographics of India are more favorable than those of China as China's labor force has already peaked. Conversely, India still has a young population and will grow at least through 2045 when the country is projected to be home to just under one billion workers.¹²⁹ This will reflect an inversion of labor force size; India will have 25% more workers than China by 2060 while China has 24% more today.¹³⁰ Additionally, while India will eclipse China's number of people living in the middle class (1.19 billion in India vs. 1.12 billion in China by 2030),¹³¹ China will still have a substantial edge in GDP per capita — roughly \$21,000 in China, compared to \$13,200 in India.¹³²

These differences account for the large projected disparity in overall GDP between China and India in 2030: \$30.6 trillion for China compared to \$13.7 trillion in India.¹³³ Nonetheless, India's growth is poised to remain elevated for the foreseeable future, even as China's economy slows. However, India's political challenges could derail its economic prospects. For example, the most recently elected lower house in India's parliament has been the least productive, most gridlocked of any cohort since independence.¹³⁴ China's political challenges are very different, but nevertheless equally daunting and without historical precedent. A highly centralized and authoritarian government system is relinquishing its grip on a widening range of economic activities and seeking to satisfy the demands of a population of over 1.3 billion people that is doubling its incomes every decade or less. Rapidly rising living standards, ever-rising education and access to social and other media means that knowledge and expectations are growing too, as are calls for participation and transparency. China is fortunate to have a leadership with higher degrees of skill, experience and expertise than perhaps any other country on earth; they will be challenged to the utmost in ensuring that China's transition remains on track.

¹²⁸ Ibid.

¹²⁹ Asian Development Bank (2011), p. 21.

¹³⁰ Ibid.

¹³¹ The middle class is defined here in the same way as in Kharas, H. and Gertz, G. (2010) to include those living in households spending between \$10 and \$100 a day in purchasing power parity terms.

¹³² Asian Development Bank (2011), p. 23.

¹³³ Price Waterhouse Cooper (2013).

¹³⁴ *Wall Street Journal* (2013).

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ASEAN – New Pistons for a Growth Engine

Although China and India are the primary drivers of growth in Asia, GDP for ASEAN — Indonesia, Malaysia, the Philippines, Singapore and Thailand — has almost doubled in real terms since the start of the millennium, with per-capita GDP rising 2-4x across countries. With a combined population of 600 million and GDP of \$2.1 trillion, IMF forecasts for GDP rising to \$3.2 trillion by 2019 and Citi seeing Indonesia as potentially the 8th largest economy by 2025, we believe that ASEAN has emerged as an economic bloc in its own right. We believe ASEAN will continue to reap dividends from favorable demographics, rising consumption and urbanization but will also look towards new levers for a sustained era of economic success.

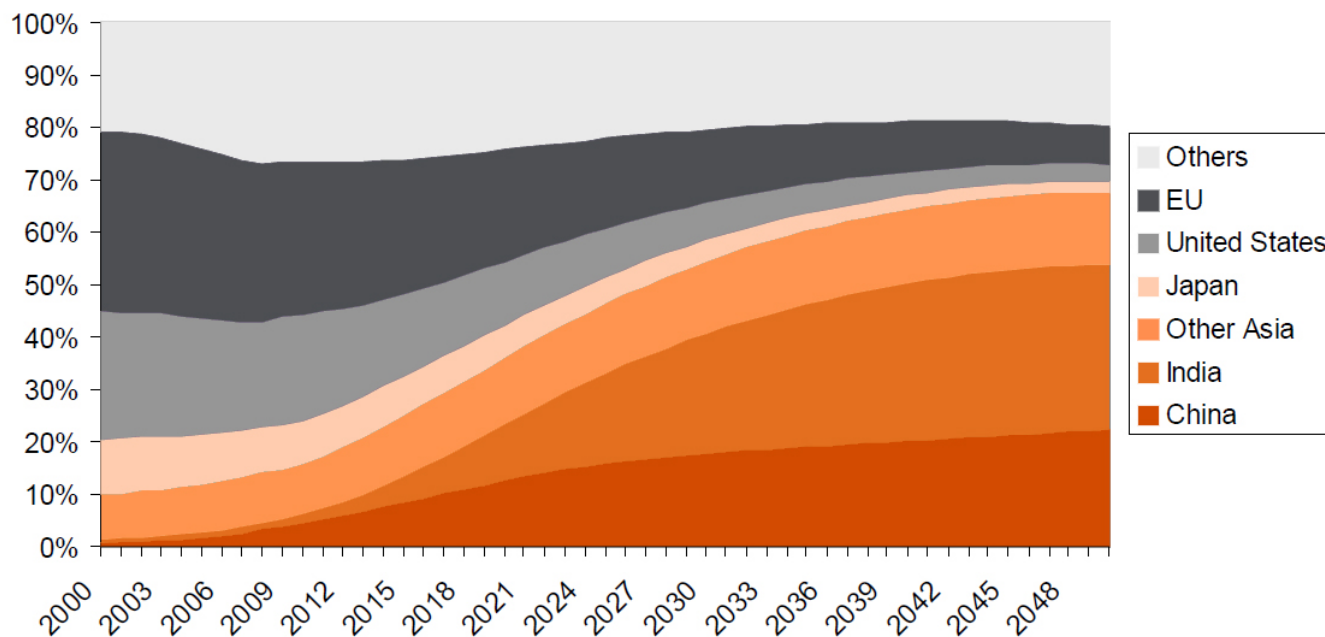
Domestic demand was the primary driver of GDP growth from 2001-13 but, given headwinds to domestic demand from high household debt and fiscal consolidation, a refocus on more productive export-oriented sectors would be a better recipe for the sustainability of the investment cycle. Fortunately, the southward diversion of foreign direct investment (FDI) from China's rebalancing provides ASEAN with a narrow window of opportunity to build its export competitiveness. There are a few reasons for this.

First, as China rebalances its economy from investment towards consumption, the wage cost advantage it once enjoyed over ASEAN in the last decade has been rapidly eroded. Partly because of relative labor costs, returns on FDI for multinational corporations operating in ASEAN have been superior to those in China, especially for US manufacturing firms.¹³⁵ Second, recent tensions between China and Japan have caused Japanese FDI to be diverted into ASEAN and, finally, Chinese companies are themselves investing more in ASEAN. FDI can also be boosted by the further lowering of barriers to movements of goods and factors of production — especially non-tariff barriers — which reduces the cost of doing business. ASEAN integration initiatives will also result in higher intra-regional trade, to meet final demand from both developed markets and within ASEAN. However, FDI does not automatically mean higher export-orientedness. It can be a substitute for imports, if the FDI produces goods and services aimed at the domestic market.

Geographical diversification of growth from the urban core to the periphery within individual countries may become increasingly relevant, given political reasons behind the pursuit of social equity across all countries. These political motivations could be reinforced by a variety of economic reasons—cost normalization pressures in the case of Indonesia and an extension of ASEAN economic integration in Malaysia and Thailand. Key success factors in the development of peripheral regions include the level and type of infrastructure spending (electricity and water in the Philippines, transport and energy in Indonesia) plus the geography and economic history in the case of Malaysia. Within countries, second-tier regions geographically and economically closest to the “core” are likely to be the largest beneficiaries of the regional development agenda, given synergies from economies of agglomeration, especially in manufacturing.

¹³⁵ Kit, W. Z. (June 2014)

Figure 22. Shares of global middle class consumption 2000-2050E



Source: OECD, Kharas, H., (2010).

Latin America: Brazil Emerges, but Region Small

Brazil's economy is expected to more than double by 2030

Currently, three Latin American economies are present among the G20: Brazil (8th largest), Mexico (14th largest) and Argentina (19th largest).¹³⁶ By 2040, the OECD forecasts Mexico will move up to the 9th largest economy in the world, above Germany, while Brazil is projected to move ahead of both Germany and the UK. In the process, Brazil's economy is slated to more than double, to \$5.28 trillion by 2030.¹³⁷ Unlike Indonesia, however, Brazil's young population is expected to drop by 5 million between now and 2030 due to a sharp decline in fertility rates.¹³⁸ Nonetheless, Brazil's median age in 2010 was 29 (compared to 45 in Japan, 44 in Germany, or 40 in the UK) and will only rise to 35 by 2030.¹³⁹ Its "demographic window" is likely to remain open until 2030. Argentina has been going nowhere for 100 years. Having been among the world's top ten economies in 1914, with average per capita incomes similar to those of the 16 richest countries, a series of catastrophic policy mistakes have seen economic growth oscillate like a pendulum, propelled by commodity booms and busts and bouts of macro orthodoxy interspersed with macro madness. On the basis of current evidence, it would not be prudent to suggest that this pattern is likely to change.

Sensitivity to China's rebalancing is key to many country's growth prospects

Unlike China's Asian trading partners, there are a number of Latin American economies that seem relatively vulnerable to China's rebalancing. In particular, the economies of Chile and Peru, where base metal exports makes up 15.1% and 2.6% of total exports, respectively, are somewhat reliant on metals exports to China. If Chinese demand slows, these countries would have to go through an adjustment process in response. Mexico, on the other hand, looks like it may have a chance of

¹³⁶ Johansson, Å., et al. (2012)

¹³⁷ Citi forecast.

¹³⁸ US National Intelligence Council, p. 24.

¹³⁹ Ibid.

reversing the relative damage to its global market share of manufacturing goods due to China's accession to the WTO in 2011.¹⁴⁰ By 2015, average manufacturing-labor costs in Mexico are projected to be 19% lower than in China, down from 58% more expensive back in 2000.¹⁴¹

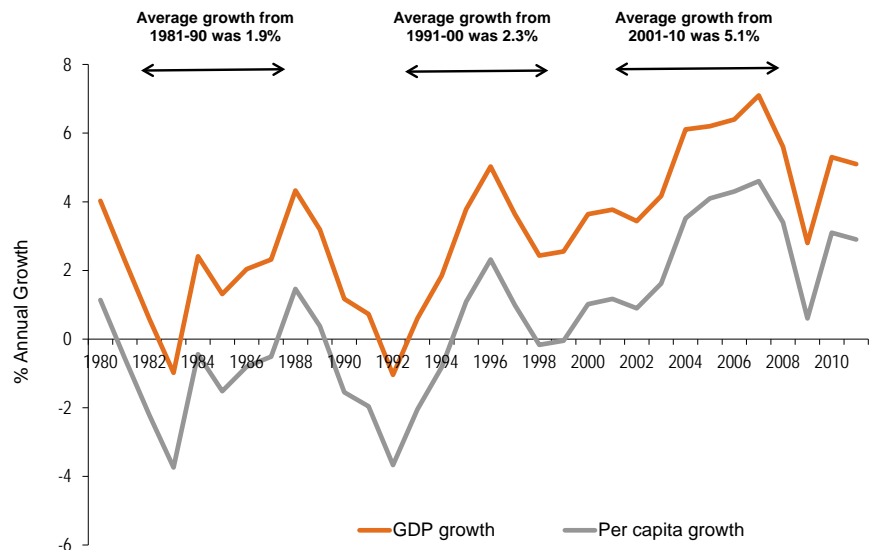
Regardless, while Latin America will grow — led by Brazil and Mexico and with robust growth from Peru and Colombia in particular — in 2030 the region is expected to be home to just around 6.3% of the world's GDP, down from nearly 9% in the 1970s, with its overall influence on the world stage correspondingly restricted.¹⁴²

Africa: Can Growth Potential Overcome Instability?

Africa's overall growth is robust but fragmented

Africa has on average enjoyed robust growth over the past two decades, averaging over 4%. Sub-Saharan Africa posted GDP growth of 4.6% in 2013, led by East Africa and West Africa, which saw regional rates of growth well above 6%.¹⁴³ These averages obscure a varied picture among the 54 African economies. Some bright spots, such as Angola, have seen rapidly accelerating growth driven by oil profits. Other countries have also managed impressive growth with strength in diamonds in Botswana plus agriculture and a rising service sector in Ethiopia both driving the economy. On the other end of the spectrum, countries like Somalia, The Democratic Republic of the Congo, and the Central African Republic have floundered due to war and political mismanagement.¹⁴⁴

Figure 23. African growth has picked up since the mid-1990s



Source: Citi GPS (2012e)

¹⁴⁰ Citi GPS (2012c).

¹⁴¹ Boston Consulting Group (2011)

¹⁴² Maddison, A. (2008).

¹⁴³ Ibid p.13. See also "Global Economic Prospects." (2013), *World Bank*. Available at web.worldbank.org.

¹⁴⁴ IMF (2013a).

Despite popular thinking, only 30% of Africa's growth story has been driven by commodities

The past two decades of strong growth have brought about a new wave of investor appetite. However, much of the investment in these markets was dependent on the widely held view that the impressive growth was due to high commodity prices and therefore an investment in the region could be seen as mainly a commodity play. This misunderstands the key drivers of growth. Citi Research analysis notes that only 30% of Africa's growth story has been driven by commodities and sub-Saharan Africa is actually very dependent on only three mineral commodities—oil, gold and copper.¹⁴⁵ Although commodity prices have bolstered growth, there has been improved political stability and economic policies prompting a new wave of investment of corporates into sub-Saharan Africa targeted at supplying local markets. A compounding factor has been the relatively slow growth until the 1990s leaving the continent with a long way to go to catch up to the rest of the world. There is plenty of room for optimism just as there are sources of concern, most notably the poor public health systems and the resulting epidemics/ pandemics (i.e., AIDS, Cholera and Ebola) which could be a major obstacle to growth in the region.

By 2050, only Nigeria is expected to break into the top 30 largest economies in the world

None of the 20 largest economies in the world are in Africa. If projections hold, none will occupy a top 30 spot by 2030, and only Nigeria is expected to break in by 2050. From 1981 until 1999, growth in Nigeria averaged only three percent per year and it served as a poster child for falling victim to the resource curse.¹⁴⁶ However, in the past decade Nigerian growth has averaged approximately 6% per year despite its oil production remaining stagnant. While great potential exists for increasing oil revenues and the benefits therefrom, the past decade shows how growth can be built upon a broad based economy with sounder infrastructure and sounder institutions.¹⁴⁷ Governance problems such as corruption and terrorism are serious threats to continued rapid growth if they remain unaddressed.

There will not be a one size fits all development model for the African continent. Instead, the challenge will be for Africa to navigate the nexus of the service, agricultural, and industrial sectors for the promotion of long-term growth. Some economies, such as those situated on the coast with greater access to shipping lanes are well placed to look outwards and stake their claim on the global stage. Other winners will be the countries that are able to harness their growing populations and resource endowments to create significant domestic markets. Landlocked fertile countries, such as Zambia and Zimbabwe, have considerable potential, not least in regional markets for their agricultural products.

¹⁴⁵ Citi GPS (2012e).

¹⁴⁶ IMF (2013a).

¹⁴⁷ US National Intelligence Council (2012), p. 10.

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Nigeria – Reforms Driving Growth

We view Nigeria as a key part of the structural frontier markets story of growth with productivity gains, improving institutions and much more.¹⁴⁸ Thanks to favorable demographics, the large size, and rapid expansion of the economy, as well as an improving political and governance backdrop which is paving the way for structural reforms and natural resource wealth, we see Nigeria as an emerging market in the making. On a 5-10 year basis, most Nigerian companies are likely to be significantly bigger than they are today.

The growth story in Nigeria in recent years has been the result of reforms introduced by the government which provided a major boost to the economy in the last decade. Despite this, Nigeria's growth rate, which peaked at 8.4% in 4Q 2010, has settled into the 6-7% range. The most obvious way to give new impetus to growth is to push ahead with much needed structural reform and the easiest way to boost growth in Nigeria would arguably be to provide a regular and affordable supply of electricity. The current administration is pushing forward with reform in key sectors, notably the agriculture and electricity sectors, while also seeking to improve transport and infrastructure. This is all set against the background of maintaining macroeconomic stability, reducing corruption, or "sealing leakages" and preventing the spread of terrorist threats to social, political, and economic stability. But this has not proved easy.

The other main problem for the growth story in Nigeria in recent years has been that oil production has continued to stagnate. This does, in part, represent the problem of slow progress with structural reform. A key reform proposed by the government has been the Petroleum Industry Bill (PIB) which seeks a comprehensive overhaul of the oil and gas sector with the goal of driving new investment and growth in the sector. But the final version of the PIB is still to be presented and approved by the National Assembly and many new investments in the sector currently remain on hold.

The Nigerian story, while exciting, is not without challenges. The government's reform 'to do' list is long. Power, energy and infrastructure are all in need of a major overhaul (reforms and improvements in each are currently at various stages). Eagerly awaited, Nigeria's Sovereign Wealth Fund should start functioning soon. Other issues that complicate the picture include the security situation in the north of the country and the all-round difficulty of doing business (Boko Haram, corruption, regulation, etc.).

Can Nigeria become a mainstream emerging equity market on a 10-year time horizon? We think it can. We highlight Nigeria's inclusion in the JP Morgan GNI-EM bond index and in the Barclays EM government bond index as encouraging developments. As well as leading to tangible inflows into government securities from index tracking funds, this is also positive for investor sentiment. In our view, Nigeria is a plausible candidate for eventual inclusion in EM equity indices too as it has many of the attributes that helped emerging markets grow in the past.

¹⁴⁸ Citi GPS (2013)

Economic power is shifting with emerging countries expected to dominate over demographically challenged advanced economies

The Global Picture: The Rise of New Economies, the Graying Old Economies

The balance of global economic power is shifting rapidly and emerging countries already account for over half of world GDP.¹⁴⁹ That figure is expected to rise to nearly 70% by 2030.¹⁵⁰ The advanced economies face demographic challenges as their populations age, while most, but certainly not all, emerging economies are able to benefit from a “demographic window” and with sound macroeconomic policies and improved governance can anticipate continued rapid and sustained growth.

While these fundamental drivers are likely to shape future economic developments, the economic outcome has not yet been decided and the prospects for any one country can be fundamentally improved or undermined by domestic policies. The importance of governance and sound macroeconomic policies in shaping future growth cannot be underestimated. In Africa, much of the explanation for sustained higher growth arises from these two factors, with many of the economies exhibiting sustained growth whereas this previously proved elusive. In Asia, while we are optimistic about the macro management in the two largest economies — China and India — uncertainty regarding the long term reflects the short track record of the leaders at the pinnacle of these two giants.

External threats can also derail any economy. Uncertainties regarding the role of North Korea, Russia, and the recently emergent fundamentalist forces of the Islamic State (ISIS/ISIL/IS) are illustrative of how external events can also bring new opportunities or frustrate even the best-prepared policies.

Along with external military threats are the new emergent systemic risks arising from the extent of integration of global systems. As we show in the discussion on systemic risk in the next chapter, small events anywhere can cascade and amplify into disruptive shocks to economies elsewhere.

The only certainty is that change is coming. Those that currently sit atop the global economic leaderboard will find they are overtaken in the coming decades. Wherever they are located, firms and investors that embrace these changes will benefit greatly.

¹⁴⁹ O'Brien, M. (2013).

¹⁵⁰ Maddison, A. (2008).

5. The Butterfly Defect: Systemic Risk in a Global Village

What is Systemic Risk?

We now are connected to one another more than ever in history ...

When Facebook analyzed its hundreds of millions of active members in 2011, they found that, on average, there were only 4.7 degrees of separation between any two users, anywhere in the world.¹⁵¹ We now are connected to one another more than ever in history. Just as we are intertwined, complex systems are also linked together, a web of physical and digital connections and nodes stretching across the globe. Fiber optic cables span the ocean floors, products are often assembled across continents and electronic flows on the Internet do not need visas to transcend borders.

Forging such connections has proved overwhelmingly beneficial. Global collaboration and connectivity has ushered in unprecedented growth, reduced poverty, sparked innovation, and accelerated progress. But connections can be — and often are — broken. This is true whether the connections are digital or physical, local, regional, or global. When disruptions or crises start, they can quickly become contagious and propagate risks which cascade well beyond the original flare point. Global systemic risk refers to this possibility — that business and society could be put at risk by an event or a series of cascading events, which cannot be contained within traditional risk boundaries.

... leaving us extraordinarily vulnerable to systemic risks

We are extraordinarily vulnerable to systemic risks. Business and political leaders appear ill-prepared for the potential perils that lurk in our globalized systems. A better understanding of these new forms of systemic risk is vital to build preparedness and resilience and to prevent a backlash against globalization. Systemic risk is endemic in all globalized systems, and can cascade across them due to their interdependence. Examples of these risks can be found in finance, supply chains, infrastructure, cyberspace, ecology, public health, and politics. Smart leaders will insulate themselves as much as possible from these risks; smart investors will avoid investing where others choose to ignore systemic risk.

Finance: Avoiding the Next Meltdown

Lessons from the financial crisis

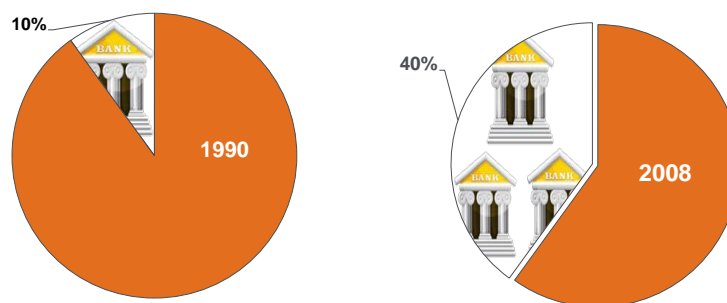
The global financial collapse of 2008 and 2009 germinated in the sub-prime market in one country, the United States. Yet its effects debilitated national economies across the world and the subsequent shock waves continue to be felt around the world. Experts still disagree about the causes of the crisis. Excessive leverage, failure of regulatory oversight, not least of derivative products and instruments, together with a globalization of distribution and a concentration of production all played a part.

Total outstanding debt of the US domestic financial sector increased from just over \$250 billion in the first quarter of 1975, to a peak value of over \$17 trillion during 2008.¹⁵² When one node of the financial network (Lehman Brothers) collapsed, the entire system was affected and may well have collapsed without a government bailout. The significant rise in market concentration in the investment banks (Figure 24) in the US has led to implicit bailout guarantees by the state in the event of insolvency.

¹⁵¹ *The Economist* (2012a).

¹⁵² Federal Reserve Bank of St. Louis (2012).

Figure 24. Market share of the three largest U.S. banks



Source: Gai, P. Haidane, A. and Kapadia, S. (2011).

However, the systemic risks in the financial sector did not only stem from the increasing concentration in the market but also due to more sophisticated products and interconnectivity. The rise of securitization and structured financial products was one of the most striking features of the financial sector in the run up to the crisis. This financial innovation, while not destabilizing in itself, led to an increased risk of contagion due to excessive opacity and complexity. Risk was repackaged and sold on the basis that institutional investors could not invest directly in loans and mortgages, as they were deemed too risky. This increased the chains of financial intermediation in the economy, creating vulnerability and therefore weakening financial stability. Furthermore, as banks started issuing securitized assets, they engineered a way to increase the share of highly rated assets and subsequently reduced the amount of capital they had to hold, lowering costs. This facilitated the large increase in leverage observed in the run up to the crisis. Lehman Brothers was the victim of systemic maturity mismatch in financial markets that led to their collapse once the fuse was set on fire.

Whereas the financial crisis reflected the risks arising from networks and unregulated innovation, the financial system is also at risk due to its geographic concentration. New York and London are home to the global financial system's nerve centers. When terrorists attacked the World Trade Center in 2001, the New York Stock Exchange was closed for a week as a result of its proximity to the towers. London and Frankfurt were also affected, as many of their firms held offices on nearby Wall Street.¹⁵³

While the 2001 disruption did not trigger a global financial crisis, it is possible that a pandemic or natural disaster could trigger financial contagion.¹⁵⁴ The recent financial crisis has also revealed further mechanisms by which systemic risk may emerge: 1) a common shock, leading to a simultaneous default of several financial institutions at once; and 2) informational spillovers where bad news about one bank increase the refinancing costs of all other banks.

Supply Chain Risk: From Floods in Thailand to Billions Lost in Silicon Valley

Supply chain vulnerabilities

The risks arising from geography are also endemic in modern supply chains. Most major multinational companies assemble products from parts that are made in several locations. While that produces a comparative advantage at each level of production, it also concentrates risk geographically. If one manufacturing hub shuts down, the entire supply chain is at risk and the global economy may be adversely affected.

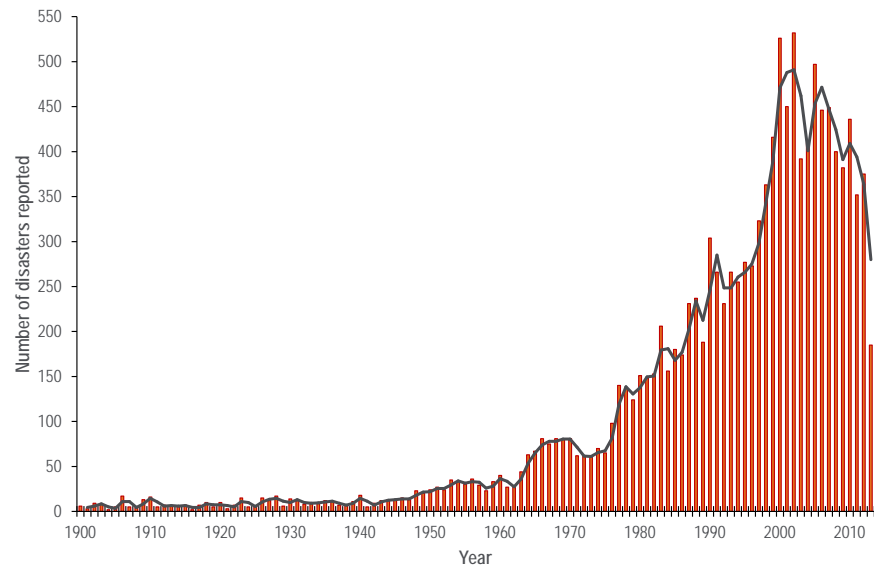
¹⁵³ Goldin, I. and Mariathasan, M. (2014).

¹⁵⁴ Goldin, I. and Vogel, T., (2010).

The trend towards “just in time” manufacturing

There is also an increasing trend toward production and distribution systems aimed at “just in time” manufacturing, reducing losses generated by excess “buffer stock” or product storage.¹⁵⁵ While these buffers may shave off profits slightly, they are essential to providing an internal insurance policy against supply chain risk. Companies that reduce margin for error in their supply chains may be penny wise but they are certainly pound foolish.

Figure 25. Growth in the number of natural disasters from 1900-2013



Source: EM-DAT: The OFDA/CRED International Disaster Database – www.emdat.be – Université Catholique de Louvain – Brussels – Belgium.

This was demonstrated in Thailand in 2011. Heavy rains forced many local factories to close. In particular, high-tech manufacturing plummeted, as Thailand is a hub for hard disk drives.¹⁵⁶ Worldwide production dropped by 28%.¹⁵⁷ Knock-on effects inflated the market price of other types of technology hardware globally. Production of notebooks, digital video recorders, and other devices was stalled. Intel's profits fell by more than \$1 billion in the last quarter of 2011 alone.¹⁵⁸ Overall, total economic losses attributed to the floods by December 1, 2011 were estimated to be \$45.7 billion, with \$32 billion in damage to manufacturing alone.¹⁵⁹

Whenever production is stratified so efficiently that disruptions at one node put the entire system at risk, small crises can be amplified. Just as the financial sector operated with razor thin margins for error, so too does a large portion of the manufacturing world.

¹⁵⁵ See Goldin, I. and Mariathasan, M. (2014) for a further discussion of slim supply chain margins and “just in time” processes.

¹⁵⁶ See Courbage, C. and Stahel, W. (2012).

¹⁵⁷ World Economic Forum (2012a).

¹⁵⁸ Ibid.

¹⁵⁹ Courbage, C. and Stahel, W. (2012)

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The Technology Supply Chain: Challenges Continue

The Global Technology Supply Chain evolution is far from over and in the next several decades several systemic opportunities and challenges will become increasingly important. During the 20th century the industry experienced the "Border Jump" followed by the "Silk Roads to China". In the "Border Jump" during the 1980s many companies (both technology as well as other sectors) shifted manufacturing from the United States to Mexico in an effort to take advantage of the lower labor cost as well as favorable government tax incentives (tax holidays for income and property taxes, labor credits, etc.). This was followed by the "Silk Roads to China" during the 1990s, where the shift was to move manufacturing to China again to take advantage of the lower labor cost as well as favorable government tax incentives in addition to being closer to the incremental new purchasers often found in Asia.

However, from these appealing opportunities sprouted material challenges which necessitated change within a decade or two after these golden investments were made for both the "Border Jump" and the "Silk Roads to China". Specific examples include the following. Plexus, physically located manufacturing in Juarez ("Border Jump"), which is one of the closest large cities to the United States immediately across the US border with the intention for shorter shipping time, distance, and costs while benefitting from the lower Mexican labor costs compared to the United States. Unfortunately over time the Juarez location has experienced a large and unexpected increase in crime with a lack of political and social stability causing the company to pull out of Juarez and move to a more distant Mexico location in Guadalajara which is approximately 800 miles away.

Flextronics, one of the world's largest Electronics Manufacturing Services (EMS) companies invested heavily in China production facilities in the 1990s and since 2000 has been facing a rapidly increasing labor rate causing the company to move manufacturing from coastal China to inland China. This has resulted in multiple years of "one time" restructuring costs which have been at shareholders' expense. Other companies have experienced labor boycotts for improved wages, working conditions and some governments have even prohibited the exporting of cash, investments, and equipment from those countries. These systemic challenges were not anticipated upon initial investment and moving the affected facility is both expensive and a distraction to the manufacturing company and its customers.

Looking ahead, we believe many of these systemic risks will continue as the technology supply chain continues to chase the low cost labor arbitrage as well as reducing the shipping time and cost to the incremental consumer which is often in emerging markets. We believe Vietnam is on the horizon for technology investments but currently the country does not have the optimal infrastructure of efficient shipping, transportation, and hub and spoke supply component distribution as well as sufficient reliable power, water, and labor force. We believe as time progresses these challenges will be improved and then the major technology supply chain companies will seek government tax incentives to make investments as prior low-cost manufacturing regions (China, Mexico etc.) see increasing labor rates and the gradual expiration of favorable tax incentives that were provided at the time of original investment. Despite this chase for low cost we note that companies will still look for a diverse global manufacturing footprint to mitigate unpredictable disruptions such as earthquakes, floods, power outages, etc., as well as the reality that shipping time and distance still play an important part for the supply chain as large item shipping costs can outweigh the labor savings and some governments mandate in country production.

No sector is immune to infrastructure collapse and infrastructure is increasingly reliant on a few narrow hubs

Infrastructure: Systemic Risk of Power, Transport, and Communication

While supply chain risk is at least (generally) isolated within sectors, no sector is immune to infrastructure collapse. Again, disruptions in one location can spread rapidly, wreaking economic havoc as they do. In 2010, the eruption of the Eyjafjallajökull volcano in Iceland prompted the biggest global air traffic disruption since World War II.¹⁶⁰ More than 100,000 fewer flights traversed European airspace than usual during a week of airport closures.¹⁶¹ Global air traffic was also severely disrupted, as several of the world's largest airports were completely shut. The economic impact of the ash cloud was estimated to be \$5 billion in total — ranging from the airlines, to the hospitality industry, to lost productivity from stranded workers, to losses of perishable or other “just in time” goods.¹⁶²

In 2003, on the ground rather than in the skies, an electronics failure allowed a single falling tree to knock power out for 50 million Americans. One node (a power plant in Ohio) shut down, with a cascading overload effect spreading across 9,300 square miles.¹⁶³ The blackout shut down half of Ford and Daimler Chrysler's North American production plants, idling hundreds of thousands of workers.¹⁶⁴ Eight oil refineries were shut down or severely disrupted.¹⁶⁵ Several major steel facilities were shut down, including a blast furnace that suffered an explosion and fire as a result of the blackout.¹⁶⁶ In total, the economic impact of the electricity disruption was estimated to be between \$4.5 billion and \$8.2 billion—all because of a single tree falling on a power line in Ohio.¹⁶⁷

Just as error margins are razor-thin in modern supply chains, infrastructure is increasingly reliant on a few narrow hubs. Heathrow Airport, for example, may be the primary gateway to Europe but snowfall of just under two inches (5cms) in early 2013 led to extensive delays and cancellations, arising from inadequate investment in snow clearing or de-icing equipment. A few oil refining and transshipment centers account for most US fuel. If one critical node fails, the fallout could be widespread. That is particularly true because infrastructure lies *below* everything else. It provides the surface that all other sectors move across. Infrastructure failures reverberate and create damaging feedback loops.¹⁶⁸

¹⁶⁰ *Oxford Economics* (2010).

¹⁶¹ *Ibid* p.2.

¹⁶² *Ibid*, 2.

¹⁶³ Belson, K. (2008).

¹⁶⁴ Electricity Consumers Resource Council (2004).

¹⁶⁵ *Ibid* p.4-5.

¹⁶⁶ *Ibid* p.6-7.

¹⁶⁷ *Ibid* p.1.

¹⁶⁸ See Goldin, I. and Mariathasan, M. (2014) for further discussion of the increasing complexity and vulnerability of infrastructure systems. See also Lerner, E. (2003).

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US Utilities: Addressing Potential Grid Failure Risks

Various US utilities spearhead initiatives both to reduce the risk of a grid failure, and to mitigate its potential impact to society. It is generally in the financial interest of the utilities to devote capital to these initiatives because companies typically earn a return on the investment. Likewise, North American Electric Reliability Corporation (NERC) and regional organizations coordinate extensive plans and drills to prepare for and respond to grid failure. Below are a few examples of preparation efforts.

Southern Company takes several steps to improve power reliability including the use of smart grid and smart transmission technology, cyber security measures, active vegetation management, transmission/ distribution upgrades, planning, self-healing transmission lines and security personnel. The company has developed extensive plans to respond to grid failures and power outages while actively monitoring the duration and frequency of outages (SAIDI and SAIFI). In addition to prevention, the company has contingency plans that include agreements with other utilities to respond and to deploy crews from throughout the US. In the event of a failure, smart technology enables the outage to be quickly pinpointed and addressed. In practice, during Hurricane Katrina, Plant Watson in Gulfport Mississippi was able to remain in operation due to its precautions including fortified storm centers, backup power, cyber security and technology driven dispatching.

In addition to the preventative and response measures that Exelon already has in place, the company is currently working on material investments in smart grid and smart meter programs to enhance resiliency of infrastructure and to minimize weather and other risks. To prepare for a large outage, Exelon has several contingency business planning programs in place to address all hazards that may occur from a business disruption. The company has also initiated black start capabilities at its facilities by adding diesel generators post 9/11. In the event of failure, in addition to working with system operators to address the challenge, Exelon provides several ancillary services including SmartGrid, VirtuWatt and Load Response to improve reliability of the grid. While all of the initiatives are designed to address historical causes of concern, the company's Corporate and Information Security Services department and corporate executives address both physical and cyber security issues based on international standards. Edison International undertakes a number of measures similar to Exelon and Southern Company but given its operations in California, the company has also worked to address forest fires and its associated challenges.

Cyber Security: Virtual System Risk in a Digitized World

Cyber risk and managing cyber security

Just as physical infrastructure is vulnerable to systemic failures, so too is cyberspace. In particular, global digital infrastructure may be damaged physically or be used as a vehicle to inflict damage intentionally. In the former, for example, in 2008 a ship's anchor in the Suez Canal managed to break a critical fiber optic cable, disrupting Internet connections throughout the Middle East and South Asia.¹⁶⁹ Similar outages have happened since, cutting off entire populations from the digital world marketplace. These outages can be avoided with geographic diversification of back-up routes and higher thresholds for cable stress testing. In an age where the loss of information technology can be life or death in health care, or can grind entire economies to a halt, it is no longer acceptable to maintain a system where one node failure can shut down the entire system.

¹⁶⁹ The Economist (2008).

In addition to accidental physical damage, the digital pathways linking us together can also be used intentionally to inflict serious damage across borders. Some hackers aim to spread chaos with software “worms,” “bots,” or viruses that take over computers, sometimes steal information, and spread quickly. Other hackers have political aims. Cyber attacks on Estonia (ostensibly in retaliation over removing a Soviet statue) occurred in 2007, creating substantial losses and even compromising high level government websites, including the site of the President. This was a wake-up call, particularly given that governments are increasingly relying upon networked computers to manage power supplies, direct traffic, and monitor power plants and oil pipelines.¹⁷⁰ All of these systems are vulnerable.

Firms and individuals are equally vulnerable to such attacks. The “waledac botnet” worm spread rapidly across the globe in March 2010 (taking control of hundreds of thousands of PCs capable of sending out an estimated 1.5 billion spam messages) before Microsoft was able to obtain the necessary legal injunctions to shut down the command and control servers.¹⁷¹ While the risk is not nearly as systemic for individuals, sabotage of coordinated payment processing, or leaks of sensitive consumer information could create long-term damage to attacked firms.

Governments may also actively employ digital sabotage against their enemies. For example, the Stuxnet virus apparently was created by foreign governments to deliberately damage a uranium enrichment facility in Iran.¹⁷² Similar attacks (and retaliatory responses) could certainly follow, with much broader ramifications.

Traditional tools to discourage aggressive and criminal behaviour are ineffective in cyberspace. The Internet allows attacks to be conducted under conditions of near perfect anonymity. It is very hard to trace the source of a particular security breach, since attacks are often conducted from compromised computers belonging to innocent bystanders. Even when an attack has been successfully traced, the evidence can be destroyed by a sophisticated cybercriminal. Moreover, there is no authoritative global governance oversight with a mandate to address cybercrime or shore up data protection and network integrity.¹⁷³

Ecological Spillovers: Systemic Risk in the Web of Life

Unlike finance, supply chains, infrastructure, and cyberspace, ecology has always been globalized. The impact of eliminating or diminishing a single species can echo across the food web and the ecosystem. Ecological damage affects us all. It makes us vulnerable. As climate change continues unabated and global temperatures creep relentlessly upward, oceans rise. More than half of the world’s population lives within 60 kilometers of the shoreline.¹⁷⁴ If the ice caps continue to melt, flooding, groundwater and crop contamination, and physical destruction could be catastrophic.¹⁷⁵ More immediately, fishery supplies present a looming crisis. Some 70% of the world’s fish species are either fully exploited or depleted, threatening the food supply of millions of people worldwide and inviting severe ecological spillover effects.¹⁷⁶

The complex interactions of society’s most basic needs requires long term systemic thinking in order to ensure the sustainable use of our basic resources

¹⁷⁰ Goldin, I. and Mariathasan, M. (2014).

¹⁷¹ Whitney, L. (2010).

¹⁷² Fildes, J. (2011).

¹⁷³ Goldin, I. and Mariathasan, M. (2014).

¹⁷⁴ WHO (2012a).

¹⁷⁵ Ibid.

¹⁷⁶ Nuttall, N. (2004).

The pattern is similar throughout ecosystems and the risk is growing. Global ecosystems provide us with food, water, resources, and climate control. Yet the Millennium Ecosystem Assessment has made it clear that we have seen a degradation of these critical systems more during the last 50 years than during any other point in human history.¹⁷⁷ Many resources which provide enormous financial benefits (and can create massive financial losses if depleted) are destroyed simply because their immediate financial cost/ benefit ratio is not specifically quantified or because the tragedy of the commons cannot be overcome.

Society's basic needs for food, water, and energy are all inextricably linked. Abrupt changes to the climate could spill over into food shortages, water shortages, and overtaxing of the energy grid. Without agreements over water management, agriculture may not be able to provide enough food for large segments of the world population. The complex interactions of society's most basic needs requires long-term systemic thinking in order to ensure the sustainable use of our basic resources.

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How Companies Tackle Ecological Risks: The Example of Australia

Many companies are involved in initiatives both to reduce the negative ecological impacts of their operations, and to mitigate ecological risks that face them.

Australian resources company Rio Tinto has been considering the physical risks of climate change for several years. Identified risks include cyclones, changes in precipitation (heavy rainfall/ droughts), temperature changes (including the impact on Arctic ice roads), and sea level rise. In recent years, wet weather, cyclones, and floods affected Rio's Australian coal, iron ore, and uranium operations, and drought affected its power costs in Quebec. Examples of Rio's adaptation include wind generation in the Arctic to reduce diesel trucking, and site specific initiatives to address surplus water. Rio has acknowledged that sustainable development contributes to its license to operate, which supports its access to people, resources, and capital. It has a group-wide target to reduce freshwater use and has completed periodic group-wide water risk assessments, focusing on water stressed regions. Operations are required to measure water use, reduce potential impacts on water resources, and understand current and future water requirements of upstream and downstream stakeholders. Businesses with significant water risk must have long-term water strategies and water management plans. Rio recognizes that external expectations around the private sector's management of biodiversity are growing therefore it aims to achieve a net positive impact (NPI) on biodiversity in regions where it operates, and to outweigh the inevitable disturbances and impacts associated with mining and mineral processing. Its "mitigation hierarchy" involves avoiding, reducing, restoring, compensating, and then seeking additional opportunities to contribute to local conservation.

Woolworths, a major supermarket chain, has a sustainable seafood initiative underway with the aim to ensure that all its seafood comes from sustainable sources. The company notes that, for wild caught fish, sustainable seafood is generally sourced from fish stock that are in abundance using methods that do not damage ocean habitats or catch large volumes of non-target species (bycatch), while sustainable farmed seafood is grown in aquaculture systems that do not destroy coastal habitats or depend on overfished wild caught fisheries as feed. Healthy oceans, sustainable fish stock and a viable fishing industry are all essential to Woolworths business well into the future. The company's ambition is to have all its wild-caught seafood range Marine Stewardship Council (MSC) certified in the long term, to implement certain sustainable practices for catching tuna to reduce bycatch and juveniles, and to have its farmed seafood certified to sustainable farming practices by credible third party certification schemes by 2015.

¹⁷⁷ UNEP (2005).

Woolworths and Wesfarmers (Coles) are members of the Roundtable on Sustainable Palm Oil (RSPO) and have committed to sourcing only RSPO certified sustainable palm oil in their own-brand products by 2015. Palm oil is under scrutiny since unsustainable practices can have negative impacts on deforestation, biodiversity, and local communities. The companies currently also use Green Palm certificates, have increased transparency of labelling palm oil in their products, and have introduced some new products that avoid palm oil. However, buyers cite a gap between the quantities of RSPO required by all product manufacturers and the amount that is available, and are working with suppliers to secure a supply of sustainable palm oil.

The risks posed by pandemics to society and business

Public Health: Pandemic Risk in the Global Village

Pandemics also pose a major threat to business. When the first case of SARS occurred in November 2002, in the Guangdong province of China, the virulence of the disease quickly resulted in an epidemic – incidences were reported throughout Guangdong, but mostly remained localized around one epicentre.¹⁷⁸ For most of human history, this would have been the end of the story. But for most of human history cases like that of Liu Jianlun were not possible. Liu, a 64 year-old doctor, who had treated SARS patients in Guangdong, travelled to Hong Kong on February 17, 2003. While staying at an elite hotel, he unknowingly infected dozens of guests, who then infected others locally, and flew around the world. In a matter of a few months, SARS patients had been identified in all continents, with 8,400 cases were reported in 30 countries.

Yet, as Larry Brilliant notes, “SARS is the pandemic that didn’t occur.”¹⁷⁹ That was lucky. The Spanish Influenza of 1918-1920 killed an estimated 50 million people (though estimates range as high as 100 million).¹⁸⁰ If a similarly virulent, deadly pathogen emerged today, it would spread much more quickly. Even though health care has improved dramatically since 1920, system capacity could easily be overwhelmed making the disease equally deadly.

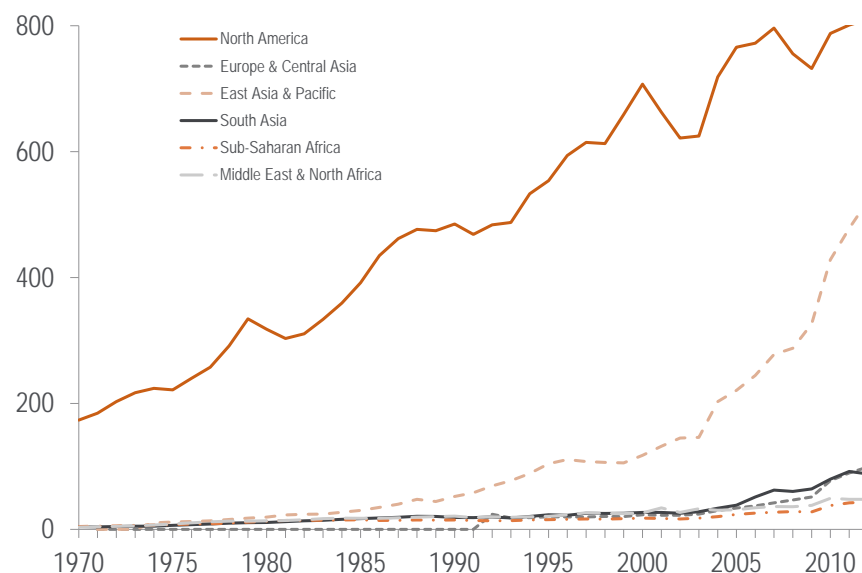
Not only could such illness bring output to a standstill, but outbreaks elsewhere could also severely disrupt supply chains a world away. Recent scares, (such as swine flu, bird flu, and SARS), have fortunately had substantial but not devastating impacts.

¹⁷⁸ This paragraph draws on Fleck, F. (2003)

¹⁷⁹ Brilliant, L. (2006).

¹⁸⁰ Johnson, NP and Mueller, J. (2002).

Figure 26. Growth in global air traffic by region (millions of passengers carried)



Source: World Bank (2013d)

Not only does the ease of global travel make every passenger a possible vector, but substantially higher levels of urbanization and population density has made rapid, widespread pathogen transmission a near certainty.¹⁸¹ Pandemics can spread more quickly now than ever before in human history. Just over four decades ago, the world did not know HIV, Hepatitis C or, currently topical, Ebola. Forecasting what diseases we may face in the 21st century is impossible and highly uncertain. But we can be certain that unless pandemic risk is mitigated, episodes like SARS could seem like a test run relative to future health crises.

Systemic Risk and Inequality: Political Stability in an Era of Disruption

Within virtually all countries, rich and poor alike, inequality is increasing

As globalization continues to rapidly change social, cultural, and political systems everywhere, the effects are uneven. Despite very wide absolute differences in incomes, there is convergence *between* the average incomes of most, but certainly not all, developing countries and the more advanced OECD economies. However, *within* virtually all countries, rich and poor alike, inequality is increasing.¹⁸²

If globalization leaves people out in the cold, they will not feel vested in the preservation of the system. It is not an accident that only three of the 27 democratically elected leaders in Europe in 2007, just prior to the financial crisis, were still in office five years later.¹⁸³ When the global system exacerbates inequality — both within and between countries — political and economic instability may follow. In May 2013 elections in the UK, for example, 23% of voters cast ballots for the far right, isolationist United Kingdom Independence Party.¹⁸⁴ Globalization, they

¹⁸¹ Goldin, I. and Mariathan, M. (2014).

¹⁸² For a much more in-depth discussion, see Goldin, I. and Mariathan, M. (2014) and Milanovic. (2011).

¹⁸³ The Economist (2012b).

¹⁸⁴ BBC News (2013b).

Protest movements are indicative of growing social unease around income inequality

felt, had turned its back on them, so they began to turn their back on globalization.¹⁸⁵

The connectivity facilitated by increased usage of mobile phones enables the spread of information and political mobilization. Protest movements in the Middle East, China and Russia are indicative of this growing trend. Authoritarian regimes also utilize the powers of digital communications to thwart attempts at dissent. This powerful network of information acts as a catalyst turning individual actions into possible mass movements.

Moreover, the more connected we are, the more that global differences in living standards and opportunities are apparent. Many feel they have little chance of succeeding in the existing global system. The Occupy (Wall Street) movement is but one example, demonstrating increasing disillusionment with what the protestors perceive to be a system that disproportionately rewards those at the top. It was born out of the feeling that the common citizen was footing the bill for those who seemed responsible for the financial crisis.¹⁸⁶

Disillusionment introduces risk and volatility. A fraying social fabric in one location can spill over into another.¹⁸⁷ Globalization and social exclusion is not a recipe for strong markets and stable futures.

Prevention and Preparation

Prevention and preparation

Businesses have a clear interest in understanding and preventing systemic risk, or at least preparing for the unavoidable. As we become more connected, we are also more vulnerable to the consequences of severed connections and spillover effects — in finance, supply chains, infrastructure, cyberspace, ecology, pandemics, and political upheaval borne by inequality. Long-term profitability may demand short-term investments.

The Oxford Martin Commission for Future Generations report *Now for the Long Term* examined global trends and risks and proposed a series of actions to overcome the gridlock in the global management of systemic risks. While some may object that we cannot afford such prescient upfront investments, the reality is that we certainly cannot afford to bear the costs of system failures. Prevention and preparation are paramount in the 21st century.¹⁸⁸

¹⁸⁵ For more information on the rise of non-traditional political parties, see *Taking it to the Streets* (Citi GPS 2014c)

¹⁸⁶ Goldin, I. and Mariathasan, M. (2014).

¹⁸⁷ The Arab Spring is a clear example of how disillusionment can spread. A similar contagion could occur with those who feel left out from globalization, rising up against existing market structures.

¹⁸⁸ Oxford Martin School (2013).

National governments cannot individually address high stakes transnational risks while international organizations are poorly prepared to manage, mitigate and govern 21st century risk

6. Global Governance: Why it's Failing and What We Can Do

"It was the best of times, it was the worst of times, it was the age of wisdom, it was the age of foolishness . . . it was the spring of hope, it was the winter of despair."¹⁸⁹ Charles Dickens' words, written in 1859, could not be more prescient for the 21st century. The 21st century could be the best of times in human history, but could also be the worst of times. Understanding the impending challenges and adapting global governance to cope with them will determine which course we follow.

All of the challenges cited in this report — globalization, migration, demographic change, new frontiers of technology, economic growth, and systemic risk — demand good global governance. With proper oversight, these changes could usher in an era of unprecedented global prosperity, but without proper management, rapid and accelerating change could prove disastrous.

The financial crisis that started in 2008 was the first of the systemic crises of the 21st century. It will certainly not be the last. Relatively small financial meltdowns — even those isolated within a given sub-sector of the economy — can now wreak global havoc. Our lack of preparation was only matched by our collective hubris. For example, Robert Lucas, a Nobel Prize winner, claimed in his 2003 presidential address to the American Economic Association that the "central problem of depression-prevention has been solved ... and has in fact been solved for many decades".¹⁹⁰ Five years later, world markets crashed.

As the financial crisis contagion spread, a swine flu epidemic emerged in Mexico, subsequently crisscrossing the globe with alarming speed. Disease can spread faster now than any point in human history given the incredible breadth, volume, and frequency of global air travel. The next pandemic could be far worse and the World Health Organization (WHO) is not ready.

Cyber attacks have become commonplace, but none have yet been catastrophic. That is unlikely to be true throughout the 21st century. Troves of data entrusted to online databases have boosted productivity, accelerated growth, and unlocked latent potential. But those systems also make us vulnerable. There is no authoritative international organization with a firm mandate to address these risks.

The failures of climate change talks and trade negotiations also loom large. International cooperation has time and again proven itself largely impotent in the face of preventable catastrophes.

In short, all of these systemic risks (and others outlined in the previous chapter) are stitched together by two common threads. First, national governments cannot address such high stakes transnational risks. Second, international organizations are worryingly unprepared to manage, mitigate, and govern 21st century risk.

The alphabet soup of global governance agencies currently in place is alarmingly outdated. The World Bank and International Monetary Fund (IMF) were founded in 1944, aimed at resurrecting economic growth and cooperation from the ashes of World War II.¹⁹¹ The United Nations followed a year later, formed of 50 nations attempting to manage the fallout as the war came to a close. There are now 193 member states. The five permanent members of the Security Council were and continue to be the Allied victors: China, the United States, the United Kingdom, France, and Russia.

¹⁸⁹ Dickens, C. (2011) p. 5.

¹⁹⁰ Lucas, R. (2003).

¹⁹¹ IMF (2013b).

The institutions of global governance came into being during a different era

The world has changed and will change further. By 2030, the world order enshrined in post-war global governance frameworks will be even more outdated. By then, the five largest economic global powers will be China, the United States, India, Japan, and Brazil or Germany in fifth place—a clear mismatch with the Security Council members.¹⁹² When the UN was created in 1945, there were fewer than 2.5 billion people alive; today there are over 7 billion.¹⁹³ World GDP was just over \$7 trillion; today it is over \$71 trillion.¹⁹⁴ Africa had four independent countries; today there are 54.¹⁹⁵ The web was where a spider lived and a tweet was a sound a bird made. Clearly, the institutions of global governance came into being and were designed for a different era. In short, globalization means that change follows a calendar of seconds, minutes, or days. Global governance reform follows a (often stalled) calendar of decades. The resulting mismatch is one of the biggest risks of the 21st century. A computer cannot be fixed at a typewriter repair shop, just as 21st century problems cannot be governed by 20th century institutions.

This does not mean that global governance institutions are useless; quite the contrary is true and their contributions to global peace, security, and economic growth have been critical components of recent progress. However, as their mandates have mushroomed and their missions have contorted, old structures are being asked to tackle new problems. In many instances, the reforms aimed to accommodate these emerging challenges are akin to rearranging the deck chairs on the *Titanic*. Most reform proposals are simply gathering dust on a UN shelf. Hyper-connectedness requires hyper-coordination and cooperation. A much more aggressive overhaul of global governance is imperative if we are to overcome the tremendous new challenges facing our planet and its citizens and harness the vast potential offered by the 21st century.

Unfortunately, as the pace of policymaking accelerates, politicians struggle to simply keep up. Looking ahead and planning for the future is increasingly viewed as a luxury, not a necessity.¹⁹⁷ What is needed and what will likely happen are, as usual, sadly divergent — A Tale of Two Visions — one likely, one ideal.¹⁹⁸

What is Likely: The Failures of Global Conferences Carried Forward

The example of climate change talks

Recent efforts at tackling global problems have largely failed. Recent experiences with climate change talks offer an illustrative example. From the Rio Conference in 1992 to subsequent efforts in Durban, Doha, and Rio+20, there has been significant agreement on identifying the problems, significant agreement on what the appropriate solutions are, and infinitesimal movement toward meaningful action that will actually stop the world's climate from heating up to crippling, potentially catastrophic levels (Figure 27).¹⁹⁹ A temperature rise above two degrees Celsius brings with it large risks of severe droughts, heat waves, and devastating floods, not to mention the destruction and disruption of ecosystems that we rely on for our survival.²⁰⁰

¹⁹² Price Waterhouse Cooper (2013).

¹⁹³ U.S. Census Bureau (2012a) Available at:

http://www.census.gov/population/international/data/worldpop/table_population.php.

¹⁹⁴ In constant \$ 2012.

¹⁹⁵ Estimates from Maddison, A. (2013).

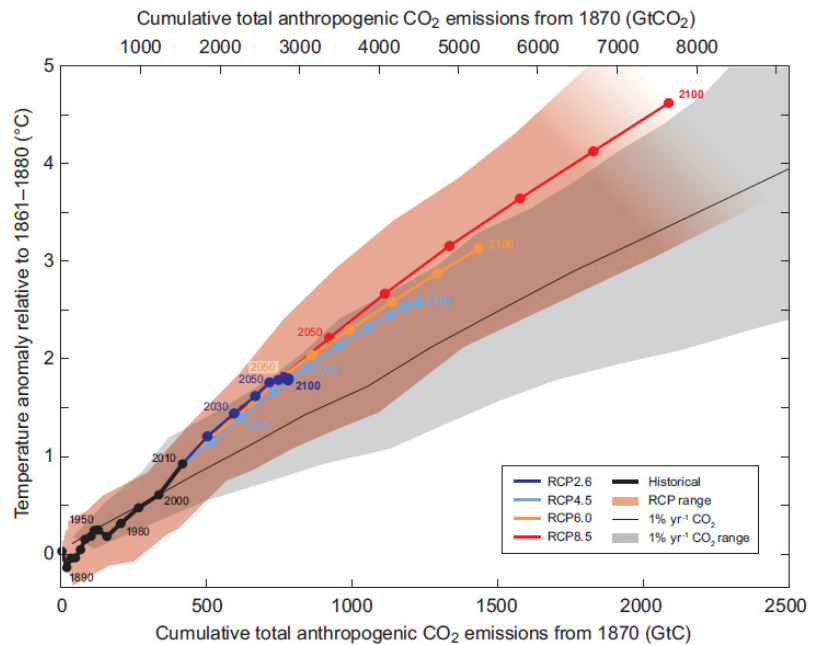
¹⁹⁶ Only Liberia, South Africa, Egypt, and Ethiopia were independent prior to 1950.

¹⁹⁷ Oxford Martin School (2013).

¹⁹⁸ Goldin, I., (2013).

¹⁹⁹ World Bank (2012b).

²⁰⁰ Ibid, p. xiv.

Figure 27. Cumulative total of anthropogenic CO₂ emissions and global temperature change

Source: IPCC (2013), p. 28

Trade negotiations offer another example of lackluster talks. The Doha round of negotiations, which began in 2001, has since stalled. Debates over agriculture, industrial tariffs, non-tariff barriers, and trade remedies have proven to be an unbridgeable gulf, particularly between the main developed economies and the emerging powerhouses of the developing world. The breakdown of talks has been so damaging that it prompted the then WTO Director-General Pascal Lamy to ask members to think hard about “the consequences of throwing away ten years of solid multilateral work”.²⁰¹

Whether it is climate talks or trade negotiations, the trend is clear: concerted action at the global level is frequently more talk than action. Results have been limited, and the perils still lurk.

There is no immediate consequence to inaction while the necessary costs of appropriate action are immediate

This happens for a variety of reasons. Some nation-states are myopic; their gaze is drawn to satisfying short-term needs of domestic constituencies rather than a long-term global vision of shared prosperity. Others are beholden to self-interest. Rising sea levels do not pose the same threat to landlocked Mongolia as they do to the Maldives or Nauru. But most importantly, there is no immediate consequence to inaction while the necessary costs of appropriate action are immediate. Until this “time horizon” issue is dealt with by tying inaction to steep upfront costs through appropriate regulatory mechanisms, nation-states will be free to ride the wave of irresponsibility as it not only washes away coastal cities but also our future.

The bottom line is simple: existing institutions do not provide a sufficiently robust framework to tackle inevitable rapid global change. The nations currently piloting global governance organizations are not the same as the nations that will drive the 21st century global economy. Current incentive structures promote inaction rather than action. And there is no meaningful framework for punishment for those that fail to act or simply free ride. Unaddressed, these trends spell a “worst of times” future.

²⁰¹ WTO (2011).

Five criteria for better governance

What is Needed: Five Criteria for Better Governance²⁰²

While the global institutions of today are overloaded and simple reforms will not suffice, there is still hope. Global governance requires radical reform. When old institutions cannot cope with important new challenges (for example, in dealing with international migration or global cyber security) they should be reformed or closed. Global governance organizations, old and new, need to be given the power, legal authority, and funding to act quickly and decisively, as nimble responses will be required to diffuse crises that can be born in an instant but be destructive for years. This will not only require some governments ceding authority when they do not wish to, it will also warrant substantially more coordination between all levels of governance — local, regional, national, international, and global. We live in an era where a pandemic can start in a village and be global within a few days, or a financial crisis in one country can send shockwaves through the global economy for years. The luxuries of a system of rigid, entrenched territoriality and national sovereignty are no longer luxuries we can afford. After all, even the richest countries were not well equipped to cope with the challenges of a systemic financial collapse on their own.

The lessons of today's failures give rise to the prescriptions for tomorrow. In particular, five principles (developed in collaboration with my Oxford colleague Ngaire Woods) should be applied to all reforms of global governance and they should be implemented aggressively and swiftly.²⁰³

First, it is important to scale our responses appropriately so that only global problems are met with global action. Sovereign states and local leaders are best equipped to deal with internal problems. Discerning the appropriate actor for each challenge is critical not only in improving effective governance but also in unnecessarily stepping on the toes of sovereign nations.

Second, all major countries that affect any given global issue *must* be involved in the negotiated regulation of that problem. Any agreement on climate change, for example, is meaningless if China or the United States — the two largest emitters of CO₂ gas — are not involved. International pressure must be used to bring the biggest players to the table and bind them in mutually agreed regulation.

Third, while the key players must be included, minimizing the extraneous number of seats at the table is preferable — negotiations conducted with more than a hundred countries rarely bear fruit. For the sake of nimble, agile, and swift responses, only the critical member states need be involved. Again, to take climate change as an example, the slowly sinking islands of the Maldives should be involved on any negotiations of how to mitigate the impact of rising sea levels, but should be left out of talks on an agreement of how to curb emissions among the major polluters. Small groups of countries with a vested interest in a certain issue will be more successful at finding consensus rather than gridlock.

Fourth, legitimacy is paramount in any global governance decision-making. Member states may disagree over what the rules of the game should be, but it is essential that they accept the authority of the referees. If the governance institutions are more legitimate in the eyes of regulated member states, they are far more likely to cede power to them and fund them — greatly increasing the chances of good outcomes.

²⁰² Goldin, I., (2013)

²⁰³ See Goldin, I., (2013) for a more thorough analysis of these policy principles. See also Oxford Martin School (2013) for a discussion of creative coalitions and new ways to break the gridlock in global affairs.

Fifth, enforceability underlies all of the previous four principles. If agencies exist to debate rules that will never be enforced, their work is bureaucratic waste. The world is becoming full of increasing amounts of hot air anyway; it would be unwise to add to that surplus with politicians wasting their breath on regulations that lack teeth.

If these principles are adopted, aggressively and swiftly, there is cause for tremendous optimism. We may stave off the systemic risks inherent in the 21st century and unleash unprecedented growth and shared prosperity. The principle that “united we stand, divided we fall,” has never rung more true. Cooperation borne of mutual long-term self-interest will allow the 21st century to be an era of prosperity, growth, and strong yields on investments. Divisive shortsightedness may spell our demise, or at least financial collapse and global insecurity.

Conclusion: Seize Opportunities and Manage Risk

Ranking Opportunities and Risks

Ranking opportunities and risks

The megatrends identified in this report represent substantial structural changes that will shape the global economy and society for decades to come. Over the next five to ten years, the early implications of these structural changes provide great opportunities for businesses and investors. They also could give rise to a number of near term risks. Ensuring that one is able to seize the positive opportunities and build resilience against the downside risks will require an open mind which welcomes discovery and learning. The pace of change requires higher degrees of alertness and sensitivity to the early signals. Global companies are particularly well placed to benefit from the rising opportunities. However, seizing the opportunities and mitigating the risks will require a change in practices. Perhaps most important is the reform of human resource management to build diverse international teams with localized knowledge.

Figure 28. Ranking of short term opportunities and risks

Rank	Opportunities	Risks
1	Global markets and growth	Pandemics
2	Emerging new middle class	Cyber security
3	Fast growing megacities	Supply chain failure
4	Favorable demographics	Financial turmoil
5	Machine to machine communications	Natural disasters

Source: Citi GPS.

Harnessing the Opportunities

Harnessing the increased integration of world markets

The greatest opportunity for firms and investors is the increased integration of world markets and the potential this brings for global growth. Existing hubs of growth are likely to remain as the fastest growing economies in the near term. Investors should ensure they have sufficient exposure to these markets. Firms should continue to seek access to emerging markets, negotiating trade arrangements, suitably locating production, and innovating with new products and services that cater to these markets.

Benefitting from an emergent middle class

The rapidly growing middle class will unlock unprecedented demand for a wide range of consumer products. By 2050, it is expected that the middle class' share of global consumption will grow from one-third to two-thirds.²⁰⁴ In the short and longer term, this represents a shift away from catering to basic needs and a movement up the value chain to products that are dependent on consumer preferences. Brand recognition, reputation, and local knowledge of specific cultures are going to play a growing role in determining success within these markets. The emerging middle class could provide a much-needed impetus for balanced global growth by boosting consumption, investing in health, education and renewable energy, and driving higher productivity and sustainable economic development. The risk for society is that if some companies and governments fail to take advantage of this opportunity it may widen the gap between nations and compound both environmental and other dangers. Increased consumption will add immense strain to scarce natural resources, at the same time it will create opportunities in making existing consumption patterns more sustainable.

²⁰⁴ See HSBC Bank (2012). As defined on the basis of absolute household income of USD\$3,000-15,000.

The rise in incomes in the emerging middle class is facilitated by urbanization

Already one in 25 people live in a megacity.²⁰⁵ By 2025 the fraction of the world's population living in cities is expected rise to 70%.²⁰⁶ The rise in incomes in the emerging middle class is facilitated by urbanization. This in turn creates new demand for goods and services specific to the urbanized economy. Infrastructure investment, logistics, and urban transport systems will be among the sectors that will enable the growth of megacities. As incomes rise in urban environments demand for energy, water, sewerage, and other services rises rapidly, placing pressure on existing utilities. The upgrading of infrastructure to cope with a doubling of incomes and population in many cities within one to two decades, offers wide ranging opportunities for utilities and project finance.

Growth of service sectors and branded goods

Higher incomes and rising education levels and expectations will be associated with particularly rapid growth in the service sector, including restaurants, tourism, and retail sales. As incomes rise beyond levels where basic needs need to be satisfied, individuals with greater disposable income increasingly will choose goods and services which offer psychological as well as material satisfaction. In this context, branded and luxury goods and services will see significant growth among the new 4 billion middle class global consumers, with over three quarters of this growth in demand arising in Asia.

Harnessing demographic trends

In labor markets, the advanced economies and certain emerging markets, such as China, are experiencing a closing of their “demographic window”, while in other countries it is opening. This “window” can usher in a period of comparatively high growth—as the share of workers relative to dependents in a country has significant implications for macroeconomic balances and competitiveness. This in turn can have important consequences for corporate profitability and investment prospects. Increases in average life expectancy and declines in fertility also change the composition of expenditure. Sectors such as health care and leisure benefit from a greater number of elderly consumers. Smaller families with rapidly rising incomes are likely to spend more of their rising disposable income on private education, branded clothing, and pets. The implications for financial markets will also be significant, as long term savings absorb a greater share of individuals’ assets. This may be expected to make bond markets more liquid, as people with longer perspectives in a world of systemic risk invest in more stable financial instruments.²⁰⁷

Machine to machine intelligence is a great technological opportunity

One example of the coming technological opportunity is machine to machine intelligence. It is estimated that by 2020, over 50 billion devices will be connected to the Internet.²⁰⁸ The falling cost of communication devices combined with the use of the Internet and cloud computing now allows any device to be equipped with a communications module. Applications that utilize these rich data sources have the potential to open new possibilities of products and enhance delivery of existing services. Sensors in transport systems have allowed the delivery of new means of transport in cities such as bicycle sharing systems found in London and Paris. In health care, pill shaped micro-cameras are ingested to send thousands of images of the digestive tract back to doctors to pinpoint the source of infection, while wireless transmitters will allow us to monitor the taking of tablets by older people and other patients at home. In supply chain management, RFID (radio-frequency identification) tags are placed on products to track their location, improving inventory management while reducing working capital and logistics costs. The

²⁰⁵ A megacity is defined as a city that has a population greater than 10 million. Goldin, I. and Mariathasan, M. (2014).

²⁰⁶ Ibid.

²⁰⁷ Stothard, M. (2013).

²⁰⁸ OECD (2012).

combination of more automation in systems and the collection of real time information needs specialist knowledge and skills to unlock value. Investors and corporations should ensure that they have sufficient systems and personnel in place to monitor and take advantage of this fast changing aspect of technological change.

Understanding the Risks

Pandemics as a high level risk that must be taken seriously

In terms of likelihood and potential damage that may be caused, pandemics pose a significant risk to both global health and economic stability. Never before have dangerous pathogens traveled so freely, stowing away inside unsuspecting people and animals in airliners, cars, trucks, ships, and trains as they crisscross thousands of miles, spanning the globe with ease. With around 40 new infectious diseases discovered in the past 40 years, of which SARS, HIV and different types of influenza are but three, the concern about further new pandemics is not a case of if but when.²⁰⁹

Integrated supply chains and financial systems mean that the spread of a pandemic could bring the global economic system to its knees—just imagine the implications of a severe pandemic on Wall Street or the City of London. It is likely that any affected areas may become isolated for some period of time. Companies must ensure that no single geographic location is 'too big to fail' in their system and should consider contingency plans if such an event were to occur. Risks such as pandemics expand a chief officer's remit to include new risks that increasingly may arise not only from outside the company but possibly also from distant parts of the world. Practical steps can also be taken to ensure best practice in the workplace, for example, ensuring that workers do not come into work when not feeling well and approaching the vulnerability of their computer and data systems with similar concerns regarding contagion as apply to personal health. The costs of preventative education and precautionary actions typically are very small relative to the consequences of systemic risks. Given the pressures for short-term results, ensuring resilience for the longer term requires educating analysts, shareholders, and other stakeholders that investments in resilience are in the longer term interests of investors, firms, and employees.

The threat of cyber attack

In an increasingly digitized world, the vulnerability of everyday goods and services to cyber attack marks a new challenge facing governments, businesses and individuals. With increasing amounts of valuable information stored online, threats of theft and malicious attacks pose significant risks. With the speed of cyber attacks, businesses must have real time monitoring systems and the ability to respond to such attacks in a matter of minutes. The need to identify malicious cyber attacks comes from both outside and inside firms. Additionally, management of reputational risks associated with cyber attacks must also occur in real time due to highly connected consumers who may herd behind rumors and false information. Companies that store customer information should be particularly concerned with achieving best in class status on data security and internal procedures. In this complex new area, specialist advice and expertise is needed.

Security of computing systems is integral to managing integrated global supply chains. However, these systems face further risks associated with small failures in one part of the system causing spillovers onto the rest of production. The example of Intel's \$1 billion loss due to flooding in Thailand is instructive.²¹⁰ Contingency plans are necessary if production security is to be maintained. Furthermore, as

²⁰⁹ Oxford Martin School (2013).

²¹⁰ World Economic Forum (2012a).

businesses attempt to minimize costs along the supply chain by reducing inventories, they increase the risk of cascading failure. There is an inherent trade-off. Too lean and the risk of cascading failure outweighs the economic benefits from security of production, but inventories that are too large impose higher costs on businesses and ultimately on consumers. The ideal level for different businesses will vary but stakeholders should be educated to ensure that necessary precautions are not misconstrued as poor management. In the auto industry this transition appears already to be well advanced, with redundancies in supply chains and the sourcing of alternative suppliers providing added resilience, and also leading to new competitive pressures on suppliers which can offset the costs to the industry of the addition of supply options.

Firms should proactively engage with their shareholders to explain their risk mitigation strategies

The growth of global markets has depended on the development of the financial sector. The recent financial crisis spilled over rapidly to other sectors in the economy causing a prolonged fall in global output. Going forward, it is vital that credit lines stay open to ensure the functioning of the world economy. Companies should not be overexposed to any individual financial institution and should have access to contingency credit lines. Firms should proactively engage with their shareholders to explain their mitigation strategies. Closer communication between shareholders and management can be critical in avoiding harmful effects of a crash in equity or debt funding and in explaining the need for costly investments which build resilience.

Natural disasters are increasing in frequency and imposing higher costs on society due to increased interconnectedness and the density of population and assets

Natural disasters are increasing in frequency and imposing higher costs on society due to increased interconnectedness and the density of population and assets, not least in vulnerable locations, such as low-lying urban centers.²¹¹ With integrated supply chains, even localized flooding has the potential to disrupt the delivery of products on the other side of the world. With prediction of the timings and locations of such disasters impossible, companies need to construct resilient crisis management systems and seek geographic diversity and security in choosing locations of production. Insurance markets may play a crucial role in hedging some of this risk. The World Bank Group is among the organizations that have developed products to pool multiple perils in multiple regions and access international capital markets for cheaper insurance against natural disasters. In 2009, Mexico issued a \$290 million bond to provide parametric insurance against earthquake, Pacific hurricane and Atlantic hurricane risks in three specific regions.²¹² The bond was well received by the market. All tranches were oversubscribed and investors were broadly distributed around the world. Sustainability requires that businesses undertake preventative measures to ensure resilience in their supply chains, human resources, capital, and all other mission critical aspects of their activities.

²¹¹ EM-DAT (2011).

²¹² World Bank (2011).

About the Oxford Martin School



The Oxford Martin School at the University of Oxford is a world-leading center of pioneering interdisciplinary research on the major challenges facing humanity.

No other university or institution hosts a research body like the Oxford Martin School. Its community of more than 300 researchers, from Oxford and beyond, is working to address the most pressing global challenges and opportunities of the 21st century. Each research program brings together academics from different disciplines which can provide fresh perspectives on complex global issues. With more than 30 programs, the Oxford Martin School develops mold-breaking research on a wide range of subjects. These include the future of the global financial system, cybersecurity, demographic change, the future of food and farming, the implications and mitigation of climate change, and the applications of innovation in healthcare.

The unifying criteria for membership of the School is that to qualify for its support research must be of the highest academic caliber; tackle issues of a global scale; have a real impact beyond academia; and require interdisciplinary perspectives to tackle the challenge.

Why?

The great challenges of our time — such as population growth, climate change, disease and inequality — share one feature. They cannot be understood and tackled by any one academic field alone. This common factor makes these challenges difficult for individuals, businesses, governments and societies to address.

The School was founded in 2005. It was made possible through the vision and generosity of Dr James Martin (1933-2013). Dr Martin believed that this century, and specifically the next two decades, will be a crucial turning point for humanity. He understood that we now have the power to destroy possibilities for future generations but, equally, we have the potential to improve dramatically the wellbeing of people across the planet. It is this combination of urgency and optimism that characterizes all the work at the Oxford Martin School.

Impact

The Oxford Martin School provides academics with the time, space and means to work collaboratively and engage effectively with business leaders, policy makers and practitioners. Its events and online resources aim to increase public understanding of the most pressing challenges of our time.

The Oxford Martin School faculty has demonstrated a strong record in informing thinking on significant global policy issues. At the global level, its experts are engaged with numerous international agencies and activities, advise multinational businesses and are involved in policy formulation in over twenty countries. They have helped develop alternatives to tackling climate change beyond the Kyoto Protocol; provided advice to the World Health Organization on understanding and combating dangerous global pandemics; and contributed to new rules to improve global financial stability. In the United Kingdom, Oxford Martin School academics regularly provide expert testimony to parliamentary hearings and have been advising the Prime Minister and cabinet members on strategic science and technology policy issues.

The Oxford Martin School regularly works in partnership with governments, the private sector, think tanks, inter-governmental and non-governmental organizations, fostering networks for exchange and advice.

The Oxford Martin School's flagship policy initiatives focus on critical gaps where its innovative research and interdisciplinary ethos are uniquely placed to influence decision making. Its policy papers distil researchers' recommendations to inform evidence-based policy making. The Oxford Martin Commission for Future Generations convened 19 global political and business leaders concerned about increasing short-termism in politics and business. The Commission was chaired by Pascal Lamy, the former Director-General of the World Trade Organization. Reporting in 2013, the Oxford Martin Commission for Future Generations' report, *Now for the Long Term*, proposed 15 practical recommendations aimed at creating a better world for future generations. It has been accessed online in 171 countries more than one million times.

For further information, please visit the Oxford Martin School website: www.oxfordmartin.ox.ac.uk or email info@oxfordmartin.ox.ac.uk

References

ABS Materials (2013) "Osorb" Accessed August 18, 2013. Available at: <http://www.absmaterials.com/osorb>

Adamy, J. and McGinty, T. (2012) "The Crushing Cost of Care," *The Wall Street Journal*, July 6, 2012. Available at: <http://online.wsj.com/article/SB10001424052702304441404577483050976766184.html>

African Elections Database (2012) "*Electoral Democracies in Sub-Saharan Africa*." Available at: http://africanelections.tripod.com/electoral_democracies.html

Agence France Presse (2010) "Scientists Develop Cancer Breath Test," *Agence France Presse*. August 11, 2010. Available at: <http://www.google.com/hostednews/afp/article/ALeqM5hruR9qdIHNz1WYwrGPID7yHFiNXQ>

Aiken, LH et al. (2004) "Trends In International Nurse Migration," *Health Affairs*, 23(3), 69-77.

Anderson, K. and Lomborg, B., (2008) "Free Trade, Free Labour, Free Growth," *Project Syndicate*. Available at: <http://www.project-syndicate.org/commentary/anderson1>

Asia Development Bank (2011) "*Asia 2050: Realizing the Asian Century*." Available at: <http://www.adb.org/publications/asia-2050-realizing-asian-century>

AUGUR (2013) "Europe in the World: 2030," *The AUGUR Project and the European Commission*." Available at: http://www.augurproject.eu/IMG/pdf/Executive_summary_final.pdf.

Barnes, B. (2012) "Hollywood Rebounds at the Box Office," *The New York Times*, December 23, 2012. Available at: <http://www.nytimes.com/2012/12/24/business/media/hollywood-rebounds-at-the-box-office.html?pagewanted=all>

BBC News (2013a) "Q&A: Schengen Agreement," *BBC News*, March 4, 2013. Available at: <http://www.bbc.co.uk/news/world-europe-13194723>

BBC News (2013b) "Local Elections: Nigel Farage Hails Results as a 'Game Changer,'" *BBC News*, May 3, 2013. Available at: <http://www.bbc.co.uk/news/uk-politics-22382098>.

Belson, K. (2008) "'03 Blackout Is Recalled, Amid Lessons Learned," *The New York Times*, August 16, 2008.

Bloom, D., Canning, D. and Fink, G. (2011) "Implications of Population Aging for Economic Growth," *Harvard Program on the Global Demography of Aging Working Paper*, 64 (2011), 1-36.

Bloomberg News (2013) "Why 3D Printing Can Make the World a Better Place," *Bloomberg News*. May 16, 2013. Available at: www.businessweek.com/printer/articles/117256-bloomberg-view-why-3d-printing-can-make-the-world-a-better-place

Boston Consulting Group (2011) “*Made in America, Again.*” Available at: <http://www.bcg.com/documents/file84471.pdf>

Bourzac, K. (2011) “New Type of Drug Kills Antibiotic-Resistant Bacteria,” *MIT Technology Review*, April 5, 2011. Available at: <http://www.technologyreview.com/news/423539/new-type-of-drug-kills-antibiotic-resistant-bacteria/>

Boyle, R. (2012) “7 Amazing Nanoparticles Changing Our Lives,” *Popular Science*. Available at: <http://www.popsoci.com/science/gallery/2012-11/7-amazing-nanoparticles-changing-our-lives>

Brown, A. (2013) “In US, Average Retirement Age Up to 61,” *Gallup Economy*, July 15, 2013. Available at: <http://www.gallup.com/poll/162560/average-retirement-age.aspx>

Brilliant, L. (2006) “Larry Brilliant Wants to Stop Pandemics,” *TED Talks*, February 2006.

Buiter, W.H. and Rahbari, E. “*Global Growth Generators; Moving Beyond Emerging Markets’ and ‘BRICS’*,” Citi Research 2011

Buiter, W.H. and Rahbari, E. “*The Long-Run Decline in Advanced Economy Investment*,” Citi Research June 2014

Centre for the Study of Financial Inclusion (2013) “*Looking Through the Demographic Window: Implications for Financial Inclusion.*” Available at: http://centerforfinancialinclusionblog.files.wordpress.com/2013/02/looking_through_the_demographic_window.pdf

Chateau, J., Rebolledo, C. and Dellink, R. (2011) “An Economic Projection to 2050: The OECD ENV-Linkages Model Baseline,” *OECD Environment Working Papers*, No. 41, OECD Publishing. Available at: <http://dx.doi.org/10.1787/5kg0ndkjvfhf-en>

Citi GPS (2011) “*Trade Transformed: The Emerging New Corridors of Trade Power*”

Citi GPS (2012a) “*Upwardly Mobile II: A Long and Winding Road for Mobile Payments – Eight Crucial Questions, Answered*”

Citi GPS (2012b) “*Energy 2020: North America, the New Middle East?*”

Citi GPS (2012c) “*China and the Emerging Markets: China is about to Rebalance: How will EM be Affected?*”

Citi GPS (2012d) “*China in Transition: What we Know and What we Don’t Know*”

Citi GPS (2012e) “*Sub Saharan Africa: The Route to Transformative Growth*”

Citi GPS (2013) “*Call of the Frontier Revisited: On Track to be Tomorrow’s Emerging Markets*”

Citi GPS (2014a) “*Disruptive Innovations II: Ten More Things to Think About*”

Citi GPS (2014b) “*Car of the Future: Transforming Mobility As We Know It*”

Citi GPS (2014c) “*Taking It to the Streets: What the New Vox Populi Risk Means For Politics, the Economy and Markets*”

Courbage, C. and Stahel, W. (2012) "Extreme Events and Insurance: 2011 Annus Horribilis," *IASIE*. Available at:

<http://www.preventionweb.net/english/professional/publications/v.php?id=25594>

Cutler, KM. (2013) "Through dirt-cheap genetic testing, Counsyl is pioneering a new bioinformatics wave," *TechCrunch.com*, April 23, 2013.

Dickens, C. (2011) *A Tale of Two Cities*, Costa Mesa, CA: Saddleback

Drexler, K.E. (2013) *Radical Abundance: How a Revolution in Nanotechnology Will Change Civilization*, New York: PublicAffairs.

The Economist (2008) "Of Cables and Conspiracies," *The Economist*. February 7, 2008. Available at: <http://www.economist.com/node/10653963>

The Economist (2012a) "Six Degrees of Mobilisation," *The Economist* September 1, 2012. Last accessed January 28, 2013. Available at:

<http://www.economist.com/node/21560977>

The Economist (2012b) "The Euro Crisis: An Ever-Deeper Democratic Deficit," *The Economist*, May 26, 2012. Available at: <http://www.economist.com/node/21555927>

The Economist (2013a) "Why does Kenya lead the world in mobile money?," *The Economist*, May 27, 2013. Available at: <http://www.economist.com/blogs/economist-explains/2013/05/economist-explains-18>

The Economist (2013b) "3-D Printing: Out of the Box," *The Economist*, August 6, 2013. Available at: <http://www.economist.com/blogs/schumpeter/2013/08/3d-printing>

Electricity Consumers Resource Council (2004) "The Economic Impacts of the August 2003 Blackout". Available at:

<http://www.elcon.org/Documents/EconomicImpactsOfAugust2003Blackout.pdf>

EM-DAT (2011) "Natural disasters reported 1900 – 2011." Available at:

<http://www.emdat.be/natural-disasters-trends>

Ernst and Young (2011) "Tracking Global Trends: How Six Key Developments are Shaping the Business World." Available at:

[http://www.ey.com/Publication/vwLUAssets/Tracking_global_trends/\\$FILE/Tracking%20global%20trends.pdf](http://www.ey.com/Publication/vwLUAssets/Tracking_global_trends/$FILE/Tracking%20global%20trends.pdf)

The European Commission (2008) "The Schengen Area." Available at:

<http://dx.doi.org/10.2758%2F45874>

The European Council (2011) "Roadmap for moving to a low-carbon economy in 2050." Available at: [http://eur-](http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=CELEX:52011DC0112:EN:NOT)

[lex.europa.eu/LexUriServ/LexUriServ.do?uri=CELEX:52011DC0112:EN:NOT](http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=CELEX:52011DC0112:EN:NOT)

Facebook (2013) "Facebook Reports Second Quarter 2013 Results," *Facebook, Investor Relations*, July 24, 2013. Available at:

<http://investor.fb.com/releasedetail.cfm?ReleaseID=780093>

Federal Reserve Bank of St. Louis. (2012) "Debt Outstanding Domestic Financial Sectors," *Board of Governors of the Federal Reserve System*. Available at:

<http://research.stlouisfed.org/fred2/data/DODFS.txt>

Fildes, J. (2011) "Stuxnet virus targets and spread revealed," *BBC News*, February 15, 2011. Available at: <http://www.bbc.co.uk/news/technology-12465688>

Fleck, F. (2003) "How SARS Changed the World in Less than Six Months," *Bulletin of the World Health Organization*, 81(8): 625–626.

Forbes (2012) "Stock Market To Reopen Wednesday After Hurricane Sandy Hammers New York," *Forbes*, October 30, 2012. Available at: <http://www.forbes.com/sites/steveschaefer/2012/10/30/all-quiet-on-wall-street-in-sandys-wake-exchanges-work-to-restart-trading/>

Fountain, H. (2013) "Next Out of the Printer, Living Tissue," *The New York Times*, August 18, 2013. Available at: http://www.nytimes.com/2013/08/20/science/next-out-of-the-printer-living-tissue.html?hp&_r=0

Fragouli et al. (2012) "Superparamagnetic cellulose fiber networks via nanocomposite functionalization," *Journal of Materials Chemistry*, 4(22) 1662-1666.

Freedom House (2013) "Freedom in the World — Electoral Democracies," *Freedom House*. Available at: <http://www.freedomhouse.org/report-types/freedom-world>

Gai, P. Haldane, A. and Kapadia, S. (2011) "Complexity, Concentration and Contagion," *Journal of Monetary Economics*, Vol. 58, Issue 5, pages 453-470, 2011

Goldin, I. (2012) "Globalization: The Good, the Bad, and the Uncertain," *The Globalist*, February 1, 2012. Available at: <http://www.theglobalist.com/globalization-the-good-the-bad-and-the-uncertain/>

Goldin, I. (2013) *Divided Nations: Why Global Governance is Failing and What We Can Do About It*, Oxford: Oxford University Press.

Goldin, I., Cameron, G. and Balarajan, M. (2012) *Exceptional People: How Migration Shaped Our World and Will Define Our Future*, Princeton: Princeton University Press.

Goldin, I. and Vogel, T. (2010) "Global Governance and Systemic Risk in the 21st Century: Lessons from the Financial Crisis," *Global Policy*, 1(1) pages 4-15, January 2010.

Goldin, I. and Mariathasan, M. (2014) *The Butterfly Defect: How Globalization Generates Systemic Risks, and What to Do about It*, Princeton: Princeton University Press.

Harney, A. (2013) "Japan's Silver Democracy: the Costs of Letting the Elderly Rule Politics," *Foreign Affairs*, July 18, 2013. Available at: <http://www.foreignaffairs.com/articles/139589/alexandra-harney/japans-silver-democracy>

Heathrow Airport (2013) Heathrow Airport Holding Ltd: Financial Information June 11, 2013. Available at: [http://www.heathrowairport.com/static/HeathrowAboutUs/Downloads/PDF/Financial Information/Heathrow BAML HY conference%20 \(June%202013\).pdf](http://www.heathrowairport.com/static/HeathrowAboutUs/Downloads/PDF/Financial%20Information/Heathrow%20BAML%20HY%20conference%20(June%202013).pdf)

HSBC Bank (2012) "Consumer in 2050: The Rise of the EM Middle Class," *HSBC Global Research*, Global Economics Report (London: HSBC Bank, October 2012), pp. 20-21. Available at: http://www.hsbc.com.vn/1/PA_ES_Content_Mgmt/content/vietnam/abouthsbc/newsroom/attached_files/HSBC_report_Consumer_in_2050_EN.pdf

Huang, L. Huang, Y., Liang, J., Wan, X., Chen, Y. (2011) "Graphene-Based Conducting Inks for Direct Inkjet Printing of Flexible Conductive Patterns and their Applications in Electric Circuits and Chemical Sensors," *Nano Research*. 4(7) 675-684.

IMF (2013a) "World Economic Outlook." Available at:
<http://www.imf.org/external/pubs/ft/weo/2013/01/weodata/download.aspx>

IMF (2013b) "The IMF and the World Bank" *Institutional History*," March 23, 2013. Available at: www.imf.org/external/np/exr/facts/imfwb.htm

International Energy Agency (2013) "Tracking Clean Energy Progress 2013: IEA Input to the Clean Energy Ministerial"

IPCC, 2013: Summary for Policymakers. In: *Climate Change 2013: The Physical Science Basis, Contribution of Working Group I to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change* [Stoker, T.F., D. Qin, G.-K. Plattner, M. Tignor, S.K. Allen, J. Boschung, A. Nauels, Y. Xia, V. Bex and P.M. Midgley (eds.)] Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA.

Janeway, W. (2012) *Doing Capitalism in the Innovation Economy: Markets, Speculation and the State*, Cambridge: Cambridge University Press.

Johansson, Å., et al. (2012) "Looking to 2060: Long-Term Global Growth Prospects: A Going for Growth Report," *OECD Economic Policy Papers*, No. 3.

Johnson, N.P. and Mueller, J. (2002) "Updating the Accounts: Global Mortality of the 1918-1920 Spanish Influenza Pandemic," *Bulletin of the History of Medicine*, 76(1) 105-115.

Johnson, R. (2011) "17 Awesome McDonald's Dishes You Can't Buy in America," *Business Insider*. June 16, 2011. Available at:
<http://www.businessinsider.com/mcdonalds-meals-around-the-world-2011-6?op=1>

Kahn, R. and Tananbaum, S. (2013) "China's Slowing Growth: Three Things to Know," *Council on Foreign Relations*, July 18, 2013. Available at:
<http://www.cfr.org/china/chinas-slowng-growth-three-things-know/p31124>

Kharas, H. (2010) "The Emerging Middle Class in Developing Countries," *OECD Development Centre Working Paper No. 285*

Kharas, H. and Gertz, G. (2010) "The New Global Middle Class: A Cross-Over from West to East," *Wolfensohn Center for Development at Brookings*

Kolesnikov-Jessop, S. (2011) "Hollywood Presses Its Global Agenda," *The New York Times*, May 22, 2011. Available at:
<http://www.nytimes.com/2011/05/23/business/media/23filmscreensingapore.html?pagewanted=all>

Kremer, W. (2013) "How Much Bigger Can Container Ships Get?" *BBC World Service*, February 2013. Available at: <http://www.bbc.co.uk/news/magazine-21432226>

Lardinois, F. (2012) "Google's self-driving cars complete 300K miles without accident, deemed ready for commuting," *TechCrunch*, August 7, 2012.

Lerner, E. (2003) "What's Wrong with the Electric Grid?" *The Industrial Physicist*, October/ November 2003.

Llewellyn Consulting (2013) "*UK Infrastructure: The Challenges for investors and policymakers*," White Paper 2013

Kit, W. Z., et al. "ASEAN Long View: New Pistons for a Growth Engine," Citi Research June 2014

Lucas, R. (2003) "Macroeconomic Priorities," *Department of Economics, University of Chicago*. Available at:

http://oldweb.econ.tu.ac.th/archan/chaityuth/New%20growth%20theory%20Review%20in%20Thai/macro%20perspectives_lucas.pdf.

Maddison, A. (2008) "Shares of the Rich and the Rest in the World Economy: Income Divergence between Nations, 1820-2030," *Asian Economic Policy Review*, June 2008.

Maddison, A. (2013) "Estimates from the World Economy: Table B-10, World GDP, 0-1998 AD," *OECD Development Centre*. Available at: <http://www.theworldeconomy.org/statistics.htm>.

Manyika, J. et al. (2013) "Disruptive Technologies: Advances that Will Transform Life, Business, and the Global Economy," *McKinsey Global Institute*. Available at: http://www.mckinsey.com/insights/business_technology/disruptive_technologies

Markoff, J. (2012) "Skilled Work, Without the Worker," *The New York Times*. August 18, 2012. Available at: <http://www.nytimes.com/2012/08/19/business/new-wave-of-adept-robots-is-changing-global-industry.html?pagewanted=all>

McDonald's (2013) "Our Company." Available at: http://www.aboutmcdonalds.com/mcd/our_company.html

McKinsey & Company (2010) "*Meeting the 2030 French Consumer*." Available at: http://www.mckinsey.com/client_service/marketing_and_sales/profiles/~media/mckinseydotcom/client_service/marketing%20and%20sales/pdfs/meeting%20the%202030%20french%20consumer.ashx

McKinsey & Company (2012) "*Mobility choices: Consumers at the Wheel*."

McLoughlin, S. and Munz, R. (2011) "Conclusions and Recommendations "in "Temporary and Circular Migration: Opportunities and Challenges," *Working Paper 35* (European Policy Centre, March 2011), pp. 65–76.

Milanovic, M. (2011) "Global Inequality from Class to Location, from Proletarians to Migrants," *Policy Research Working Paper 5820*. Washington DC: World Bank.

Nathwani, A. et al. (2011) "Adenovirus-Associated Virus Vector-Mediated Gene Transfer in Hemophilia B," *New England Journal of Medicine*, 365, 2357-2365.

Neal, R. (2013) "3D Printed Gun Gets More Powerful: Grizzly 2.0 Rifle Successfully Fires 14 Live Rounds," *International Business Times*, August 6, 2013. Available at: <http://www.ibtimes.com/3d-printed-gun-gets-more-powerful-grizzly-20-rifle-successfully-fires-14-live-rounds-video-1373871>

- The New Scientist (2013) "Designer Babies are on the Horizon but aren't Here Yet," *The New Scientist*, July 10, 2013. Available at: <http://www.newscientist.com/article/mg21929252.800-designer-babies-are-on-the-horizon-but-arent-here-yet.html#.UhlQgmTXScI>
- The New York Times (2006) "Global Sludge Ends in Tragedy for Ivory Coast," *The New York Times*. October 2, 2006.
- Nuttall, N., (2004) "Overfishing: A Threat to Marine Biodiversity, Ten Stories," *United Nations*. Available at: <http://www.un.org/events/tenstories/06/story.asp?storyID=800>
- O'Brien, M. (2013) "Emerging Power: Developing Nations Now Claim the Majority of World GDP," *Atlantic Monthly*, June 4, 2013
- OECD. (2010) "The Impacts of Nanotechnology on Companies: Policy Insights from Case Studies," *OECD Publishing*.
- OECD (2011) "Pensions at a Glance 2011: Retirement-income Systems in OECD and G20 Countries," *OECD Publishing*. Available at: http://dx.doi.org/10.1787/pension_glance-2011-en/
- OECD (2012), "Machine-to-Machine Communications: Connecting Billions of Devices," *OECD Digital Economy Papers*, No. 192, OECD Publishing. Available at: <http://dx.doi.org/10.1787/5k9gsh2gp043-en>
- OECD (2013a) "Annual survey of large pension funds and public pension reserve funds: Report on pension funds' long-term investments," *OECD Publishing*, October 2013.
- OECD (2013b), *OECD Economic Outlook*, Vol. 2013/1, OECD Publishing. http://dx.doi.org/10.1787/eco_outlook-v2013-1-en
- Oxford Economics (2010) "The Economic Impacts of Air Travel Restrictions Due to Volcanic Ash." Available at: http://www.airbus.com/company/environment/documentation/?docID=10262&elD=dam_frontend_push
- Oxford Martin School (2013) "Now for the Long Term: The Report of the Oxford Martin Commission for Future Generations." Available at: http://www.oxfordmartin.ox.ac.uk/downloads/commission/Oxford_Martin_Now_for_the_Long_Term.pdf
- Paxton, R. (2009) "Russia Unveils \$2 Trillion Energy Growth Plan," *Reuters*, November 26, 2009. Available at: <http://uk.reuters.com/article/2009/11/26/russia-energy-investment-idUKGEE5AP25J20091126>
- Peri, G., Romiti, A., and Rossi, M. (2013) "Immigrants, Household Production and Women's Retirement," IZA Discussion paper no. 7549.
- Population Reference Bureau (2010) "2010 World Population Data Sheet." Available at: <http://www.prb.org/Publications/Datasheets/2010/2010wpds.aspx>
- Price Waterhouse Cooper (2013) "World in 2050, The BRICs and Beyond: Prospects, Challenges and Opportunities", (January 2013).

Reuters (2013) "Pentagon weapons-maker finds method for cheap, clean water," *Reuters*, March 13, 2013. Available at: <http://www.reuters.com/article/2013/03/13/us-usa-desalination-idUSBRE92C05720130313>

Saez, E. (2013). "Striking it Richer: The Evolution of Top Incomes in the United States". *University of California Berkeley*, September 2013. Available at: <http://elsa.berkeley.edu/~saez/saez-UStopincomes-2012.pdf>

Sheets, N. and Sockin, R. "Is Immigration the Antidote to Ageing Demographics in the Advanced Economies?" Citi Research (2013)

Social Security Administration (2013) "Life Expectancy for Social Security." Available at: <http://www.ssa.gov/history/lifeexpect.html>

Smith, R. (2013) "How to Sell Coke to People Who Have Never Had a Sip," *National Public Radio*, June 7, 2013. Available at: <http://www.npr.org/blogs/money/2013/06/07/189184092/how-to-sell-coke-to-people-who-have-never-had-a-sip>

Stothard, M. (2013) "Bonds to Benefit from Ageing Population," *Financial Times*, July 25, 2013.

The Telegraph (2013) "The World's First 3-D Printed House," *The Telegraph*, June 10, 2013. Available at: <http://www.telegraph.co.uk/travel/ultratransport/the-next-big-thing/10110195/The-worlds-first-3D-printed-house.html>

Trippel, M. and Groth, H. (2011) "Demographic Shifts in EU27, Norway, and Switzerland: Population and Dependency Ratio Forecasts until 2030," *World Demographic and Ageing Forum*, No. 2011/9, 2011.

Twitter (2012) "Twitter Turns Six," *Twitter Announcements*, March 21, 2012. Available at: <https://blog.twitter.com/2012/twitter-turns-six>

UNEP (2005) "Global Assessment Report.." Available at: <http://www.unep.org/maweb/en/Global.aspx>

UNICEF (2012) "Progress on Drinking Water and Sanitation 2012 Update," *World Health Organization and UNICEF*, 2012. Available at: <http://www.unicef.org/media/files/JMPReport2012.pdf>

UNCTAD (2012) "Twenty years of India's Liberalization: Experiences and Lessons." Available at: http://unctad.org/en/PublicationsLibrary/osg2012d1_en.pdf

United Nations Department of Economic and Social Affairs, Population Division (2013). *World Population Prospects: The 2012 Revision, Key Findings and Advance Tables*, Working Paper No. ESA/P/WP.227.

U.S. National Intelligence Council, (2012) "Global Trends 2030: Alternative Worlds." Available at: www.dni.gov/nic/globaltrends.

U.S. Census Bureau (2012a) "Total Midyear Population for the World: 1950-2050." Available from: http://www.census.gov/population/international/data/worldpop/table_population.php

U.S. Census Bureau (2012b) "Projections of the Population by Selected Age Groups and Sex for the United States: 2015 to 2060 (NP2012-T2)," *U.S. Census Bureau*, Population Division. Available at: <http://www.census.gov/population/projections/data/national/2012/summarytables.html>

Vidyasekar, A. (2013) "New Megatrends in the United Kingdom," *Frost and Sullivan*, Visionary Innovation Research, July 5, 2013.

von Holst, H. (ed.) (1997) "*Transportation, Traffic Safety and Health: The New Mobility*." Springer Publishing,

Wall Street Journal (2012) "Shell Weighs Natural Gas-to-Diesel Processing Facility for Louisiana," *The Wall Street Journal*, April 4, 2012 Available at: <http://online.wsj.com/news/articles/SB10001424052702304072004577323770856080102>

Wall Street Journal (2013) "Gridlock Snarls India's Parliament," *Wall Street Journal*, August 21, 2013. Available at: <http://online.wsj.com/article/SB10001424127887323980604579026580134066134.html>

West, D. (2012) "How Mobile Devices are Transforming Healthcare," *Brookings*, Center for Technology Innovation, (May 2012).

Whitney, L. (2010) "With Legal Nod, Microsoft Ambushes Waledac Botnet," *CNET News*, February 26, 2010.

WHO (2012) "10 Facts on Climate Change and Health, Factfile," Available at: http://www.who.int/features/factfiles/climate_change/facts/en/index.html

World Bank (2005) *Global Economic Prospects: Economic Implications of Remittances and Migration*, Washington DC: World Bank.

World Bank (2011) "Mexico MultiCat Bond: Transferring Catastrophe Risk to the Capital Markets," *Global Facility for Disaster Reduction and Recovery*. Available at: http://www.gfdrr.org/sites/gfdrr.org/files/documents/DRFI_MexicoMultiCat_Jan11.pdf

World Bank (2012a) "New Estimates Reveal Drop in Extreme Poverty," *World Bank*, Data and Research, February 29, 2012. Available at: <http://econ.worldbank.org/WBSITE/EXTERNAL/EXTDEC/0,,contentMDK:23129612~pagePK:64165401~piPK:64165026~theSitePK:469372,00.html>

World Bank (2012b) "Turn Down the Heat: Why a 4 degree C Warmer World Must Be Avoided." Available at: http://climatechange.worldbank.org/sites/default/files/Turn_Down_the_heat_Why_a_4_degree_centrigrade_warmer_world_must_be_avoided.pdf

World Bank (2013a) "Container Port Traffic, TEU (20 Foot Equivalent Units)," *World Development Indicators*; Accessed August 29, 2013. Available at <http://data.worldbank.org/indicator/IS.SHP.GOOD.TU/countries>

World Bank (2013b) "The State of the Poor: Where are the Poor and Where are the Poorest?" Available at: http://www.worldbank.org/content/dam/Worldbank/document/State_of_the_poor_paper_April17.pdf

World Bank (2013c) "Air Transport, Passengers Carried." Available at:
<http://data.worldbank.org/indicator/IS.AIR.PSGR>.

World Economic Forum (2012a) "Impact of Thailand Floods 2011 on Supply Chain," mimeographed,

World Economic Forum (2012b) "Global Population Ageing: Peril or Promise?" Available at:
http://www3.weforum.org/docs/WEF_GAC_GlobalPopulationAgeing_Report_2012.pdf

WTO (2011) "Cover Note from the Chair: Documents from the Negotiating Chairs," *World Trade Organization*, Doha Development Agenda, April 21, 2011. Available at:
http://www.wto.org/english/tratop_e/dda_e/chair_texts11_e/chair_texts11_e.htm

WTO (2013a) "Understanding the WTO: Members and Observers," World Trade Organization. Available at:
http://www.wto.org/english/thewto_e/whatis_e/tif_e/org6_e.htm

WTO (2013b) "World Trade Report: Factors Shaping the Future of World Trade," World Trade Organization

Wuestner, C. (2012) "BMW Finds New Ways to Improve Productivity with Aging Workforce," *Bloomberg*, September 8, 2012.

Xing, Y., and Detert, N. (2010) "How the iPhone Widens the United States Trade Deficit with the People's Republic of China," *ADB Working Paper*, No. 257. Tokyo: Asian Development Bank Institute. Available at:
<http://www.adbi.org/workingpaper/2010/12/14/4236.iphone.widens.us.trade.deficit.pr/c/>

Zhao, Y. et al. (2012) "Photoreactive Azido-Containing Silica Nanoparticle/Polycation Multilayers: Durable Superhydrophobic Coating on Cotton Fabrics," *Langmuir*, 28(15) 6328-6335.

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NOW / NEXT

Key Insights regarding the future of Globalization



LABOR MARKET

In 1950 there were 200 million people over the age of 60 in advanced economies. Today that number has grown to nearly 800 million. / **Aging advanced economies will need to adapt to face demographic realities given projections are that by 2050 there will be 2 billion people over the age of 60. Pension structures must be reformed, health care costs need to be reined in, retirement ages need to be extended, and workplaces will need to find ways to keep their employees working productively for longer.**



REGULATION

There are a plethora of international agencies charged with managing global problems, which deserve credit for averting another world war, eradicating smallpox and polio, and until 2008, helping avoid a global depression. / **Countries with diminishing geopolitical strength increasingly are unable to provide world leadership, while the new economic powerhouses have not yet shown the capacity to resolve global challenges, either alone or in concert with the old power.**



SHIFTING WEALTH

The United States, France, Germany, the UK, Canada, Italy, and Japan have been the advanced economies which have dominated the world economy since the late 20th century. / **The Emerging 7 (China, India, Brazil, Russia, Indonesia, Mexico, and Turkey) could possibly hold a greater share of the world's GDP than the G-7 by 2020.**



